BYTE

the small systems journal

FEBRUARY 1982 Vol. 7, No. 2
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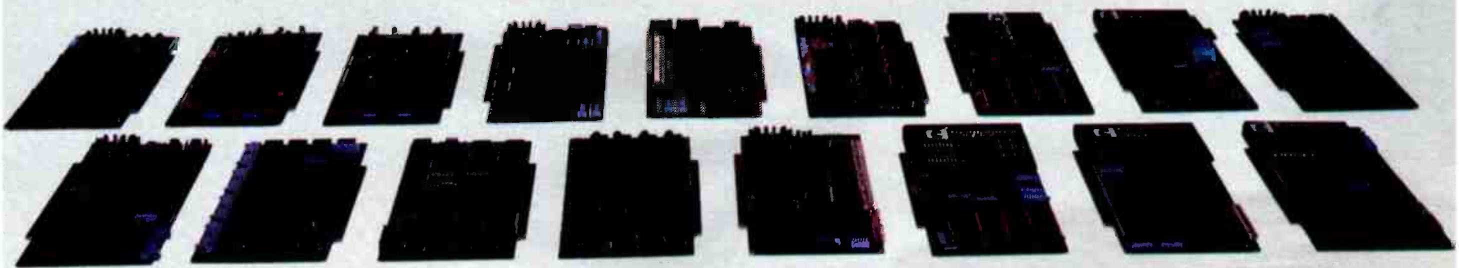
WINTER COMPUTING

A new small computer that won't limit you tomorrow

New Cromemco System One shown with our high-capability terminal and printer.



Expandability

Here's a low-priced computer that won't run out of memory capacity or expandability halfway through your project.

Typically, computer usage tends to grow, requiring more capability, more memory, more storage. Without a lot of capability and expandability, your computer can be obsolete from the start.

The new System One is a real building-block machine. It has capability and expandability by the carload.

Look at these features:

- **Z80-A processor**
- **64K of RAM**
- **780K of disk storage**
- **CRT and printer interfaces**
- **Eight S-100 card slots, allowing expansion with**
  - **— color graphics**
  - **— additional memory**
  - **— additional interfaces for telecommunications, data acquisition, etc.**
- **Small size**

GENEROUS DISK STORAGE

The 780K of disk storage in the System One Model CS-1 is much greater than what is typically available in small computers. But here, too, you have a choice since a second version, Model CS-1H, has a 5″ Winchester drive that gives you **5 megabytes** of disk storage.

MULTI-USER, MULTI-TASKING CAPABILITY

Believe it or not, this new computer even offers multi-user capability when used with our advanced CROMIX* operating system option. Not only does this outstanding O/S support multiple users on this computer but does so with powerful features like multiple directories, file protection and record level lock. CROMIX lets you run multiple jobs as well.

In addition to our highly-acclaimed CROMIX, there is our CDOS*. This is an enhanced CP/M† type system designed for single-user applications. CP/M and a wealth of CP/M-compatible software are also available for the new System One through third-party vendors.

COLOR GRAPHICS/WORD PROCESSING

This small computer even gives you the option of outstanding high-resolution color graphics with our Model SDI interface and two-port RAM cards.

Then there's our tremendously wide range of Cromemco software including packages for word processing, business, and much more, all usable with the new System One.

ANTI-OBSOLESCENCE/LOW-PRICED

As you can see, the new One offers you a lot of performance. It's obviously designed with anti-obsolescence in mind.

What's more, it's priced at only $3,995. That's considerably less than many machines with much less capability. And it's not that much more than many machines that have little or nothing in the way of expandability.

Physically, the One is small — 7″ high. And it's all-metal in construction. It's only 14⅛″ wide, ideal for desk top use. A rack mount option is also available.

CONTACT YOUR REP NOW

Get all the details on this important building-block computer. Get in touch with your Cromemco rep now. He'll show you how the new System One can grow with your task.

*CROMIX and CDOS are trademarks of Cromemco Inc.
†CP/M is a trademark of Digital Research

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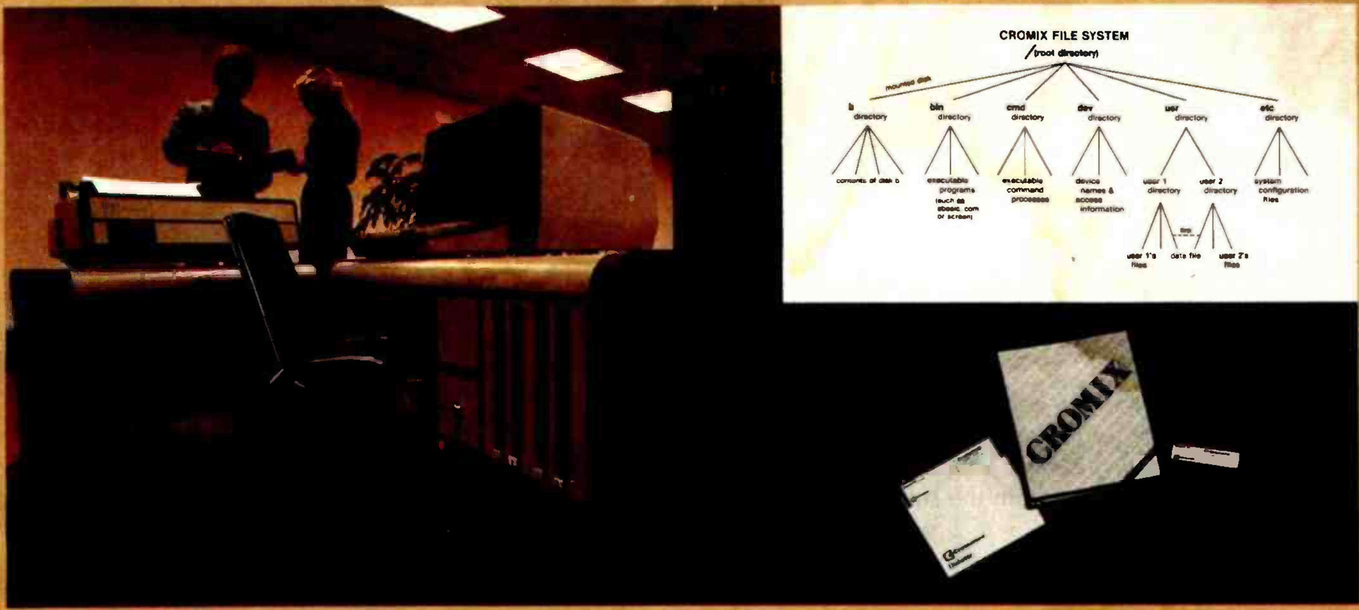
Tomorrow's computers today

Circle 96 on Inquiry card.



CROMIX*— Cromemco's outstanding UNIX†–like operating system

CROMIX is just the kind of major development you've come to expect from Cromemco. After all, we're already well-known for the most respected software in the microcomputer field.

And now we've come up with the industry's first UNIX-lookalike for microcomputers. It's a tried and proven operating system. It's available on both 5" and 8" diskettes for Cromemco systems with 128K or more of memory.

Here are just some of the features you get in this powerful Cromemco system:

- Multi-user and multi-tasking capability
- Hierarchical directories
- Completely compatible file, device, and interprocess I/O
- Extensive subsystem support

FILE SYSTEM

One of the important features of our CROMIX is its file system comprised of hierarchical directories. It's a tree structure of three types of files: data files, directories, and device files. File, device, and interprocess I/O are compatible among these file types (input and output may be redirected interchangeably from and to any source or destination).

The tree structure allows different directories to be maintained for different users or functions with no chance of conflict.

PROTECTED FILES

Because of the hierarchical structure of the file system, CROMIX maintains separate ownership of every file and directory. All files can thus be protected from access by other users of the system. In fact, each file is protected by **four separate access privileges** in each of the three user categories.

TREMENDOUS ADDRESS SPACE, FAST ACCESS

The flexible file system and generalized disk structure of CROMIX give a disk address space in excess of one gigabyte per volume — file size is limited only by available disk capacity.

Speed of access to disk files has also been optimized. Average access speeds far surpass any yet implemented on microcomputers.

'C' COMPILER AVAILABLE, TOO

Cromemco offers a wide range of languages that operate under CROMIX. These include a high-level command process language and extensive subsystem support such as COBOL, FORTRAN IV, RATFOR, LISP, and 32K and 16K BASICs.

There is even our highly-acclaimed 'C' compiler which allows a programmer fingertip access to CROMIX system calls.

THE STANDARD O-S FOR THE FUTURE

The power and breadth of its features make CROMIX the standard for the next generation of microcomputer operating systems.

And yet it is available for a surprisingly low $595.

The thing to do is to get all this capability working for you now. Get in touch with your Cromemco rep today.

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†UNIX is a trademark of Bell Telephone Laboratories

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Circle 97 on inquiry card.

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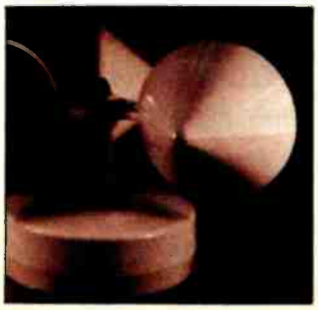
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In This Issue

It's time again to start worrying about your annual accounting to Uncle Sam. April 15 is only two months away. And it's probably time you sat down to crunch out those numbers. As Robert Tinney's cover suggests, staying warm by your computer is an attractive alternative to braving the cold winter winds. To help ease the pain, we review two software packages designed specifically for computing taxes. If you have access to UCSD Pascal, Edward Heyman's federal income tax program can help you avoid overpayments and lost interest. In "Tax Tips for Computer Owners" Melvyn Feuerman and Melvyn Moller discuss tax breaks for computer owners.

This month we begin another new series: The Input/Output Primer by Steve Leibson. The six-part tutorial will take you through computer interfacing from simple serial and parallel ports to IEEE-STD-488. The Atari Tutorial continues with a look at Atari BASIC. William Barden details an easy way to provide voice synthesis for the Color Computer. And Steve Ciarcia shows you how to build a computerized weather station that will talk to you.

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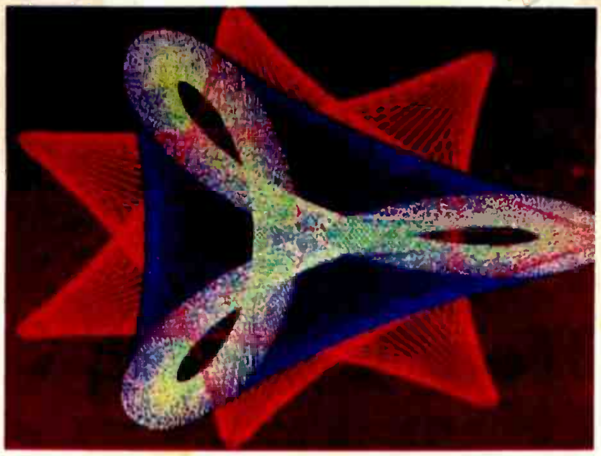
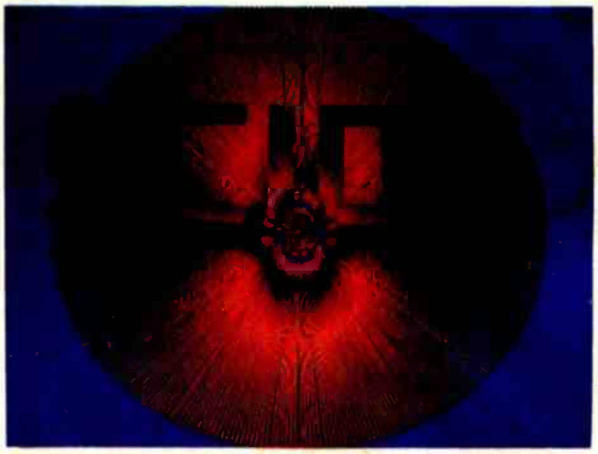
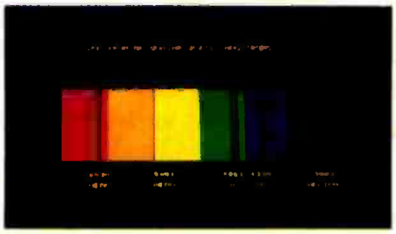




"...stands well above other S-100 graphics displays in its price and performance range."
BYTE, Product Review



"...better monochromatic display...."
ELECTRONIC DESIGN, 1981 Technology Forecast

MICROANGELO

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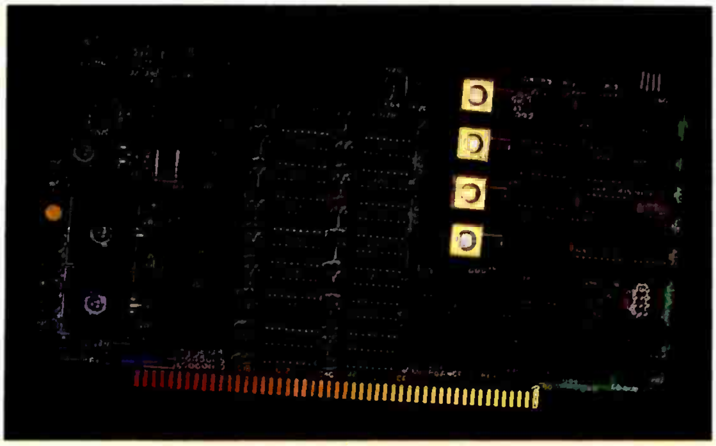

Light pen interface

Time multiplexed refresh

4K resident Screenware™ Pak I operating system

32K RAM isolated from host address space

High speed communications over parallel bus ports

Screenware™ Pak I

A 4K byte operating system resident in PROM on MicroAngelo™. Pak I emulates an 85 character by 40 line graphics terminal and provides over 40 graphics commands. Provisions exist for user defined character sets and directly callable user extensions to Screenware™ Pak I.

Screenware™ Pak II

An optional software superset of Pak I which adds circle generation, polygon flood, programmable split screen for separate graphics and terminal I/O, relative coordinates, faster vector and character plotting, a macro facility, full UCSD Pascal compatibility, and more.

And now...COLOR!!

The new MicroAngelo™ Palette board treats from 2 to 8 MicroAngelos as "bit planes" at a full 512 x 480 resolution. Up to 256 colors may be chosen from 16.8 million through the programmable color lookup table. Overlays, bit plane precedence, fade-in, fade-out, gray levels, blinking bit plane, and a highly visual color editor are standard.

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Editorial

Report from COMDEX

by Chris Morgan, Editor in Chief

Software is growing up—fast. And hardware isn't far behind.

That was the double-barreled message from the COMDEX show, an exhibition designed to pair up small-systems vendors with their independent sales organizations. Held in Las Vegas last November, COMDEX has become a major event in the personal computing world. A record 631 exhibitors displayed their wares. With a nonstop flurry of press conferences and receptions, the atmosphere was more reminiscent of the NCC than of a small-systems show. What follows are some of the highlights.

Photo 1: *The Fortune 32:16 microcomputer with Motorola 68000 processor.*

Photo 2: *Microsoft's new Multiplan, a Visicalc-like spreadsheet program.*

The Fortune 32:16 Computer

A big hit was the Fortune 32:16 desktop microcomputer. Within the unit's elegant exterior are a Motorola 68000 processor, 32-bit data and address registers, a 24-bit memory address bus, and a 16-bit data bus. The basic model, which sells for $5000, features 128K bytes of memory; a 720K-byte (formatted) 5¼-inch floppy-disk drive; keyboard; and a 12-inch, 80-column black-and-white video display. A 5¼-inch Winchester disk drive with optional 5, 10, or 20 megabytes of storage is also available. The machine supports BASIC, COBOL, FORTRAN, Pascal, and C, and I found the Fortune's menu-driven business software packages to be promising. (Fortune Systems Corporation was launched with $8.5 million of venture capital, which the company claims is the largest amount of money ever raised to start a microcomputer company.) The Fortune 32:16 computer will be sold in Computerland stores and other outlets. We plan to review it in detail soon.

The "Visiclones" Are Coming

In our business, imitation is the sincerest form of survival. Personal Software's Visicalc has the nearest thing to software sex appeal and the sales figures to prove it. Consequently, a plethora of Visicalc-like electronic spreadsheets is upon us. First it was Supercalc from Sorcim; now the second generation has arrived. It's too early to tell how good they are, but we'll be reviewing them soon. At the forefront is Microsoft's Multiplan, a financial spreadsheet program that sports such interesting features as text windows à la Smalltalk. Win-

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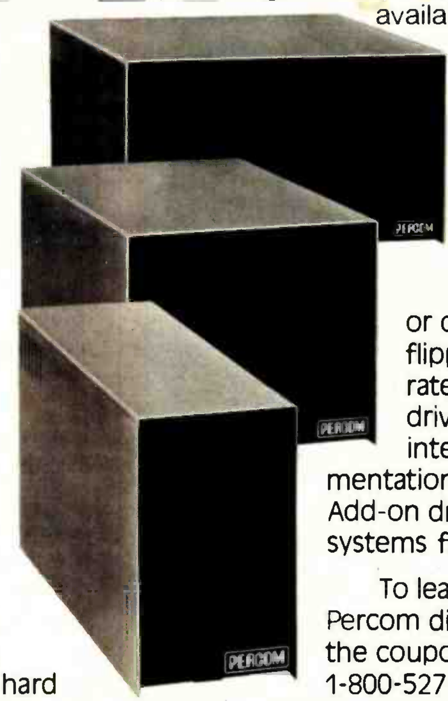

At Percom, our business is making disk storage systems for microcomputers — something we've been doing right, since 1977.

From the design of rock-solid drive controller circuitry to quality controls that include 100% life testing of every drive shipped, you can expect to get more out of Percom Disk Systems.

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FLOPPY MINI-DISK STORAGE SYSTEMS

40 or 80-track drives, single or dual-head, flippy or non-flippy — all double-density rated. Available in 1, 2 and 3-drive add-on units, 1 and 2-drive internal units, with full documentation and software support. Add-on drives from $399, complete systems from $459.95.

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Enormous storage capacity plus high speed. Percom 5¼ inch hard disk systems are 40 times faster than single-density floppy mini-disks, 20 times faster than double-density units. Systems include a smart, four-drive controller featuring state-of-the-art data encoding and separation, adaptable industry-standard disk interfacing. Plug-in-compatible version for

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I'm interested in floppy disk storage for my...
TRS-80 ☐ Mdl III ☐ Mdl I ☐ IBM PC
☐ H/Z-89 ☐ H-8 ☐ AIM/KIM/SYM ☐ System-50

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Other computer? ______________________
(☐ floppy disk or ☐ hard disk?)

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dows can be "closed" or "opened" so you can see the effect of what you're doing in an area off the screen. Available commands are displayed at the bottom of the screen. A lot of attention has been given to the documentation. Incidentally, Microsoft has announced a series of executive program aids called the "Manager Series." It will include Time Manager (currently available) and Project Manager and Personnel Manager (now being completed).

Photo 3: *Commodore's new, under-$100 modem for the VIC-20 color computer. The VIC-12 plugs directly into the VIC-20 and features a modular jack.*

I was given a demonstration of Time Manager. It's definitely a useful tool.

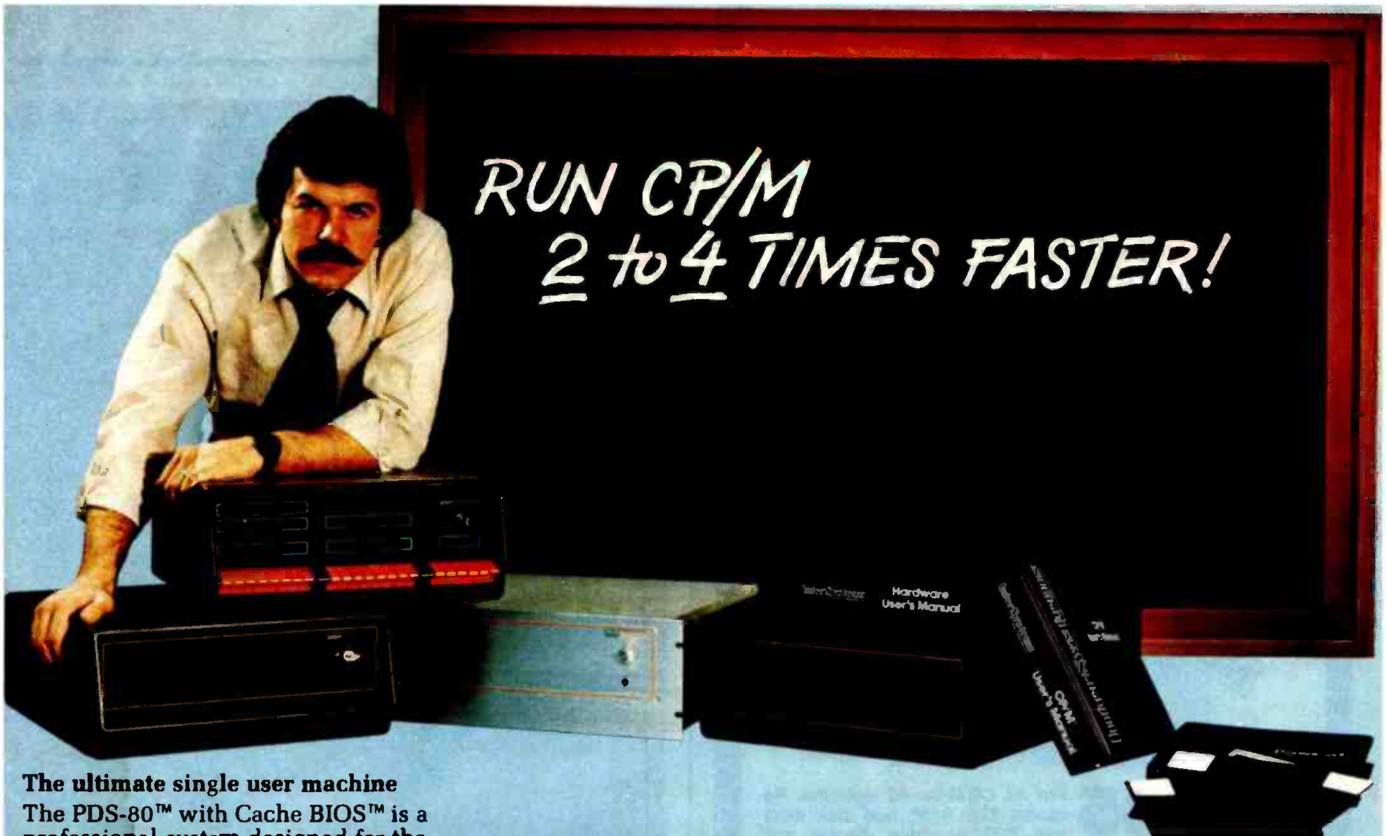
From Target Software Inc. of Atlanta comes a series of business-planning programs, including Plannercalc and Masterplanner. Plannercalc is a financial-planning tool that has a couple of interesting features: the program lets you enter procedures in English using conventional mathematical logic, and it can be integrated with the Masterplanner program. The latter has a more extended spreadsheet and "gridsheet" program.

Context Management Systems Inc. of Torrance, California, has announced its MBA program for the IBM Personal Computer. It's a combination database, electronic spreadsheet, word-processing, graphics, and communications package. It's also available in a version for the Apple III.

NEC Home Electronics USA announced "Report Generator," a CP/M-based program being marketed with NEC's PC-8000 series microcomputer system. It is designed to generate income statements, balance sheets, sales forecasts, and other business reports.

Other Software Developments

Intel has signed agreements with both Microsoft and Digital Research to distribute both companies' operating systems for a wide variety of Intel microcomputer systems and boards. This is a continuation of an interesting phenomenon that began when IBM announced it was go-



The ultimate single user machine

The PDS-80™ with Cache BIOS™ is a professional system designed for the most rigorous single user CP/M* environments ... in business, software development, scientific, educational and industrial research ... where speed and program space are critical factors.

SymBIOSis quadruples speed

No matter what high-level language you use ... Cobol, Basic, Fortran, PL/1, or Pascal ... PDS-80 offers more speed, power and reliability than any other floppy based CP/M system currently on the market. The InterSystems Cache BIOS fully exploits the advanced DMA and interrupt features of our reliable Series II hardware to buffer whole tracks in extended memory so most operations run two to four times faster than on other floppy based systems ... actually equals the speed of many small hard disk systems. And Cache BIOS also provides many sophisticated system test and protection features to assure reliable operation.

An advanced CP/M application system

PDS-80 has all you need for commercial systems integration and applications software development ... including a choice of the industry's only integral 8 bit front panel. Best of all, PDS-80 allows the systems integrator or applications developer addressing a vertical market to develop on the same components he configures for resale. The highly expandable modular design with 20 slot S-100 mainframe allows almost unlimited options to suit any end use environment ... including a choice of tabletop or rackmount design.

InterSystems will work with you at whatever level is appropriate to configure the target system you need ... right up to fully assembled and tested systems with floppy and Winchester disk drives.

Full software support

In addition to InterSystems' Cache BIOS and the CP/M operating system, models of PDS-80 can include Pascal/Z,

our highly acclaimed Z-80® native code Pascal compiler, and InterPak 80™, a special set of utilities including a powerful screen editor and versatile spelling editor to assist in the rapid editing, proofing and documentation of your code. These powerful programming aids are also available as standalone products.

It's upgradeable!

Both hardware and software are designed to provide for upgrade to 16 bit operation. Programs written for Pascal/Z are fully compatible with I•Pas 8000™, our Z-8000® native code compiler, and all PDS-80 systems are upgradeable to our 16 bit multi-user DPS-8000.

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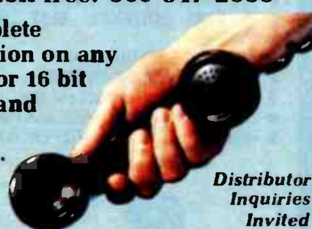

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Editorial

Photo 4: *Techmar's new expansion chassis for the IBM personal computer shown directly beneath the IBM main chassis.*

ing to make available both Microsoft's DOS operating system and CP/M-86 for the IBM Personal Computer. With corporate giants like Intel giving Microsoft and Digital Research a boost, it appears that both families of operating systems will coexist for quite some time.

Systems Group of Orange, California, demonstrated some of the practical advantages of the CP/M system on its System 2800 microcomputer line. Its CP/M error-recovery routines are more sophisticated than others we have seen. We plan to analyze this system in greater detail later this year. CP/M users should also check out Epic Software's Supervyz, an application software control program for CP/M. Supervyz does a nice job of cleaning up some of CP/M's rough edges.

Hardware News

First Metamorphics announced one; now Caltech Computer Services in San Diego is offering an 8088 plug-in card for the Apple II. Called Macrosystem-88, it contains an 8088 microprocessor, 64K bytes of RAM (expandable to 128K bytes) and 4K bytes of PROM all on a single board, and its power supply is contained in a case designed to sit on top of the Apple. A DMA (direct-memory access) control card enables the communication between the Macrosystem-88 and the Apple. This card may be installed in any slot (except 0) within the Apple. The Macrosystem-88 can run CP/M-86 as well as UCSD

Editorial continued on page 14

S-100 Fast-Aid.

Including 3 new boards for system design relief.

The MB64.

An economical, high-performance 64K static RAM memory.

Just what the doctor ordered. A new 64K static RAM configured as two 32K blocks that's fast (in excess of 6MHz), reliable and economical. The MB64 supports IEEE 696/S-100 24-bit extended addressing for up to 16MB of RAM. Bank switching permits compatibility with popular multi-user computer systems (such as CROMIX*). Up to 8K can be replaced with 2716 EPROMs. The MB64 offers low power consumption (typically less than 600 milliamps). And a provision for optional battery backup.

(The MB64 is priced at less than $850.)

*CROMIX is a trademark of Cromemco, Inc.

The IO8.

An I/O board featuring eight serial interfaces, individually programmable baud rates, and an interrupt clock.

Give your system fast-aid—including easier testing and speedier diagnosis—with SSM's new IO8. This board features eight asynchronous serial RS-232 I/O ports with LED data transfer indicators. Individually programmable I/O port baud rates (110-19,200) meet all your specific configuration requirements. A timer (50/60 Hz) supports real-time or multi-user applications.

And all our Fast-Aid boards offer:

- Card ejectors for painless card removal.
- LEDs for easy troubleshooting and monitoring.
- IEEE 696/S-100 compatibility.

The IO5.

A two-serial/three-parallel I/O board with programmable timer.

The perfect remedy for fast system integration, more precise diagnosis, and far healthier system operation. The IO5 features two RS-232 asynchronous serial interfaces for maximum peripheral compatibility. The board supports a variety of devices with high-speed serial data transmission (110-19,200 baud). Three parallel ports, providing a total of 32 bits, support various I/O configurations: a 16-bit software programmable bi-directional interface, and two 8-bit interfaces. One 8-bit interface supports direct connection to Centronics-compatible printers. The other provides 8 bits of parallel input for such devices as keyboards. The IO5 also offers a software-programmable timer for real-time or multi-user applications.

For more details about these new boards, or any of SSM's S-100 compatible boards (including various CPU, EPROM, video and development boards), just call your local dealer or SSM today.

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Editorial

Photo 5: *Epson's HX-20 prototype computer. This new brief-case-sized computer, which looks like the Sony Typecorder, will be formally introduced this summer.*

Pascal-77 and BASIC. To switch between Apple DOS and CP/M-86, you simply boot up with the appropriate disk. The price of the system is $995.

Speaking of 16-bit capability, Techmar exhibited an impressive array of IBM plug-in boards and an expansion chassis for the IBM Personal Computer. Included in this new product line are a speech masterboard with a built-in standard vocabulary of 143 words; a Winchester disk and controller; a video digitizer board to convert images from any standard video camera for use with the computer; a board that allows up to four IBM computers to share the same printer; a stepper motor controller; and a series of memory-expansion boards.

Digital Equipment Corporation unveiled its new Letterprinter 100. This machine offers near-letter-quality printing for less than $3000.

Epson displayed an intriguing prototype of the Epson HX-20 personal computer. Looking a lot like the Sony Typecorder, the HX-20 has the advantage of a four-line liquid-crystal display. The HX-20 and the Typecorder signal the beginning of a new trend to what I call "briefcase" computers: battery-operated machines that combine portability with powerful computer features. It's the sort of design that will appeal to people on the move.

Also on display at the Epson suite was a newly designed 5¼-inch floppy-disk drive that stands 1 inch high. It will be formally announced later this year, along with the HX-20. Epson is definitely a company to watch in the personal computing field.

For further information on some of the new products I have described in this editorial, see this month's New Products section.

* * *

Postscript

This past November, I was honored to give the keynote address at the Symposium on Small Computers in the Arts held in Philadelphia. It was sponsored by the

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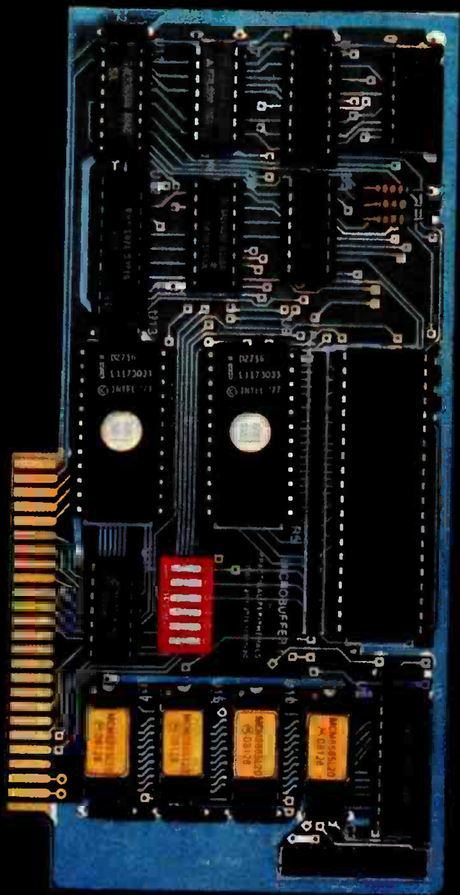

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IEEE Computer Society and the IEEE Philadelphia section and organized by the Personal Computer Arts Group of Philadelphia. Dick Moberg's organizing committee brought together artists, musicians, and computer scientists from around the country to discuss microcomputer music and art. I urge all BYTE readers interested in the use of small computers in the arts to contact the Personal Computer Arts Group. Write to: Personal Computer Arts Group, POB 1954, Philadelphia, PA 19105.■

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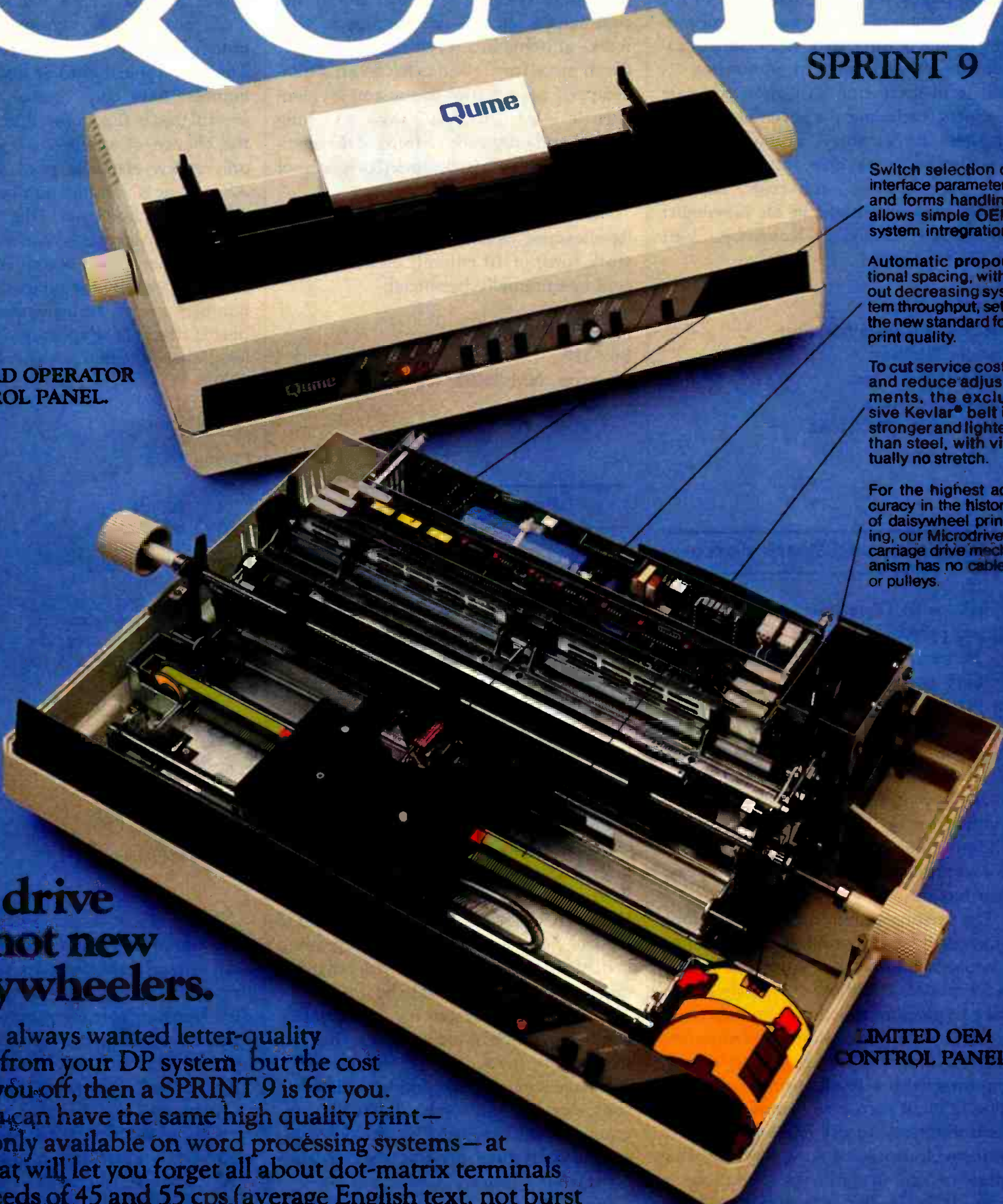

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Letters

Canon Dealer Organization

Sol Libes has been misinformed as to Canon policy regarding marketing of the CX-1 computer. Canon markets all system products through a dealer organization and is dedicated to supporting its dealers in marketing all Canon software products, including the seven accounting packages (order entry, accounts receivable, accounts payable, inventory control, general ledger, job costs, payroll) which were mentioned in his November column (BYTELINES, November 1981 BYTE, page 302).

Irwin Danowitz
National Software Manager
Systems Division
Canon U.S.A., Inc.
One Canon Plaza
Lake Success, NY 11042

An Untapped Work Force

Perhaps BYTE readers can help handicapped persons overcome some frustrating barriers. Most handicaps result in a mobility problem that effectively leaves the person house-bound (or, if lucky, car-bound). Many handicapped persons are in minimum-income situations that barely allow them to meet the expenses of survival. It is ironic that handicapped individuals may be highly trained, but without the ability to relocate or commute to a workplace daily, they cannot increase their income.

The personal computer could go a long way to solving this problem. For example, a house-bound worker with a computer and a modem could use off-the-shelf software to perform functions from accounting and data processing to engineering analysis and even managerial assistance. A printer with a Braille printhead would allow a blind person to communicate via electronic mail, to use databases, and to perform electronic-banking services being considered by many banks. The problem seems to be finding a "conduit" to companies willing to take on such employees.

I have approached about five hundred companies nationwide (IBM, ITT, GTE, and Boeing, among them). Their personnel departments treat me as a disabled person seeking employment at their plant location. Their management and data-processing systems, it seems, cannot accommodate an off-site employee who works at home in a service-type capacity. (Even more frustration is felt when a handicapped person tries to use employment agencies—this usually involves long delays, and only about a third of the agencies even bother to acknowledge receipt of your resume.)

Perhaps BYTE readers could help the handicapped (who represent an untapped work force of 10 million) on a level that could be mutually beneficial.

Kenneth Willoughby
Box 317
Fairacres, NM 88033

Faster Algorithms

From time to time I'm sure most readers have run across benchmarking articles comparing various pieces of hardware or software and found these articles followed up by letters to the editor critical of a particular algorithm which was used incidental to the test. In general, it seems, such criticisms are unfair, bearing little relation to the purpose for which the original article was written.

I introduce my comments this way for fear that I might otherwise be accused of a similar unfairness. I am speaking of the article "BASIC, Pascal, or Tiny-c? A Simple Benchmarking Comparison" by Phil Hughes (October 1981 BYTE, page 372) in which he uses a card-shuffling program to benchmark three languages with regard to speed of execution. In this he does a fine job. My only reason for commenting about his choice of algorithms is that this seems to be a routine that many readers will have some use for and be inclined to copy directly into some application program. For such readers I would like to offer an alternative program, which runs considerably faster.

First, however, let me make some observations about the routine used by Mr. Hughes and some of the characteristics leading to its slowness. The strategy used in this program (a modified version of which appears as listing 1 below) is to generate a random number and check to see if this number has been generated earlier in the sequence. If not, it is added; if so, the duplicate is ignored and another random number is generated and tested. This is continued until 52 distinct random numbers have been created. For the first several passes this causes no problem since the chance of duplication is small and only a few elements need to be tested. After 10 or 20 random numbers have been generated, however, the chance of duplication increases significantly, and the time needed to search for duplicates also increases. By the time the last 10 or 15 numbers are to be generated, the combined effect of duplication and search length has slowed this algorithm considerably.

Listing 1

```
100 DEFINT A-Z
110 DIMC(51)
120 RANDOM
130 A$ = TIME$
140 J = 0
150 T = RND(52)
160 IF J = 0 THEN 200
170 FOR I = 0 TO J - 1
180       IF C(I) = T THEN 150
190 NEXT I
200 C(J) = T
210 J = J + 1
220 IF J < 52 THEN 150
230 FOR I = 0 TO 51
240       PRINT C(I);
250 NEXT I
260 B$ = TIME$
270 PRINT
280 PRINTA$,B$
```

The program shown in listing 2 is a variation of one I have used several times both for card-shuffling routines and for programs to generate nonduplicated random numbers for programming bond retirement. The strategy here is to start with a sorted sequence and literally shuffle it. This is done by generating a random number between 1 and the total number of objects to be shuffled. Then comes the key step in this algorithm: the object in the position given by that random number is exchanged with the object in the last position.

Next, the maximum number of objects is decremented by 1 and the process is re-

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peated until this maximum equals 1.

Stepping through an example may be useful. Suppose we wish to shuffle 10 elements. We start out by arranging them in order as:

1 2 3 4 5 6 7 8 9 10

Next we generate a random number between 1 and 10, say 6. Now we exchange the objects in position 6 (the number generated) and 10 (the top of the range for the random-number generation). This leaves:

1 2 3 4 5 10 7 8 9 6

For the next step we generate a random number between 1 and 9 (10 −1). Suppose this time we get 4. Then we exchange the objects in positions four and nine and decrement the maximum element count to 8. We now have

1 2 3 9 5 10 7 8 4 6

The entire set will be sorted after 10 random numbers have been generated. (By the way, this does bring up one criticism of the algorithm used by Mr. Hughes for benchmarking. Because of the nature of his algorithm it is likely that every time the program is run a different number of random numbers will have to be generated due to the chance occurrence of duplication. While this should work out to a predictable average, the possibility of variation makes its usefulness as a benchmark somewhat doubtful.)

I ran both versions of the shuffling program which appear here on my TRS-80 Model I. As mentioned above, the timing on listing 1 was quite variable, ranging from 40 to 66 seconds. For listing 2 the time was consistent at 3.5 to 4 seconds. (And no, I didn't compile the second version. I did subsequently compress it, deleting spaces and packing the entire program on a single line and got average speeds of about 2.25 seconds.)

Listing 2

```
100 DEFINT A-Z
110 RANDOM
120 N  =52
130 DIM A(N)
140 A$=TIME$
150 FOR I = 1 TO N
160         A(I) = I
170 NEXT I
180 FOR I =N TO 2 STEP -1
190         R = RND(I)
200         T=A(I)
210         A(I) = A(R)
220         A(R) = T
230 NEXT I
240 FOR I =1 TO N
250         PRINT A(I);
260 NEXT I
270 PRINT
280 B$=TIME$
290 PRINTA$,B$
```

Finally, I'm not sure of the origin of this second algorithm. I don't remember inventing it, but then I don't recall reading or hearing about it elsewhere. I do know that it has been very useful to me. I hope BYTE readers will find it equally valuable.

David R. Borger
16835 Westmoreland
Detroit, MI 48219

Mr. Hughes's article comparing BASIC, Pascal, and Tiny-c for writing a card-shuffling program is useful for comparing the ease of programming in those languages. Some caution must be exercised in using the timing results, however. The algorithm he uses is very sensitive to the order of the random numbers. The algorithm is as follows:

A. Get a number from 1 to 52 from the random-number generator. If the number has already been used, repeat this step.
B. Put this number in the array (deck) at the next location. If we have 52 numbers, we are done. Otherwise go back to step A.

As we get toward the end of the deck, there are fewer acceptable numbers. One number generator may require many more calls than another. To get a "good" sequence of random numbers, the range of the random-number generator should be much larger than the range required by the program. In order to compare Mr. Hughes's algorithm in the three languages, we should assure ourselves that the number of calls to the random-number generator is at least on the same order.

It's possible to generate a random list of numbers *n* long with only *n* calls to the random-number generator. The idea is to generate *n* random numbers and then sort them. The random numbers are distributed across the range of the number generator, not the range of the program. If the random-number generator is good, this means that any number generated will not be repeated until all other numbers in the range of the number generator have been generated.

Here is one possible algorithm for get-

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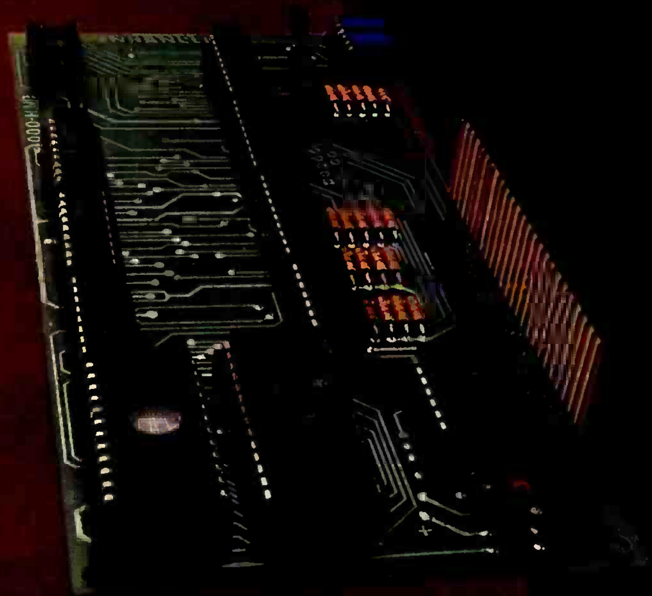

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ting a shuffled deck of cards. Use two arrays, KEY and CARD:

A. Initialize CARD by letting CARD(I) = I for elements in CARD.
B. Put a random number in each element of KEY.
C. Find the smallest element of KEY that has not been used. This is the next card. Save it in array CARD. Repeat this step until all the elements of KEY have been used.

A BASIC program that performs this algorithm follows. Note that the sort used is a bubble sort and is not as efficient as some others.

```
10 DIM C(51), K(51)
20 GOSUB 1000
30 FOR I = 0 TO 51
40 PRINT C(I);
50 IF INT ((I + 1) / 10) = (I + 1) /
     10 THEN PRINT
60 NEXT I
70 PRINT
80 PRINT "ALL DONE!"
90 END
1000 FOR I = 0 TO 51
1010 K(I) = RND (0)
1020 C(I) = I
1030 NEXT I
1040 FOR I = 0 TO 50
1050 S = I
1060 FOR J = I + 1 TO 51
1070 IF K(J) © K(S) THEN S = J
1080 NEXT J
1090 K(S) = K(I)
1100 T = C(I)
1110 C(I) = C(S)
1120 C(K) = T
1130 NEXT I
1140 RETURN
```

I hope this will be of some use to those who shuffle cards. The inside loop is performed approximately 1352 times, so if you require fewer calls than this to your random-number generator to get 52 numbers, Mr. Hughes's algorithm may be better.

Emmet R. Beeker III
1123 Maple Dr.
Mountain Home, ID 83647

Single-Drive Success Story

The review "The Radio Shack FORTRAN Package" by Tim Daneliuk (October 1981 BYTE, page 385) is a good overview of an excellent software package. However, I must take exception to the statement "In single drive systems, the relocatable object file must always be on the disk containing the linker and FORTRAN library." This is not true. In fact, the source, relocatable, listing, and object codes may reside on a disk separate from both supplied FORTRAN disks.

First I'll name the three disks that I'll be using and then I'll lead you through the steps necessary to compile and link a FORTRAN source program using one disk drive. It did take some time to figure this out because Radio Shack forgot to document the procedure. The disk containing the editor and the FORTRAN compiler will be called FOR/EDIT, the disk containing the linker and the FORTRAN library will be called FOR/LINK, and the disk containing the source, relocatable, and object codes will be called PROGRAM.

1. Insert the FOR/EDIT disk and boot the system. Load and execute the editor by entering EDIT.
2. After the editor has loaded and you receive the prompt, remove the FOR/EDIT disk and insert the PROGRAM disk that contains, or will contain, the source program.
3. Create or change the source code, as necessary. When finished, write the source code to the PROGRAM disk.
4. Remove the PROGRAM disk and insert the FOR/EDIT disk. Load and execute the FORTRAN compiler by entering F80.
5. After the compiler has loaded and you receive the prompt, remove the FOR/EDIT disk and insert the PROGRAM disk that contains the program to be compiled, and where the relocatable code is to reside.
6. Enter TEMP,TEMP=TEMP, or whatever program name you are working with. This will compile the source code and write out the relocatable code along with a print file.
7. Remove the PROGRAM disk and insert the FOR/LINK disk. Load and execute the linker by entering L80.
8. After the linker has loaded and you receive the prompt, remove the FOR/LINK disk and insert the PROGRAM disk that contains the relocatable code to be linked.
9. Enter TEMP, or whatever program name you are working with. This will load the relocatable code and display all the undefined globals.
10. Remove the PROGRAM disk and insert the FOR/LINK disk. Enter FORLIB/REL-S to search the FORTRAN Library to resolve all undefined globals. If you need to search other files to satisfy undefined globals, enter FILENAME-S.
11. Remove the FOR/LINK disk and insert the PROGRAM disk that will contain the executable object code.
12. Enter TEMP-N to name the output object code. Then enter -E to write out the object file and exit the linker.
13. You are now ready to execute the command (object) file TEMP/CMD.

Note that no data was written to the two FORTRAN disks. In fact, I keep write-protect tabs on these disks just to avoid disasters. This procedure seems to be a lot of work, but those of us with single-drive systems are used to the inconvenience. If we couldn't hack it, we'd have two disks!

Spencer R. Lepley
1655 Capital Circle SE, Lot #12
Tallahassee, FL 32301

Tim Daneliuk replies:

Mr. Lepley seems to be absolutely correct! I entered a short FORTRAN program and linked it as he suggested: it works just fine. As he points out, the documentation does not discuss single-drive use in any real depth. Personally, I think a book is needed that would document these kinds of procedures as well as the many advanced features of both the Radio Shack/Microsoft FORTRAN and the M-80 Macro Assembler. How about it Radio Shack?

One other point has come to my attention since I first did the FORTRAN review: as of this writing, the package has not been implemented on the TRS-80 Model III. However, Model III systems that use the LDOS disk operating system can use not only FORTRAN, but M-80 Macro Assembler, BASCOM compiler, RS COBOL compiler, and RS BASIC compiler. This is accomplished by "patching" the Model I versions of these languages. Complete instructions for these procedures are found in the latest issue of the LDOS Quarterly *(Vol. 1, No. 2).*

More on VOS

Since Sol Libes's mention of the Software Tools Virtual Operating System in BYTELINES (October 1981 BYTE, page 306) our research group at the Lawrence Berkeley Laboratory has been inundated with requests for information. Although

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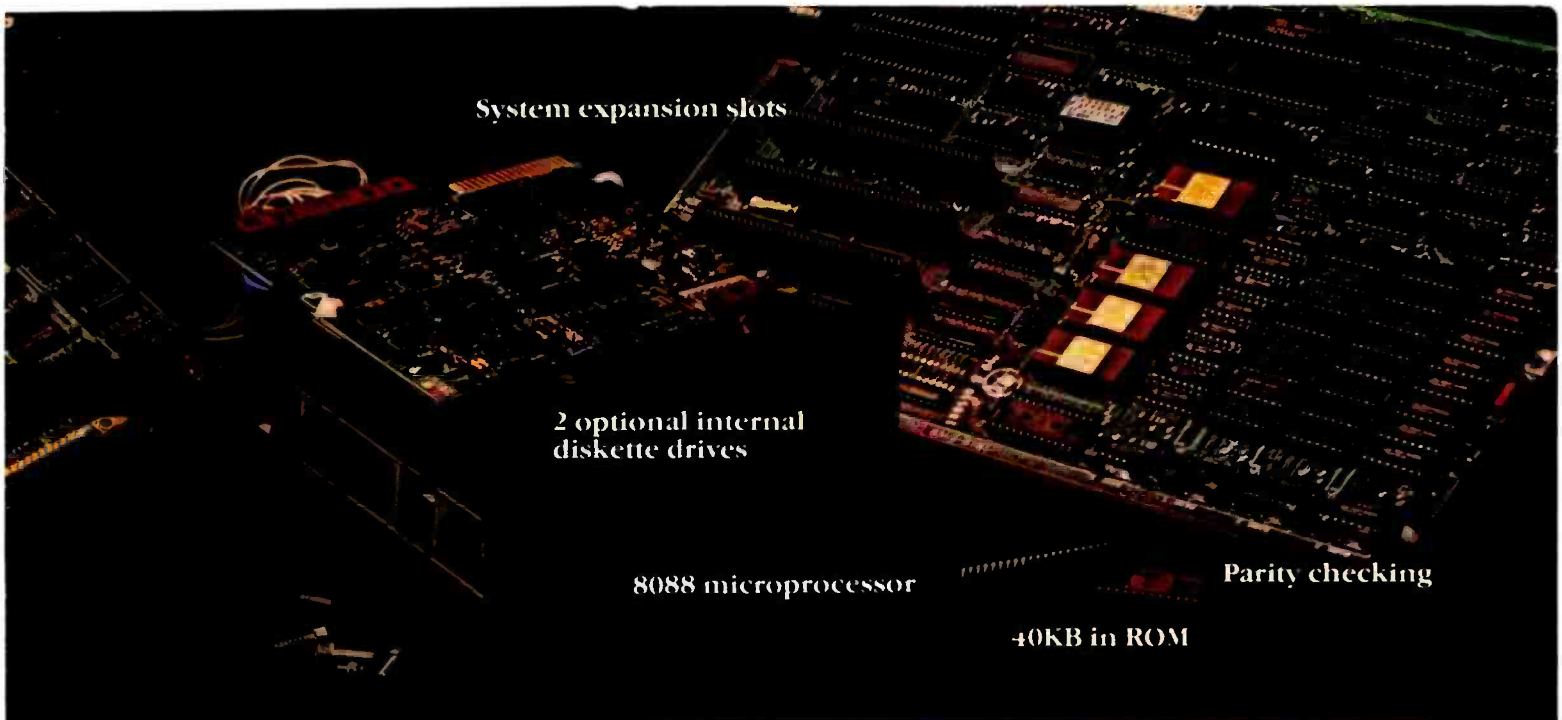

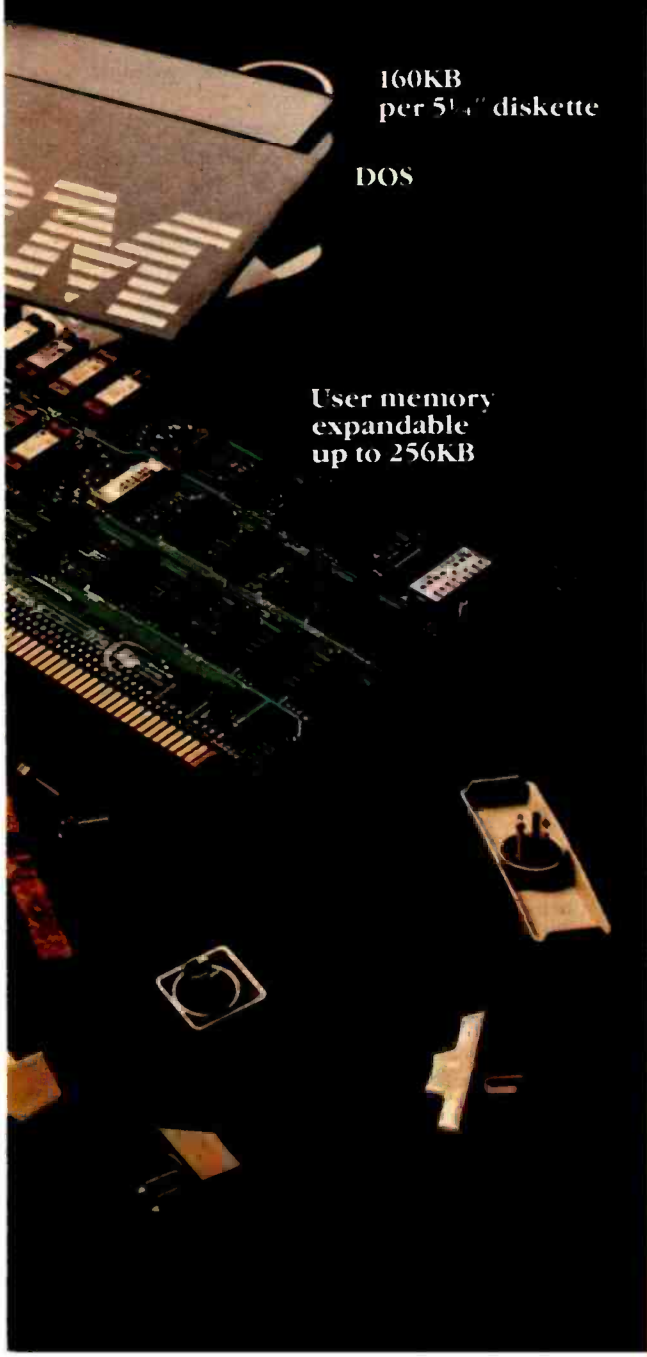

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we are certainly pleased with the interest, the Users Group is better able to deal with these requests than we are. Inquiries should be addressed to:

Software Tools Users Group
1259 El Camino Real, Box 242
Menlo Park, CA 94025

The 1600-member group issues newsletters, distributes a software catalog, provides an information referral service, produces a distribution tape, and holds biannual meetings. I am sure the Users Group would welcome the inclusion of microcomputer enthusiasts.

And, to answer the question most asked by BYTE readers who contacted us: Yes, the software tools have been brought up on a CP/M system. This implementation includes all the tools distributed through the Users Group, plus many of the extensions specified in the CACM article describing the VOS project ("A Virtual Operating System," Dennis Hall, Deborah Scherrer, and Joe Sventek, *Communications of the ACM*, September 1980, pp. 495-502). For more complete CP/M information, BYTE readers should contact:

Unicorn Systems
30261 Palomares Rd.
Castro Valley, CA 94546

We welcome the enthusiasm and interest shown by BYTE and its readers and hope the above information will answer most of their questions.

Deborah K. Scherrer
Computer Scientist
Lawrence Berkeley Laboratory
University of California
Berkeley, CA 94720

"BYTE" Fights Mice

The staff at the Poricy Park Nature Center was delighted with the article, "Bridging the 10-Percent Gap," by Paul Brady (October 1981 BYTE, page 264) which described our computer system.

On the day we received the magazine, we were given a black cat to help keep the mice from the bird seed we sell. We have appropriately named the cat "BYTE."

Patricia Contreras, Director
Poricy Park Nature Center
POB 36
Middletown, NJ 07748

Ultra-Low-Cost Protocol

Ken Clements and Dave Daugherty's article, "Ultra-Low-Cost Network for Personal Computers" (October 1981 BYTE, page 50), presents an excellent idea. Personal computing does need a low-rent Ethernet, especially for group applications, such as schools. However, the protocol described is both more complex and less reliable than necessary. A few minor changes would fix this.

In the RECEIVER layer, if a message has a bad checksum, just throw it away—there's no need to tell the protocol layer because it doesn't do anything with bad messages. In the PROTOCOL layer, pick one protocol and stick to it. A good simple one is as follows:

1. Every message has a message number. This includes ACK (acknowledge) utility messages.
2. Message numbers are either 0 or 1.
3. The sender starts by sending a message with a number of 0. The original sender then awaits a corresponding acknowledgment from the original receiver. Upon receiving an "ACK 0" message (with a correct checksum) the original message is considered acknowledged and the sender can send the next message, with message number 1. The sender expects an "ACK 1" reply to its number 1 message. This cycle repeats indefinitely.
4. All the receiver has to do is send a matching ACK whenever a message addressed to it is received, i.e., ACK 0 is sent in reply to a message number of 0, and ACK 1 in reply to a message number of 1. However, the receiver throws away (after ACKing them) messages with the same number as the last good message received, because such messages are duplicates.
5. When the sender fails to get a proper ACK in a reasonable time, the last message should be re-sent. After some number of unsuccessful attempts, the sender should give up and report the receiver down.

This protocol provides a guarantee that messages are not lost or duplicated, unlike the ACK/ACK-ACK protocol, provided that a bad message doesn't get past the checksum error-detection mechanism. A longer checksum (say 16 bits) will reduce the odds of this substantially—from 1 in 256 to 1 in 65,536. In a contention-type local network, there *will* be errors when

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messages collide, so this is not a minor consideration.

As a last point, it is very useful to provide a high-level time-out interval, say of about 30 seconds, so that if nothing happens during that length of time, everything gives up trying to communicate and goes back to the initial state. Otherwise, if for some reason things get stuck, it may be necessary to reset *all* the computers connected to the network to get them all back in synchronism on message numbers. If all the systems in your classroom full of microcomputers need to be reset whenever any one gets fouled up, this trick is a big help.

With these fixes, the Ultra-Low-Cost Network should fly. There are more elaborate schemes, but this is the simplest one that doesn't get intermittent errors.

John Nagle
340 Ventura, Apt. 11
Palo Alto, CA 94306

Software Considerations

I would like to comment on "Bridging the 10-Percent Gap" by Paul Brady (October 1981 BYTE, page 264). Mr. Brady points out that a wide range of reasonably priced hardware for small-business requirements is available. This is true and should encourage progressive small-business owners to move into the computer age. However, Mr. Brady demonstrated the classic "small-business mistake" in this statement: "We barely managed the funds required for the hardware. We simply cannot spend hundreds or thousands more on software."

Prospective computer owners need to realize that good software is a labor-intensive product and must be included in the budgeting for a computer system. Mr. Brady was lucky that his organization had people willing to donate their time to design, code, test, and document customized software. Not all small businesses have this advantage.

My advice to a small-business owner who needs a computer but lacks the time and inclination to become a computer expert is to hire a local computer professional or small firm to put together the best hardware and software combination for his application. I will be glad to mail free copies of my article, "The Small-Business Owner's Guide to Hiring a Computer Expert," to anyone who sends me an address and 40¢ in stamps.

Diane P. Kerkhoff
Kerkhoff Computers
6309 Ambassador Dr.
Orlando, FL 32808

Altos Gamesmen

While Thomas Wadlow's "The Xerox Alto Computer" (see September 1981 BYTE, page 58) was most interesting, I'm sorry he didn't mention that Xerox also donated four Altos to the Computer Science Department at the University of Rochester in 1974. In fact, two of the games pictured in the article were written by graduate students there.

Trek is the work of Eugene Ball, who also wrote Death Star (in which you pilot your Alto down a trench in the Death Star and fire a torpedo at its only vulnerable spot to save the Federation). Pinball was written by Clint Parker. You can jiggle the "table" by holding down the space bar. Overly energetic application of the space bar results in a "tilt." Clint's version of Space Invaders remains one of the most popular Alto games. It keeps track of the top ten scores on the net. No still photograph can convey the fine graphic details of these programs.

Incidentally, the four original Altos at University of Rochester are named John, Paul, George, and Ringo (my own suggestion was Groucho, Harpo, Chico, and Zeppo).

Michel Denber
Xerox
800 Phillips Rd.
Webster, NY 14580

Exploring Zork's Origins

While praising so highly the efforts to fight software piracy undertaken by the vendors of "Zork, The Great Underground Empire," Bob Liddil in his review (February 1981 BYTE, page 262) perhaps forgot to mention that the release of Zork seems to be an act of software piracy itself. From the description given, I infer that Zork is just an implementation of the well-known PDP-11 game Dungeon, distributed by Digital Equipment Corp.'s user group, DECUS. All the situations, descriptions, treasures, reactions, etc. are nearly identical to those found in Dungeon: the white house with the sack

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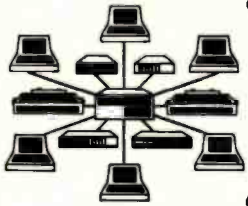

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of peppers on the kitchen table, the forest where players are reincarnated, the jewel-encrusted egg in a nest on a tree, and more. The colorful description of situations has especially set Dungeon apart from preceding adventure games. Even the name Zork is taken from a situation in Dungeon. Yet in Zork's advertising you will not find a tiny nod to any of the numerous authors outside Personal Software Inc. who have done 99 percent of the work.

Greetings from a fanatic BYTE reader.

Hans Strasburger
Dipl. Math. Dipl. Psych.
Tal 58/IV
D-8000 Munich 2
West Germany

Response to Hans Strasburger:

A call to Personal Software Inc. revealed that Zork will no longer be distributed by that company. Zork is now being sold by Infocom of Cambridge, Massachusetts. Joel Berez, president of Infocom, gave us a short history of Zork.

According to Mr. Berez, Zork was originally developed around 1977 and run on a Digital Equipment Corporation PDP-10 using a language called MDL. Sometime later a version was developed for the PDP-11 using FORTRAN, and this is the version being distributed by DECUS. This version was written by someone who had access to the original Zork source code. The microcomputer version formerly sold by Personal Software and now by Infocom was written by the authors of the original Zork: Marc Blank, Dave Lebling, Bruce Daniels, and Tim Anderson. The first micro-Zork, Zork I, was a subset of the original version. Zork II includes more of the original Zork situations than Zork I plus some additional enhancements. A future Zork III will contain the remaining original Zork material plus even more enhancements. Thus, the combination of Zork I, Zork II, and Zork III would give the user all the original PDP-10 version plus many enhancements. For more information on Zork, see "Zork and the Future of Computerized Fantasy Simulations," December 1980 BYTE, page 172.

Old Clothes Issue New Clarion Call

I enjoyed BYTE's reprint of Charles Anthony Richard Hoare's Turing lecture of 1980. (See "The Emperor's Old Clothes," in the September 1981 BYTE, page 414.) One of the points he made about the programming language Ada deserves some extension. He said, ". . .do not allow this language in its present state to be used in applications where reliability is critical. . . . The next rocket to go astray as a result of a programming-language error may not be an exploratory space rocket on a harmless trip to Venus. It may be a nuclear warhead exploding over one of our cities."

Some BYTE readers may not know that a hardware error nearly caused us to launch a nuclear attack against the Soviet Union on June 6, 1980. The North American Air Defense Command (NORAD) command center in Colorado Springs detected an illusory Soviet nuclear attack on us, and our bombers were taxiing to take off, our nuclear-missile submarines alerted, and our land-missile launch keys inserted into their sockets, ready to go in retaliation. The error was detected with little time to spare. It was traced to a $0.46 integrated circuit. This was not an isolated incident. A similar alert was signaled only three days earlier. (See *The Progressive* magazine, August 1980, pages 29-30.)

As we automate more and more of the decisions involved in launching our arsenal of 10,000 strategic nuclear weapons, most of which are far more powerful than the bombs used in Hiroshima and Nagasaki in 1945, we leave ourselves more and more vulnerable to computer errors. Professor Hoare's warning comes at a critical time.

To prevent accidental nuclear war, "debugging" our software and hardware plays a part. But, most important, we as computer professionals and human beings must speak out in favor of nuclear-weapons limitations. Specifically, we can endorse the "Call to Halt the Nuclear Arms Race," a statement that says that "the U.S. and the U.S.S.R. should adopt a mutual freeze on the testing, production, and deployment of nuclear weapons and of missiles and new aircraft designed primarily to deliver nuclear weapons. This is an essential, verifiable first step toward lessening the risk of nuclear war and reducing the nuclear arsenals." The "Call" is available in bulk for $0.05 per copy, plus postage, from:

American Friends Service Committee
1501 Cherry St.
Philadelphia, PA 19102

Single copies and more information can be obtained from:

Nuclear-Weapon Freeze
251 Harvard St.
Brookline, MA 02146

Many other organizations around the country are also working to support a weapons freeze. Would you believe, High-Technology Professionals for Peace, in Cambridge, Massachusetts? (See *Computer* magazine, September 1981, page 95.)

I hope that we can see the day when Professor Hoare's caution will be unnecessary.

Steven Pacenka
812 Hanshaw Rd.
Ithaca, NY 14850 ■

A Note on Our Database Issue

BYTE readers have shown a great deal of interest in the articles on database management systems, the theme of the November 1981 BYTE—particularly the article "A Survey of Data-Base Management Systems for Microcomputers" by Kathryn S. Barley and James R. Driscoll. While we are pleased that our readers liked the articles in that issue, we are concerned about some of the questions we have been asked, such as "What's wrong with this database? It wasn't listed in your November issue."

Readers must keep in mind that we are not the definitive source for microcomputer information; we cannot review every product on the market. We operate in a world of time constraints and deadlines. We present as many reviews of as many products as time and personnel resources allow. Barley and Driscoll noted that their survey of 18 databases was not comprehensive and that "a potential buyer . . . can determine which database features he or she considers most important and then seek a system that offers those features."

Database management is one of the fastest-growing fields in the microcomputer industry. We will try to keep you informed about as many products as we can. Please remember that the absence of a product review in BYTE does not imply that we have a negative opinion of it. Look for additional database reviews in future issues of BYTE.

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Software Review

The Flexibility of VisiPlot

Robert E. Ramsdell
POB 59
Rockport, MA 01966

One of the most important communication functions your microcomputer can perform is to create, display, and print charts and graphs. For several months I have been using the methods described here to develop presentations for my clients. The graphics format dramatically increases my ability to communicate complex financial information and analyses to the client. In addition, charts and graphs tend to hold an audience's interest during a presentation.

Some of the many uses for this type of graphic communication include stock-market charting, budget analyses, and forecast and projection display. You can do all of this with VisiPlot, the latest and most powerful plotting and graph-generating program available for Apple computers.

About the Program

VisiPlot is a series of programs that allow entry and editing of data, design of a graphic screen presentation, and printing of the screen's contents to a graphics printer. All features are menu selected using the arrow keys, space bar, and return key. The data program allows full entry and editing of the information to be graphed, with as many as 645 points in 16 series. In addition, data can be automatically transferred to the program from a Data Interchange Format file created by another program, such as VisiCalc or DB Master. A comprehensive storage management program allows extensive file manipulation. Completed graphs (which I refer to as *slides*) can be saved to the disk and/or printed on any graphics printer.

The plotting program is extremely comprehensive and permits line, bar, half-bar, area, pie, high-low, and scatter graphs. Display-value ranges for the two axes are automatically determined by the program, but these default values can be overridden. After the basic graph is on the screen, VisiPlot's flexibility becomes evident.

A vast number of titling, formatting, and color options are available. The five fixed-title options have a choice of

About the Author

Robert E. Ramsdell, CPA, is a microcomputer consultant who lives and works in Rockport, Massachusetts. His company, Pansophics Ltd., publishes business- and financial-modeling applications software for use with VisiCalc and SuperCalc programs.

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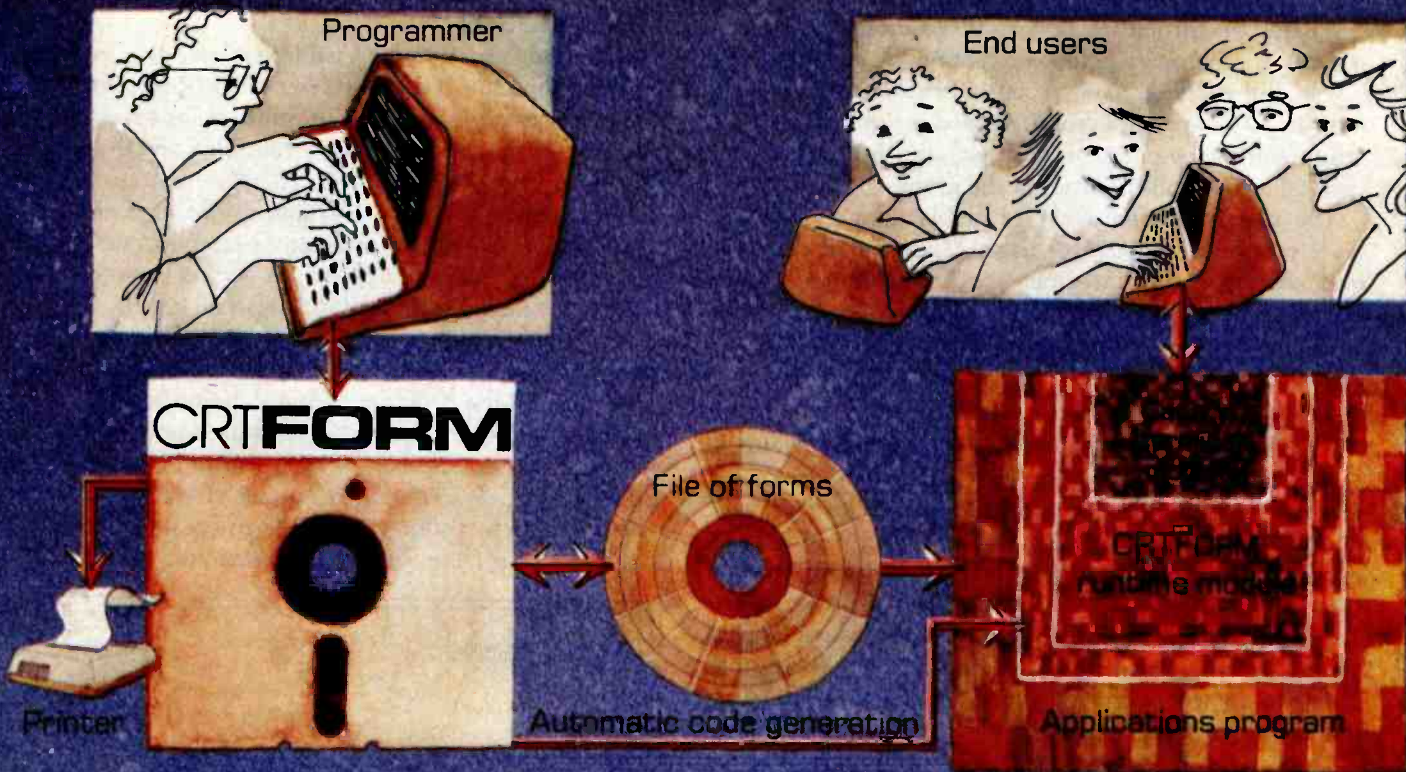

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normal or boldface type, though the movable-title option is by far the most powerful. A title can be created, moved, and placed anywhere on the screen in normal or reverse (black-on-white) print. This feature allows you to label individual points on the graph.

Among the formatting options is the ability to simultaneously compare two graphs (except the pie graph) on the screen, either side-by-side or one over the other. Bars in the bar graph appear as solid, shaded, or in outline. One graph can be overlaid on another, and horizontal and vertical grids facilitate reading the graph.

The user is offered a choice of black, white, violet, blue, orange, and green for use as background or in the bars, areas, and pie segments of the graphs. Printer drivers for most graphics printers are included on the disk and operate automatically from within the program.

Specific Examples

I have prepared several examples of graphs. Figure 1 shows the dramatic effect on profitability and customer returns resulting from an improved inspection program; figure 2 shows the distribution of a company's sales dollar; figure 3 compares sales and net operating income for a 10-year period; figure 4 compares the average inventory with the cost of sales for a company during seven years; figure 5 shows the performance of "My Mutual Fund" in comparison with the NYSE Index; figure 6 is a scatter graph of some mathematical functions.

In each example, you can see that the information is much more interesting and understandable when presented graphically. On a color monitor, the impact is even more dramatic.

Documentation

The documentation for VisiPlot is thorough, inclusive, and contains tutorial and reference sections. Because of the many possible uses, the program takes several hours to learn, but the tutorial is easy to follow and the user interface is very well designed. The disk contains sample data files that the user can examine, edit, and graph.

The reference section contains examples and full explanations of every command. A pocket reference card with less detailed information is also included.

Program Constraints

Because of the program's sophistication and the many options it offers, much work is required at the keyboard to create a slide. Another major constraint is that the program cannot reload and adapt a slide already created and stored. It takes about 15 minutes to create a slide, and you must start from scratch each time you want to make

At a Glance

Name
VisiPlot

Type
High-resolution color-graphing and plotting program for data-series display

Author
Mitch Kapor for Micro Finance Systems Inc.

Distributor
Personal Software Inc.
1330 Bordeaux Dr.
Sunnyvale, CA 94086
(408) 745-7841

Price
$199.50

Format
5¼-inch floppy disk

Language
Applesoft Basic and 6502 machine language

Computers
Apple II Plus and Apple III computers, minimum 48 K bytes of programmable memory

Documentation
Loose-leaf binder with 140-page tutorial and reference manual; reference card

Enhancements
Data Interchange Format files for communication with other programs (VisiCalc, DB Master, etc); also available with time-series analyses (VisiTrend/VisiPlot)

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The disk cannot be copied or backed up, but a backup copy of the disk can be obtained from the distributor for an additional $35.

Conclusions

VisiPlot is a well-designed software package that will prove useful to all those who want to use screen or printed graphics in their communications processes. The user interface is well planned, with all options selected from menus, and the data-entry and editing procedures are well conceived and implemented.

The ability to interchange data with other programs makes VisiPlot an integral part of any business systems package, while the combination of VisiPlot and a time-series analysis program (VisiTrend) is the most powerful forecasting and analysis software presently available. ■

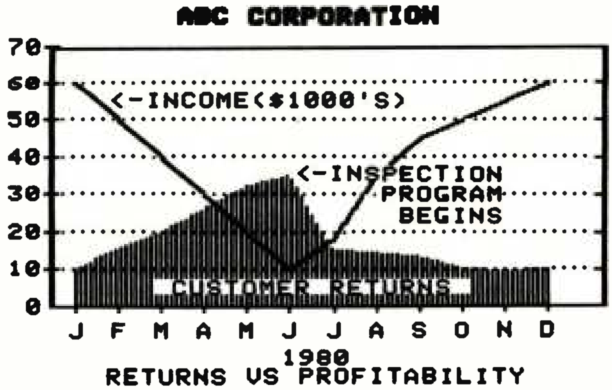


Figure 1: *A line and area graph created using VisiPlot.*

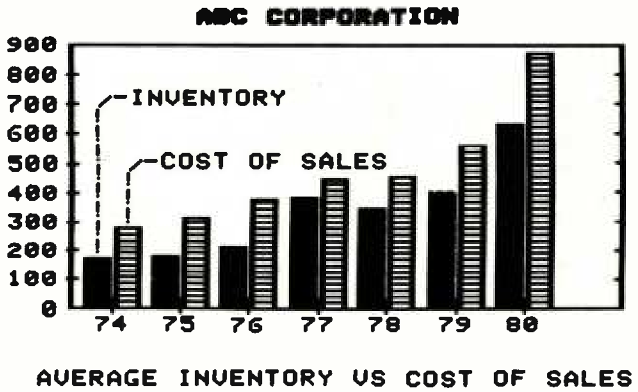


Figure 4: *This chart combines bar and half-bar representations.*

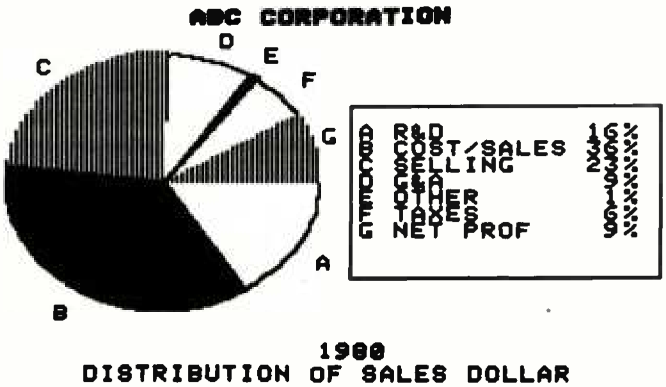


Figure 2: *A pie chart, used to illustrate relative quantities.*

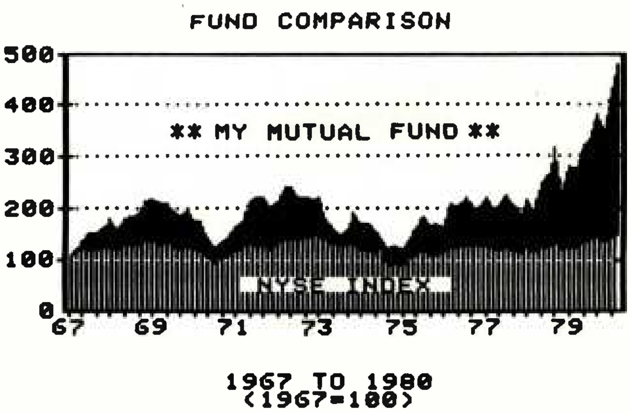


Figure 5: *An area graph that plots investment activity over time. (The graph is real—the profits are imaginary.)*

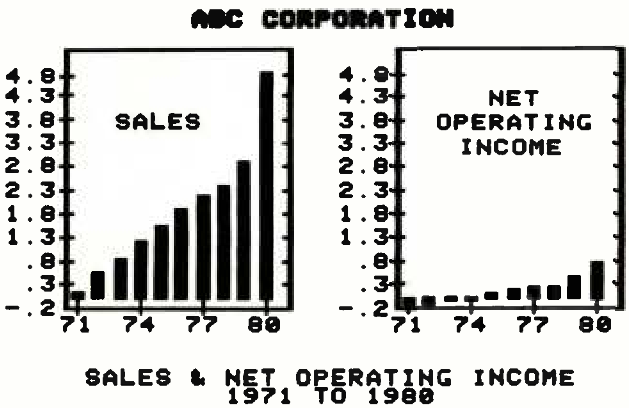


Figure 3: *A bar chart or bar graph.*

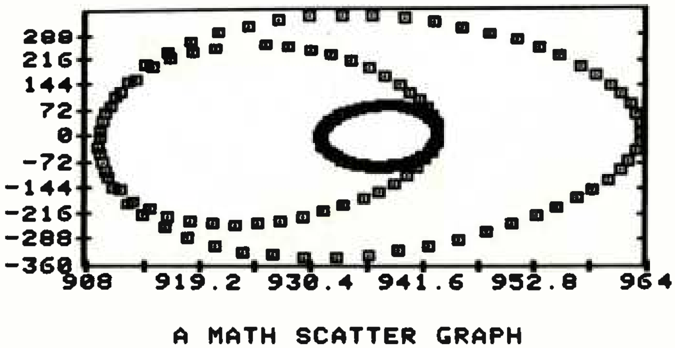


Figure 6: *A scatter graph of some mathematical functions.*

Build a Computerized Weather Station

Steve Ciarcia
POB 582
Glastonbury, CT 06033

One of the few redeeming features of the weather here in New England is the abundance of wind. It may change directions five times a day, but there always seems to be a breeze.

For some time I have been thinking of installing a windmill at my house to provide supplemental electrical power. Maps and charts of my locale suggest that it might be feasible, but considering the complexities of the interactions of climate and terrain in Connecticut, I thought it might be worthwhile to gather more on-site weather data before pouring concrete.

The practical problem of collecting the data inspired this article. I started out by adapting a commercially available anemometer (wind-speed gauge) and wind vane for computer attachment. To simplify getting the data to the computer inside the house, I decided to convert the parallel output from the rooftop transmitter/sensor unit into serial format. Instead of stringing 200 feet of 12-lead cable from the rooftop unit to the computer, I could run a single two-conductor twisted-pair cable.

After this unpretentious start, I got a little carried away thinking how I could do away with even this one cable. But first let me describe the system as I initially built it, starting with the wind sensors.

Photo 1: *Wind-velocity measurements are taken by a cup anemometer and wind vane mounted high above any obstruction to air flow on a section of television-antenna mast.*

Weather Instrumentation

Devices capable of sensing and measuring wind speed and direction can be built from several different basic designs, but probably the most cost-effective wind-speed and direction sensors are the familiar cup anemometer and wind vane, shown in photo 1. The cup anemometer captures the moving air in cup-shaped air scoops that are attached via spokes to a shaft. The assembly spins at a rate proportional to the wind's velocity.

A wind vane looks and works like an arrow with a big tail. As the wind blows, the tail fin acts like a sail, causing the vane to align itself with the direction of the wind.

I briefly considered trying to design a homebrew cup anemometer and wind vane, but several factors argued against this.

In my application, survivability

and accuracy are important. To determine the economic feasibility of a windmill, measurements must be taken, for several months, from a location exposed to the full fury of the weather. An anemometer constructed from paper cups and a small permanent-magnet motor/generator would have been a kluge at best. It might have been capable of measuring wind speed for a little while, but it would not have survived exposure to the elements for very long. Also, I needed to have reliable accuracy to determine the potential power output of a windmill, which is a function of wind speed.

It is not easy to construct a reliable cup anemometer and wind vane. For weather instruments to work, they must survive the weather they are to monitor.

I prefer to concentrate on the applications of electronic technology rather than on techniques of fabrication or artistic excellence. Instead of attempting homebrew sensor designs, I decided to use the wind sensors from a commercially available weather-monitor kit, the Heathkit ID-1890 Digital Wind Computer, sold by the Heath Company, Benton Harbor, Michigan. This is a microprocessor-based unit that displays wind velocity and the date and time of peak gusts. The unassembled parts of the anemometer are shown in photo 2.

If you wish to duplicate my project, you can order the complete kit from Heath and use the appropriate parts. It is unlikely that the required parts will be available separately. (At the time of this writing, the ID-1890 Digital Wind Computer kit is on sale at $164.95, reduced from the regular price of $194.95.)

The required parts from the ID-1890 kit are listed in the text box on page 48. The ones unique to the kit are marked with an asterisk, while the rest are fairly common hardware or electronic parts.

The same wind vane and anemometer are used in the more complex ID-4001 Digital Weather Computer kit, which displays wind velocity, temperatures, barometric pressure, and the current date and time and stores weather data for future recall. The ID-4001 sells for $399.95. (In addition, the ID-4001 contains an output port designed to feed data into a Heath H-8 computer system for logging of weather conditions; it is likely that other computers could be connected through this interface as well.)

If you want to build an anemometer, you might try a different

Photo 2: *The anemometer and wind vane were constructed from parts used in the Heathkit ID-1890 Digital Wind Computer, shown here.*

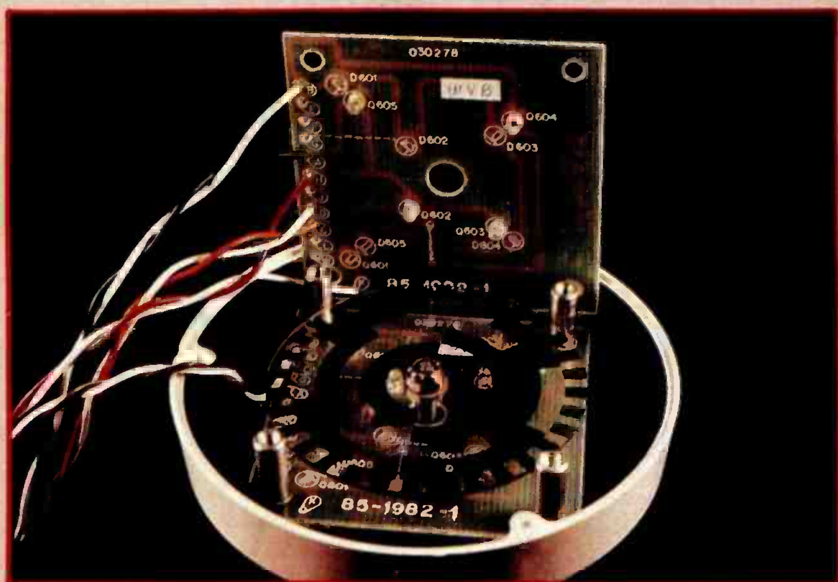


Photo 3: *The partially assembled data encoder. The optical encoder disc is mounted on a shaft between the phototransistors and the LEDs. The opaque areas of the disc block the light path between appropriate phototransistor/LED pairs, producing a unique Gray-coded output value.*

measuring technique, such as the sonic anemometer described in BYTE several years ago by Neil Dvorak (see reference 5, listed on page 68). His design used four ultrasonic transducers to measure wind speed, direction, and the temperature of the air. But due to the tight tolerances of the analog circuitry involved, I recommend the cup-anemometer approach.

Adapting the Wind Sensors

The output from the Heathkit cup anemometer and wind vane consists of encoded electrical impulses, which must be specially interpreted by the computer to derive information about wind conditions. Each of these wind-sensor units is not much more than a weatherproof mechanical housing for pairs of phototransistors and LEDs (light-emitting diodes) separated by an optical encoding disc.

As shown in figure 1, the anemometer and wind vane each have six basic components: the air-catching apparatus (the wind cup or vane), the top housing, two printed-circuit (PC) boards, the plastic optical encoder disc, and the bottom housing. The wind cup (or vane) and encoder disc are connected by a shaft supported by ball bearings. As the cup and shaft turn, the shaft rotates the encoder disc between the phototransistors, which are mounted on the top PC board, and the infrared LEDs, which are mounted on the bottom PC board.

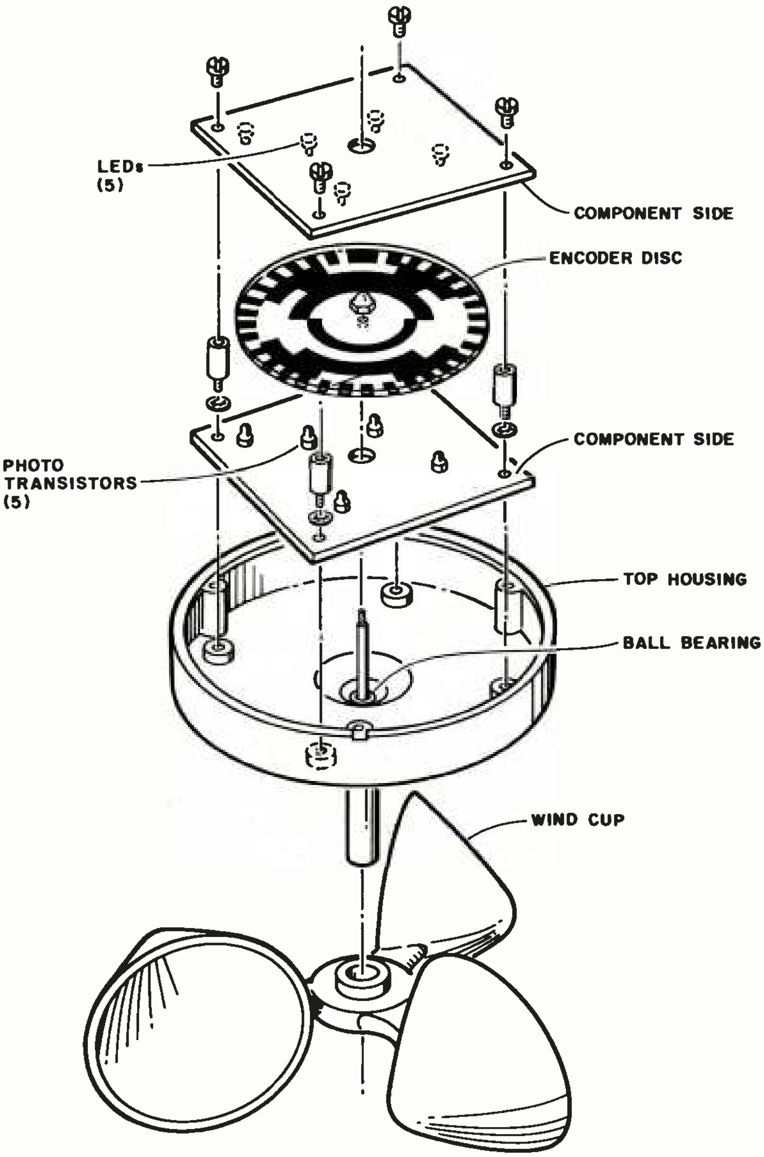


Figure 1: *Exploded mechanical diagram of the inverted Heathkit anemometer unit, showing the five LED and phototransistor positions on the two PC boards. The wind vane uses four LED/phototransistor sets, while the anemometer actually uses only one set.*

As the encoder disc turns, the opaque portions of its surface interrupt the light path between the LEDs and the phototransistors. A schematic diagram of the configuration is shown in figure 2.

There are five separate concentric bands on the encoder disc, as shown in figure 3. An identical disc is used in both the wind vane and the anemometer, but the two units use different portions. In the anemometer, the outside ring of the disc is positioned between a single LED/phototransistor pair. For each revolution of the cup shaft, 32 electrical pulses are generated as the 32 opaque disc areas pass the LED. The wind speed can be measured by simply determining the frequency of these pulses.

The wind vane uses four LED/phototransistor pairs to read the four inner tracks of the encoder disc. These four outputs form a 4-bit Gray-code value (interpreted in table 1), which defines the angular position to a resolution of 1 part in 16. Gray code is a modified binary code in which sequential numbers are represented by expressions that differ in only one bit position. This technique is preferable in slowly revolving encoders because "bit chatter" (oscillation between a 0 and 1 logic level at the point of transition) is less conspicuous than in simple binary or binary-coded-decimal (BCD) encoders. In such encoders, all four bits can change in certain positions (from 0111 to 1000, for example) with only a small change in angular position. Bit chatter can lead to ambiguous indications of direction.

A fairly simple circuit (shown in figure 4 on page 43) provides a 20-mA (milliamp) current to the LEDs and conditions the output from the phototransistors. The outputs of the 74LS04 inverter are TTL- (transistor-transistor logic) compatible and can be connected to any computer's parallel input port should you care to use the wind sensors as they are presently configured. Four LEDs connected to the vane output light up to aid calibration.

Calibrating the Wind Vane

Calibration of the vane for installation is simple and requires only a compass. Observe the state of the indicator LEDs with power applied to the vane. Rotate the housing and the vane until the indicators show all zeros. This setting of the vane should be oriented toward true north when the vane is installed. Be sure that the vane housing is secured so it won't rotate.

(In Connecticut there is a 14-degree difference between magnetic and true north, and the vane must be oriented 14 degrees from magnetic north to compensate. This sort of adjustment must be made in most of North America.)

Calibrating the Anemometer

Calibrating the anemometer is another story. The instructions that come with the kit make no mention of how many pulses are produced per second as a function of wind speed. The conversion of pulses to conventional units of speed (miles per hour [mph], kilometers per hour [kph], or knots) is handled by a microprocessor in the Digital Wind Computer, and this information is unnecessary for most users.

For me, however, it was essential. The only way to determine it was by empirically measuring the pulse rate in a known wind velocity. This can be accomplished by moving air across the anemometer, as in a wind tunnel, or moving the anemometer itself in still air. The indications should be the same.

As you can see in photo 6 on page 46, I moved the anemometer in still air by hanging the anemometer out the side window of my car while driving down a side street near my house (I got some strange looks). As I drove, I measured the output frequency of the encoding mechanism.

Because it was inconvenient to use my frequency counter in the car while driving, I used a battery-operated audio-cassette tape recorder. Connecting it using the circuit of figure 5, which is a portable version of the conditioning circuit previously discussed, I simply recorded the tone produced as the cups spun. The frequency rose and fell as the relative wind velocity increased and decreased. After returning home, I played back the recording into the frequency counter.

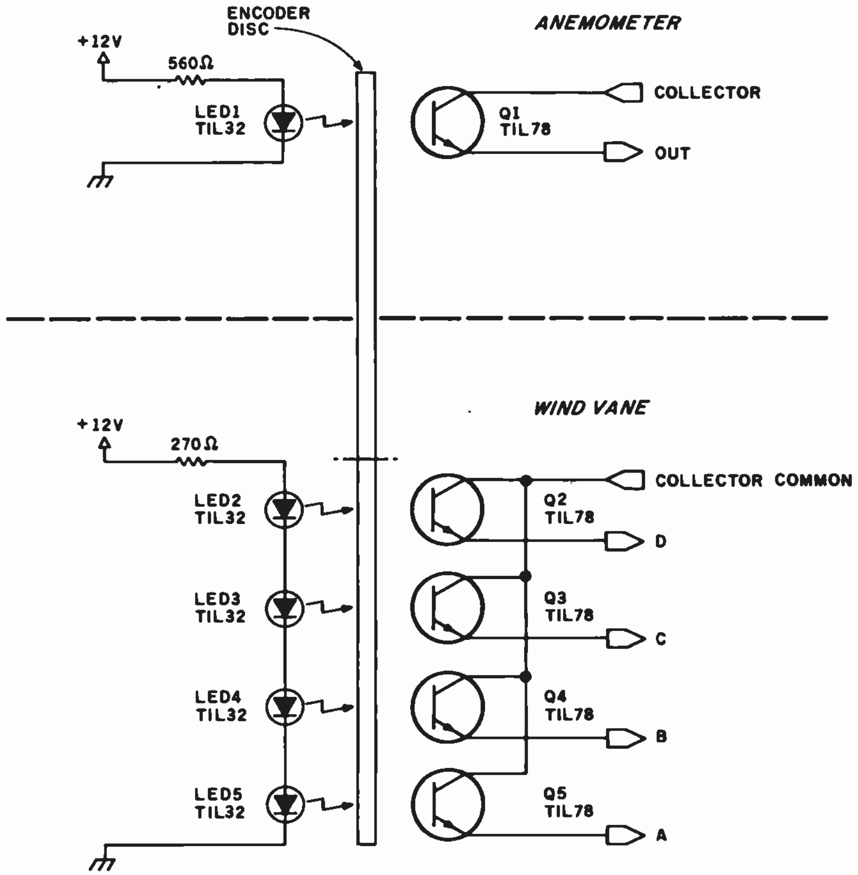


Figure 2: *Schematic diagram of the simple position-encoding circuitry inside the Heathkit wind-sensor units. The TIL32 LEDs and the TIL89 phototransistors operate in the infrared region.*

I tried various speeds between 15 and 60 mph, and the results were fairly consistent. (I was unable to drive slower than 15 mph without creating a traffic jam.)

The results of my calibration runs are shown in figure 6 on page 46. The output of this anemometer appears to be 11.6 pulses per second per mile per hour. A frequency of 600 Hz (hertz) corresponds to 50 mph. The curve is quite linear between 20 and 60 mph, but I suspect that readings below 10 mph might exhibit nonlinearities.

Decoding the reading of the anemometer with a computer can be accomplished most easily in software. The anemometer's pulse output can be measured by a machine-language subroutine that simulates a frequency

Figure 3: *The optical encoding disc uses a Gray code to eliminate ambiguity in angular position of the wind vane, while in the anemometer only the outermost ring is used as a sort of tachometer.*

counter; the algorithm for this will appear later in this article. The result is simply divided by 12 (close enough) to convert to miles per hour.

Adding a Digital Thermometer

With my scheme for measuring wind velocity well under way, I decided that I could easily upgrade the system to keep track of other weather conditions as well. While wind parameters were essential to my feasibility study, monitoring temperature provided an extra dimension to the data-gathering effort.

Most temperature indicators are analog in nature and require an A/D (analog-to-digital) converter to be read by a computer. This is not only an added complication, but it consumes more parallel-port resources to accommodate the A/D converter. A conversion resolution of 0.4 percent in parallel conversion requires 8 bits and generally occupies an entire 8-bit input port. Similarly, 0.002-percent converters use 16 bits.

Fortunately, parallel conversion is not a necessity in this application and others like it, which require modest accuracy but where input lines are at a premium. Here an analog-input-to-digital-frequency converter is more applicable. In my weather-monitoring system, I already had a digital frequency input from the anemometer. It was advantageous, therefore, to treat the temperature as a second frequency input and use the same software to measure it.

Figure 7 on page 48 is the schematic diagram of a temperature-to-frequency converter suitable for this application. IC1 is an LM134 analog current source/temperature sensor with an operating range of −55 to

To add excitement to the project, I decided to make my weather station talk.

+125°C (degrees Celsius). (You could substitute an LM334 to function within a temperature range of 0 to +70°C.) With a 230-ohm value set on the calibrating potentiometer (the R_{SET} value), the voltage from it will increase 10 millivolts per degree Celsius (mV/°C) from some nominal output. Through IC2, the rate is amplified to 100 mV/°C and the offset adjusted to a convenient value. IC3 is a type-2207 voltage-controlled oscillator that acts as a voltage-to-frequency converter. As configured, a 0- to 10-V input will result in a 0- to 10-kHz output. This output frequency is then measured by the computer.

Calibration is best established by immersing the temperature sensor (IC1) in ice water at 0°C and then in a liquid at a known elevated temperature. The calibration curve will be linear, but its slope is dependent on the particular components used to build the sensor. It's probably best to have a frequency of 2 kHz represent 20°C and 5 kHz represent 50°C. Conversion from Celsius to the Fahrenheit scale should be done by the host computer.

Serial Link to the Roof

Most wind sensors are located remotely from the recording devices. In the Heathkit units, a 150-foot 8-conductor cable is available for this connection. I don't like stringing any more wire than I have to, and I prefer to communicate digested rather than raw data.

The easiest way to condition the weather-sensor outputs and reduce the wiring is to attach a computer directly to the wind and temperature sensors. Any computer could be

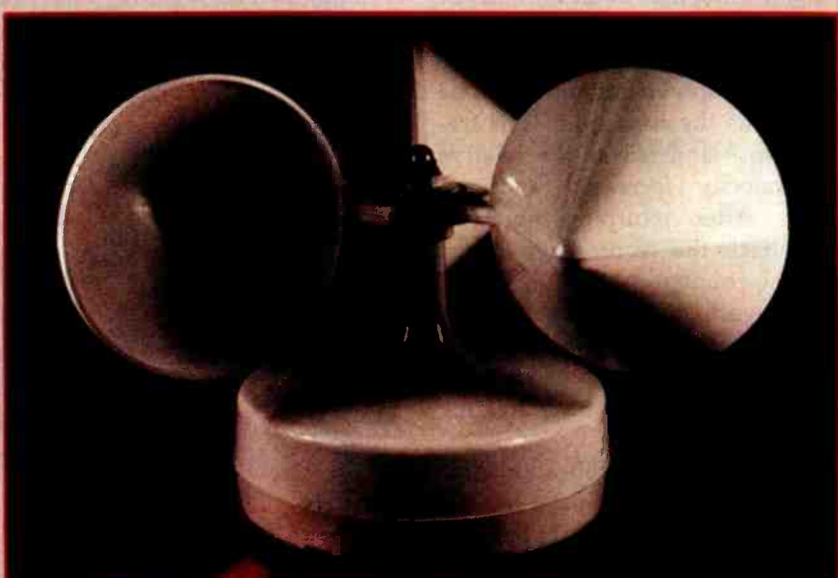


Photo 4: *Completed Heathkit anemometer assembly.*

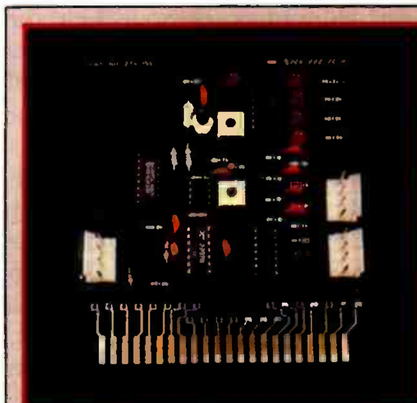


Photo 5: *Prototype of the wind-sensor signal-conditioning circuit board, which combines the input-conditioning and calibrating-display circuitry of figure 4 with the digital-thermometer circuitry of figure 7. The two 4-pin connectors on the right side connect to the wind vane, and the connector on the left goes to the anemometer.*

Number	Type	+5 V	GND
IC1	74LS04	14	7
IC2	7406	14	7

used, of course, but I decided that this was a natural application for the Z8-BASIC Microcomputer (which I described in the July and August 1981 issues of BYTE) used as a device controller and data concentrator, because it contains the necessary I/O (input/output) ports and can be programmed directly in BASIC.

I connected the Z8-BASIC Microcomputer/controller to the sensor units, ran my twisted-pair cable, and set up the computer/controller to use its RS-232C serial port to transmit the results to another computer inside the house for recording or for display on a video terminal.

A message sent down the serial link for recording need only consist of a header and the reduced data. A program running on the display computer could format the data as a compass diagram on the screen, or the Z8-BASIC Microcomputer could perform the formatting, given a more sophisticated program. In either case, the Z8-BASIC Microcomputer/controller board has the latent capability to reduce, record, and format the wind and temperature data as desired.

A Synthesized Weatherman

Having come so far in devising a versatile weather-monitoring system, how could I stop without giving it the ultimate in capability? Using serial communication for recording data was satisfactory, but dull. To add futuristic excitement to the project, I decided to make my weather station talk.

Exploiting as-yet-unused system resources, I connected a parallel-port Sweet Talker voice synthesizer (the subject of my September 1981 article) to port 2 on the computer/controller. I stored a simple phonetic vocabulary consisting of words like "wind," "velocity," and "temperature" in a table in the Z8-BASIC Microcomputer's memory and wrote a program to

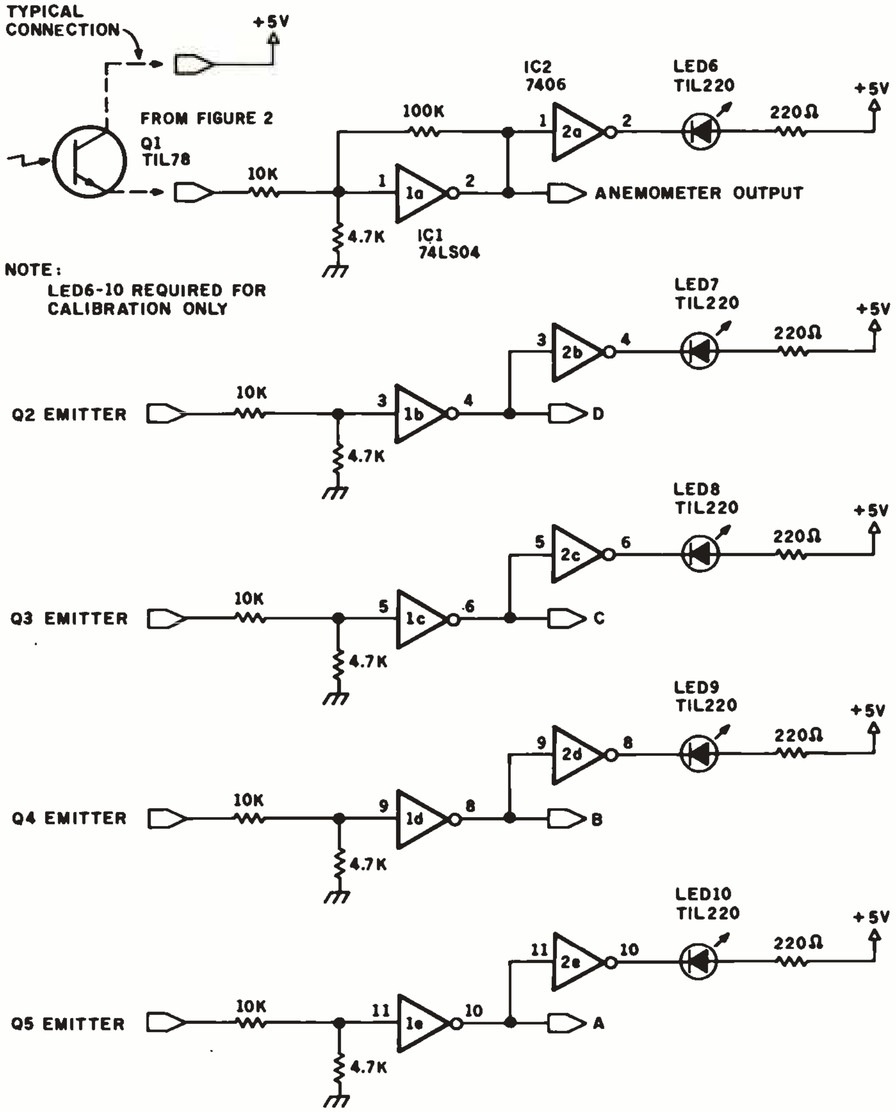


Figure 4: *Schematic diagram of the signal conditioner that accepts output from the phototransistors in the wind sensors and sends it to the controlling computer system. LED6 through LED10 are required only for calibration of the vane.*

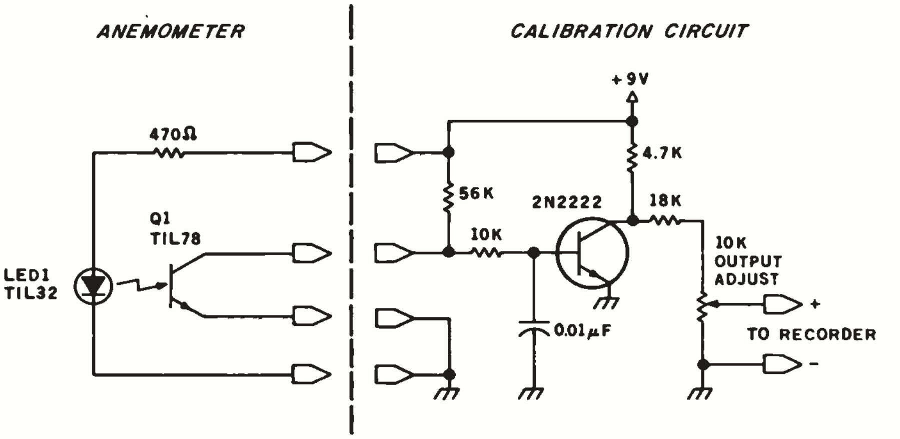


Figure 5: *A simple circuit that allowed me to calibrate the anemometer from my moving car by holding it out the window. The anemometer's output was fed through this circuit into a small, battery-operated cassette tape recorder, and the tape was later played back into a frequency counter.*

read the sensors and send appropriate word phonemes out the port to the Sweet Talker. (A list of appropriate words is contained in table 2.) Continuing along this line of thought to its logical conclusion, I connected the audio output of the Sweet Talker to the input of a low-power radio transmitter.

In the final configuration, the computer/controller board digests the weather-instrument data, the Sweet Talker converts it to English, and the transmitter transmits it to my radio. For up-to-the-minute weather data, I merely tune my radio to 98 MHz and listen to my own synthesized weatherman announcing, "Wind heading: north northwest at twenty miles per hour."

System Configuration

Figure 8 on page 54 shows an outline of the connections in the completed system between the wind instrumentation, the temperature sensor, and the computer/controller board. The circuit boards are shown

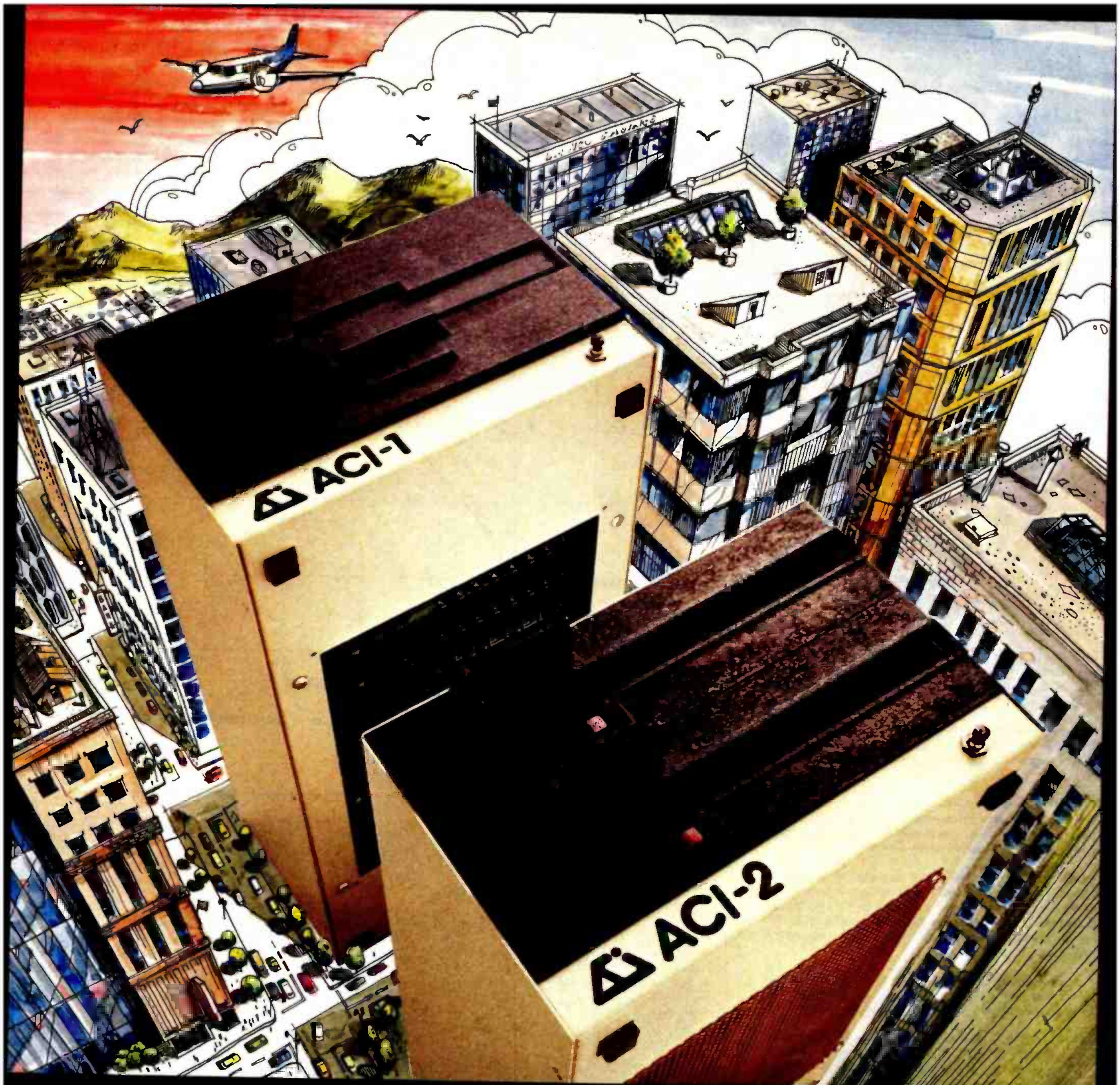
Compass Position	D	C	B	A
N	0	0	0	0
N N W	0	0	0	1
N W	0	0	1	1
W N W	0	0	1	0
W	0	1	1	0
W S W	0	1	1	1
S W	0	1	0	1
S S W	0	1	0	0
S	1	1	0	0
S S E	1	1	0	1
S E	1	1	1	1
E S E	1	1	1	0
E	1	0	1	0
E N E	1	0	1	1
N E	1	0	0	1
N N E	1	0	0	0

(Gray Code: D C B A)

Table 1: *Interpretation of the optical Gray code produced by the LED/phototransistor detectors inside the Heathkit wind-vane sensor unit.*

anemometer	AE, N, AH1, M, AW1, AW2, M, I3, T, ER
average	AE1, EH3, V, R, I1, D, J
Celsius	S, EH1, L, S, I1, UH2, S
computer	K, UH1, M, P, Y1, IU, U1, T, ER
direction	D, I1, R, EH1, K, T, SH, UH3, N
east	E1, AY, S, T
Fahrenheit	F, EH1, R, I2, N, H, UH3, AH2, Y, T
frequency	F, R, E1, K, W, EH3, N, DT, S, Y
hour	AH1, UH3, W, ER
kilometers	K, I1, I3, L, AW1, M, I1, T, ER, Z
maximum	M, AE1, EH3, K, PA0, S, EH3, M, UH2, M
miles	M, AH1, EH3, I3, UH3, L, Z
minimum	M, I2, N, I2, M, UH3, M
north	N, O2, O2, R, TH
peak	P, E1, AY, K
per	P, ER
south	S, AH1, UH3, U1, TH
temperature	T, EH1, EH3, M, P, ER, UH1, T, CH, ER
velocity	V, UH1, L, AW1, S, I1, T, E1, Y
west	W, EH1, EH3, S, T
wind	W, I1, I3, N, D, D

Table 2: *A list of words useful in describing weather conditions, with their Votrax phonemes. These phonemes can be transmitted to the Sweet Talker voice synthesizer by the controlling software running on the Z8-BASIC Microcomputer, in accordance with the prevailing weather.*



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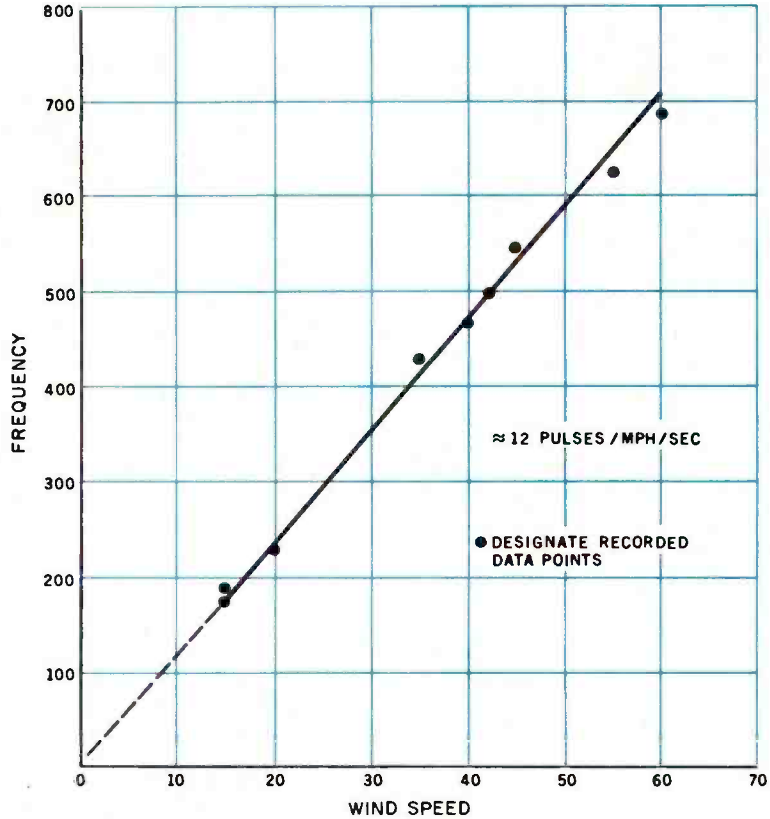

Figure 6: *Graph of anemometer-output voltage as a function of relative wind speed.*

Photo 6: *The anemometer was calibrated by moving it relative to still air; holding it out the window of a moving automobile worked quite well. Driving at a known speed, I used the circuit of figure 5 to record its pulses; the characteristic curve is shown in figure 6.*

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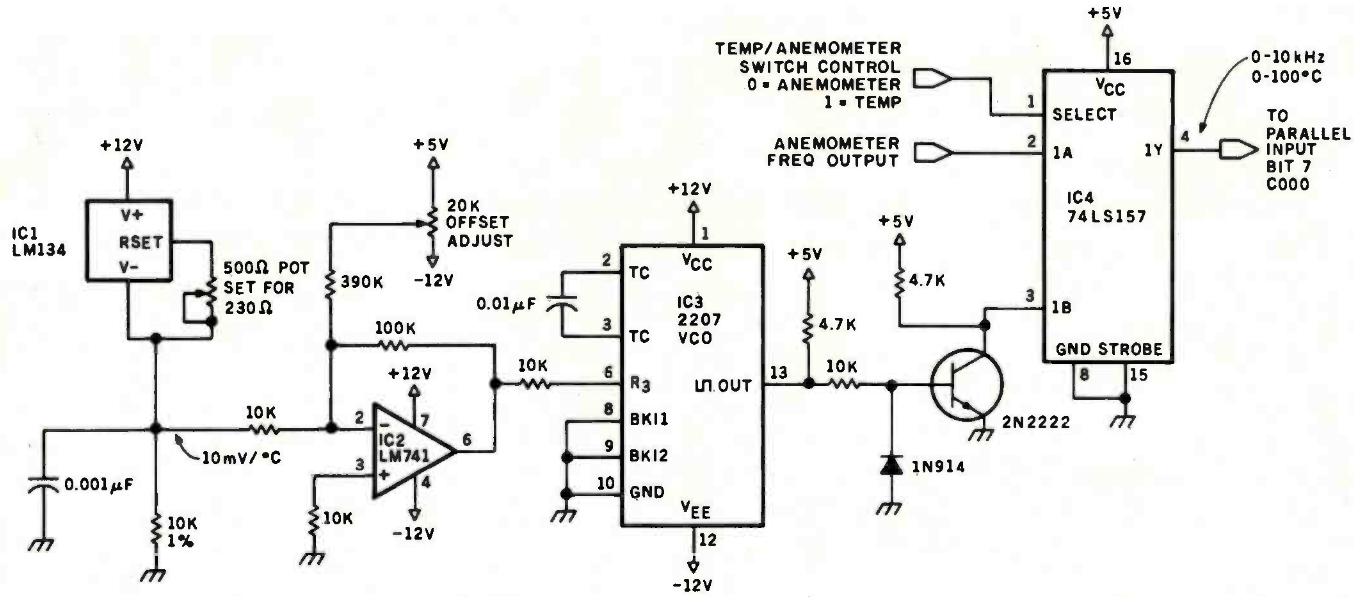

Figure 7: *Schematic diagram of a digital thermometer that varies its output frequency as a function of ambient temperature. The output can be read by the same frequency-counter software that interprets the wind-speed data from the anemometer.*

Component Sources

The following parts list is taken from the Heathkit ID-1890 Digital Wind Computer assembly manual. This list comprises the components necessary to build the wind-vane and cup-anemometer assemblies. Parts unique to the project are marked with an asterisk.

Part Number	Quantity	Description
250-235	8	6-32- by 1/4-inch stainless-steel screw
250-1168	6	#4 by 1-inch stainless-steel screw
254-25	8	#6 lockwasher
253-713	1	#6 rubber washer
252-80	1	6-32 cap nut
255-735	8*	short spacer
250-328	1	8-32 by 3/8-inch stainless-steel screw
250-43	2	8-32 by 1/4-inch setscrew
252-27	2	6-32 locking nut
253-1	2	#6 fiber flat washer
85-1982-1	4*	sensor printed-circuit board
412-635	5	TIL32 infrared light-emitting diode
417-919	5	TIL78 phototransistor
214-208-1	2*	top housing
214-209-1	2*	bottom housing
266-930	1*	wind vane
266-939	1*	wind cup
266-942	1*	wind vane cap
266-943	1*	counterweight
266-1032	2*	optical encoder disc
453-282	2*	1/8- by 3-inch shaft
253-712	4*	C-ring
455-643	4*	bearing
142-711	1	boom parts
142-712	1	boom
595-2399	1*	ID-1890 assembly manual
		miscellaneous hookup wire

mounted on a connecting motherboard in photo 8 on page 64.

Figure 9 on page 56 is a flowchart of a minimal application routine that reduces and transmits the resulting data down the serial communication line. Figure 10 on page 60 is the flowchart of a frequency-counter subroutine written in Z8 machine language. This routine reads the inputs from the temperature sensor and anemometer and derives numeric values in hertz. The routine is stored in memory beginning at hexadecimal location 1500 (as presently assembled) and is invoked from the BASIC/Debug interpreter by the statement

A=USR(%1500)

The value returned in the variable A is the frequency. Listing 1 on page 52 is the assembly-language listing.

If you wish to set up a radio weather station with a personal touch, as I did, you can use a low-power transmitter: either the AM (amplitude modulation) transmitter in figure 11a on page 62 or the FM (frequency modulation) unit in figure 11b on page 64.

Ideas for Improvement

I have thought about enhancing the

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Listing 1: *Assembly listing of the "Windy" routine in Z8 machine language. "Windy" is called by the BASIC statement A=USR(%1500). The frequency is read from bit 7 of the input port mapped into memory-address space at hexadecimal 1500, and the numeric value is returned to BASIC in the variable A. The routine "Windclk" is called in response to an interrupt that occurs every 0.01 seconds.*

```
                 Op
Address          Code  D1    D2  Line      Label      Mnemonic              Comment

                                           * Windy-   Count anemometer pulses coming in at hexadecimal
                                           *          C000, bit 7 (pin K)
                                           *
                                           * Inputs-  None. Called as a "USR" routine from BASIC/Debug
                                           *
                                           * Output-  Count of number of pulses seen at location C000, bit 7
                                           *          Result returned in registers R12 and R13
                                           *
                                           * Uses-    R12 - R13             Accumulate number of pulses
                                           *          T1,T1 prescale        Set to provide 0.01-second interrupt clock
                                           *          R32                   Save old value of work-register pointer
                                           *          R33                   Counts the number of 0.01-second interrupts
                                           *          R34 - 35              Indirect pointer to location C000
                                           *          R36 - 38              Work registers. R37 becomes 'DONE' flag
                                           *          LOC. 100F-1011        JP op code to vector the interrupt to my routine
                                           *
                                           * Calls-   None, but tests flag set by interrupt-
                                           *          driven routine "Windclk"
                                           *
                                           * Notes-   All register notation is as follows:
                                           *            RXX - Denotes full 8-bit register address
                                           *            WX - Denotes work-register address
                                           *            WPX - Denotes work-register-pair address
                                           *            XX - Denotes hexadecimal data
                                           *            ** All notation is in hexadecimal radix **
                                           *            ** unless otherwise indicated **
                                           *
                                           *

1500             8F                        Windy      DI                    Don't bother me 'til I'm set up
1501             E4    FD    32                       LD R32, RFD           Save current work-register pointer
1504             E6    FD    30                       LD RFD, 30            Point to my work registers
1507             E6    F3    03                       LD RF3, 3             Set up T, Prescale for mod-n, 64 count
150A             E6    F2    90                       LD RF2, 90            Set up T, to give 0.01-second interrupt
150D             E6    FB    20                       LD RFB, 20            Turn on IRQs I/R mask
1510             4C    C0                             LD W4, C0               Registers 34 and 35 point
1512             5C    00                             LD W5, 00                 to the data-input address
1514             B0    12                             CLR R12               Clear registers 12 and 13. We
1516             B0    13                             CLR R13                 will pass count in them.
1518             3C    00                             LD W3,00              Clear number of I/R's accumulator
151A             6C    10                             LD W6,10              Set up registers 36 and 37 to
151C             7C    0F                             LD W7,0F                store I/R vector for IRQ5
151E             8C    8D                             LD W8,8D              1st byte to store is JP op code
1520             92    86                             LDE WP6, W8           Move register 38 to address at registers 36 and
                                                                            37
1522             7E                                   INC W7                Step to next byte
1523             8C    15                             LD W8, 15             2nd byte is high byte of address
1525             92    86                             LDE WP6, W8           Store it.
1527             7E                                   INC W7                Step to next byte
1528             8C    55                             LD W8, 55             3rd byte is low byte of address
152A             92    86                             LDE WP6, W8           Store this too
152C             46    F1    0C                       OR RF1, 0C            Initialization all done, start T1
152F             7C    00                             LD W7, 0              Clear register 37 to be used as flag
1531             9F                                   EI                    Turn on I/Rs to catch timer pops
                                           *
                                           *
                                           *
                                           *
```

Listing 1 continued on page 54

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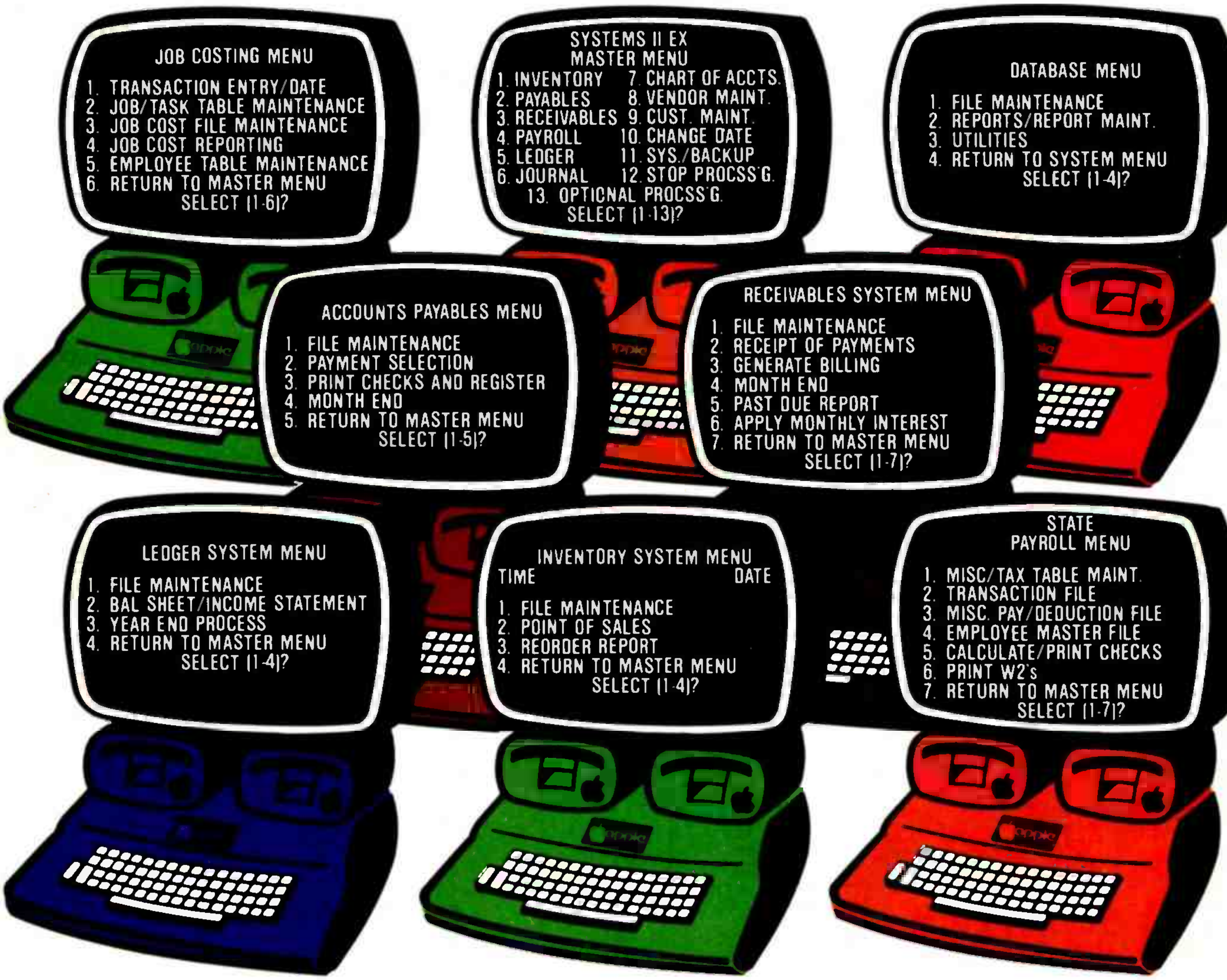

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Listing 1 continued:

Address	Op Code	D1	D2	Line	Label	Mnemonic	Comment
					*This is the main counting loop		
					*		
1532	76	37	80		Count	TM R37, 80	Test to see if we're done
1535	EB	17				JR NZ, Done	If bit on, we're through
1537	82	84				LDE W8, WP4	Load data at C000 into R38
1539	76	38	80			TM R38, 80	Is bit 7 at logic 1?
153C	6B	F4				JR Z, Count	If not, loop until it is
153E	76	37	80		Lowwait	TM R37, 80	Check to see if done just like before
1541	EB	0B				JR NZ, Done	If bit on, we're through
1543	82	84				LDE W8, WP4	Pick up data at C000 again
1545	76	38	80			TM R38, 80	Check bit 7 for transition to 0
1548	EB	F4				JR NZ, Lowwait	If not, wait for it
154A	A0	12				INCW R12	If yes, then high-to-low = 1 pulse
154C	8B	E4				JR Count	Do the whole mess over again
					*This is what we do when we're finished		
154E	56	F1	F3		Done	AND RF1, F3	Shut down T1 counter
1551	E4	32	FD			LD RFD, R32	Restore work-register pointer for BASIC/Debug
1554	AF					RET	Go back to BASIC pgm/monitor
					*		
					* This is the interrupt-driven routine that counts clock cycles		
1555	3E				Windclk	INC W3	Add 1 to number of cycles
1556	A6	33	64			CP R33, 64	have we done 100?
1559	1B	02				JR LT, More	No, do more
155B	60	37				COM R37	Turn all bits on in register 37
155D	BF				More	I RET	Issue Return-from-interrupt
					* That's all, folks!		
					*		
					*		

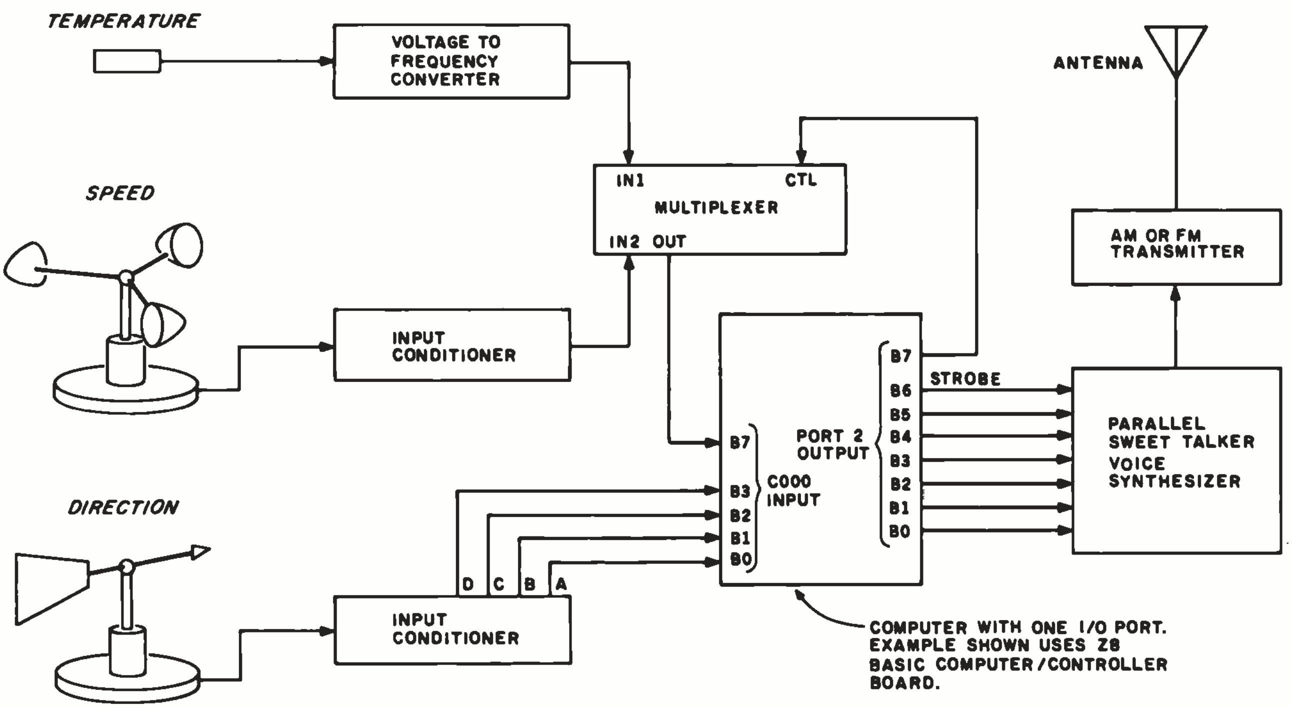

Figure 8: *Block diagram of the complete computerized, voice-synthesized weather radio station. The weather data may be directed to a host computer system for logging if radio transmission is not desired, or the output of the Z8-BASIC Microcomputer/controller could be sent directly to a printer or video terminal.*

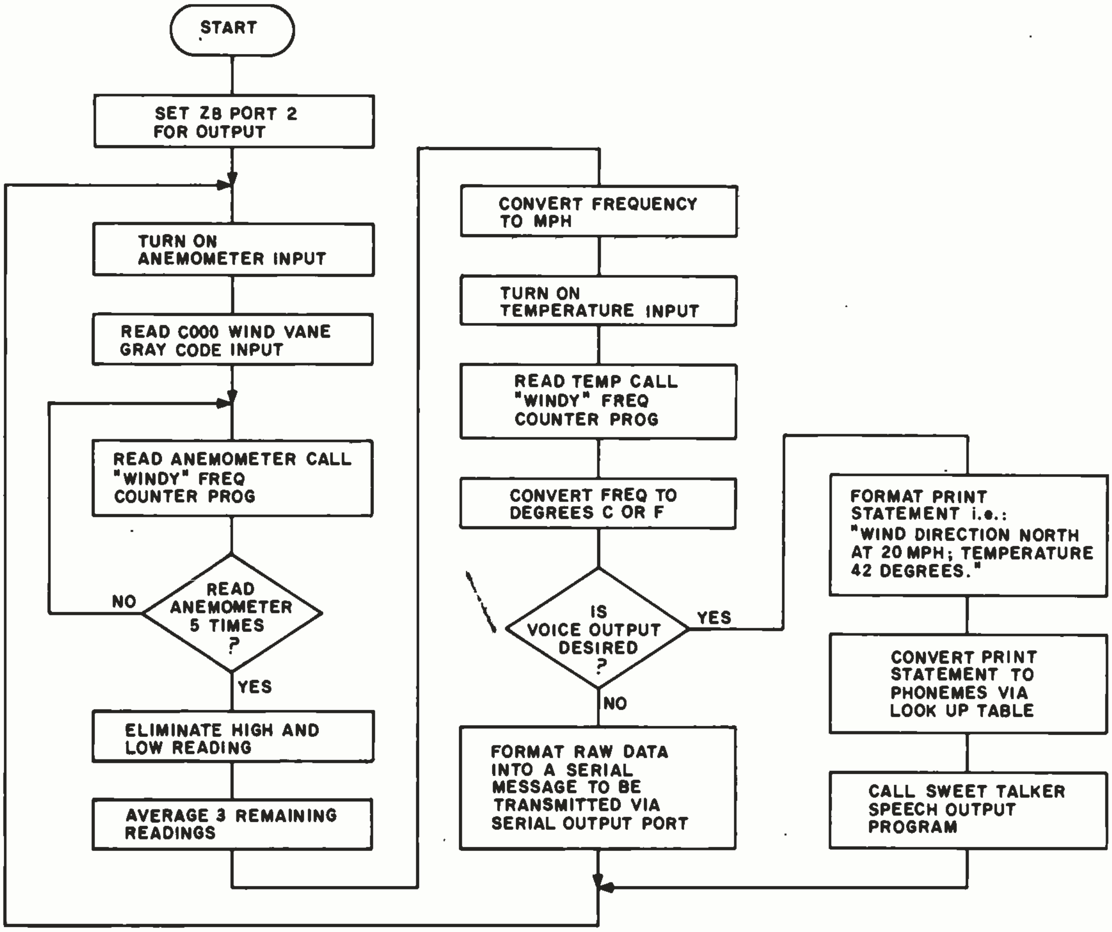

Figure 9: *Flowchart of the program that directs the Z8-BASIC Microcomputer to collect raw data from the wind sensors, digest it, and provide output either to the serial communication line or the Sweet Talker voice synthesizer.*

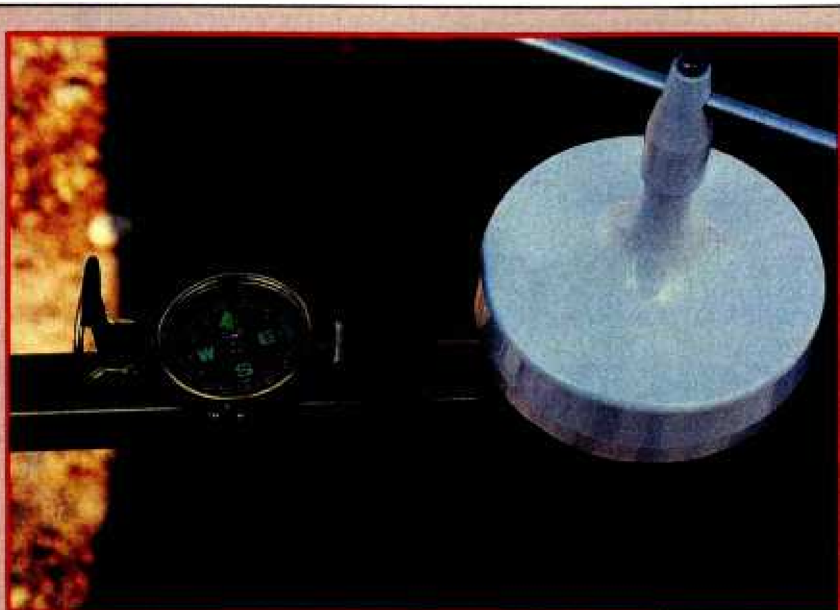

Photo 7: *The wind vane must be oriented in accordance with true north, which may vary from the magnetic north shown on the compass. Point the vane to the north and rotate the housing until the Gray-code value shown in the calibration display reads all zeros.*

system to measure barometric pressure in addition to the wind velocity and temperature. Conceivably, it could be accomplished with the hardware as presently configured plus one more sensor.

The method I thought might work was some sort of capacitance detector. The majority of modestly priced ($100) barometers are spring-and-bellows pressure detectors. The bellows contracts and expands with the changes in atmospheric pressure. Given the extremely short linear motion and low masses involved, a measuring technique that doesn't require mechanical sensing seems best.

One idea is to use the bellows as one side of a two-plate capacitor. As the pressure changes, the bellows contracts, changing the spacing of the capacitor plates and therefore the capacitance. This capacitor is in turn used to set the frequency of an oscillator. As the capacitance

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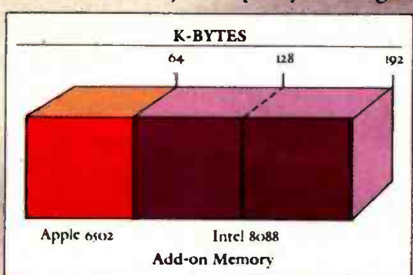

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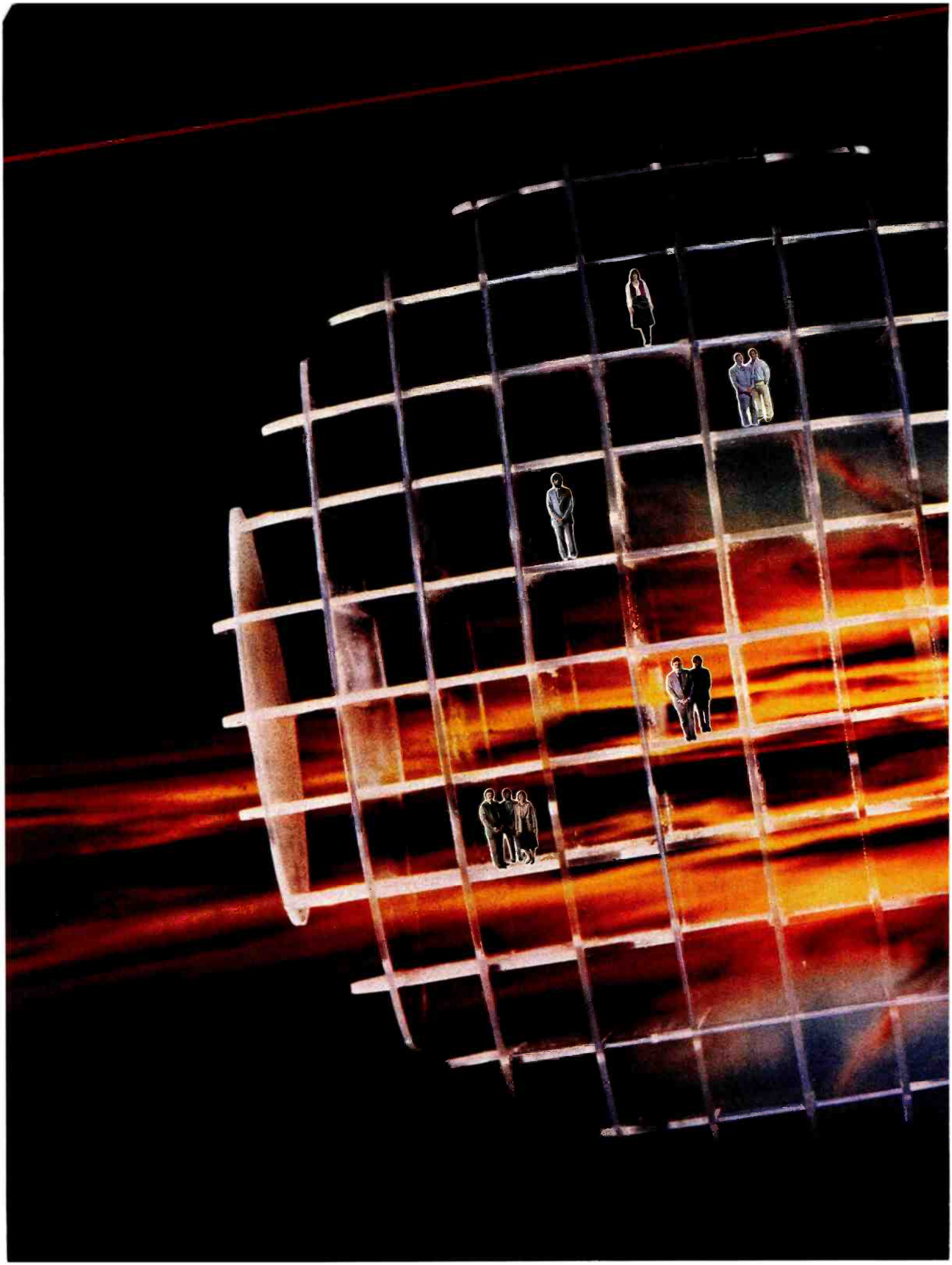


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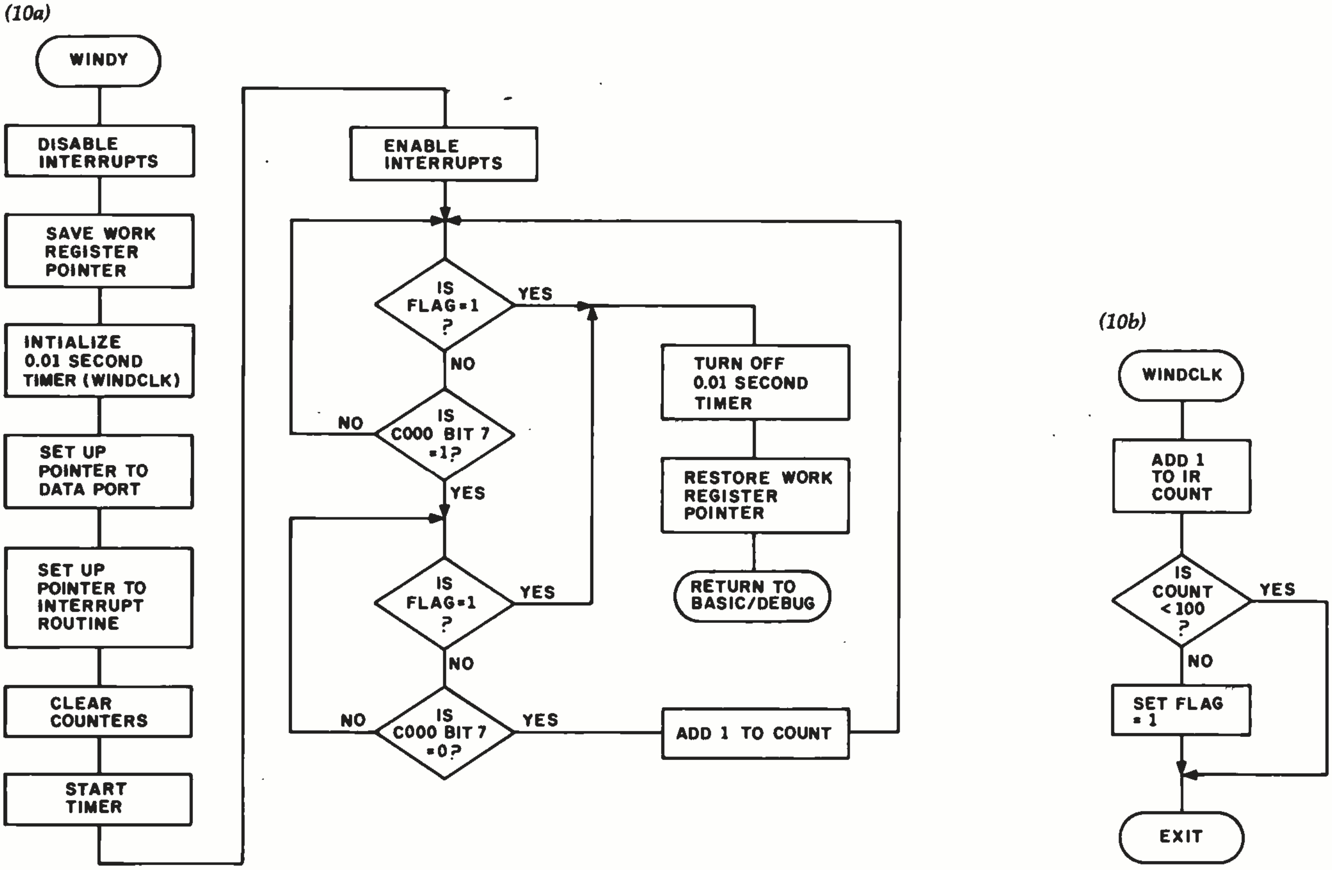

Figure 10: *Flowcharts of the machine-language routine "Windy" (figure 10a) and "Windclk" (figure 10b). The assembly-mnemonic listing is given as listing 1 on page 52. "Windy" is called from the BASIC interpreter by the statement A=USR(%1500), while "Windclk" is called when the Z8 processor receives an interrupt from the real-time clock.*

changes, it varies the frequency. This output frequency can then be read by the computer/controller in the same way as the anemometer and thermometer.

Concluding Thoughts

I doubt that many of you will go to the extremes that I did to eliminate a few wires, but even directly attaching weather sensors to your computer is a satisfying project. In the process of reading about the specifics of my "synthesized weatherman," you may have seen an application for one of the subsystems. Or with this informa-

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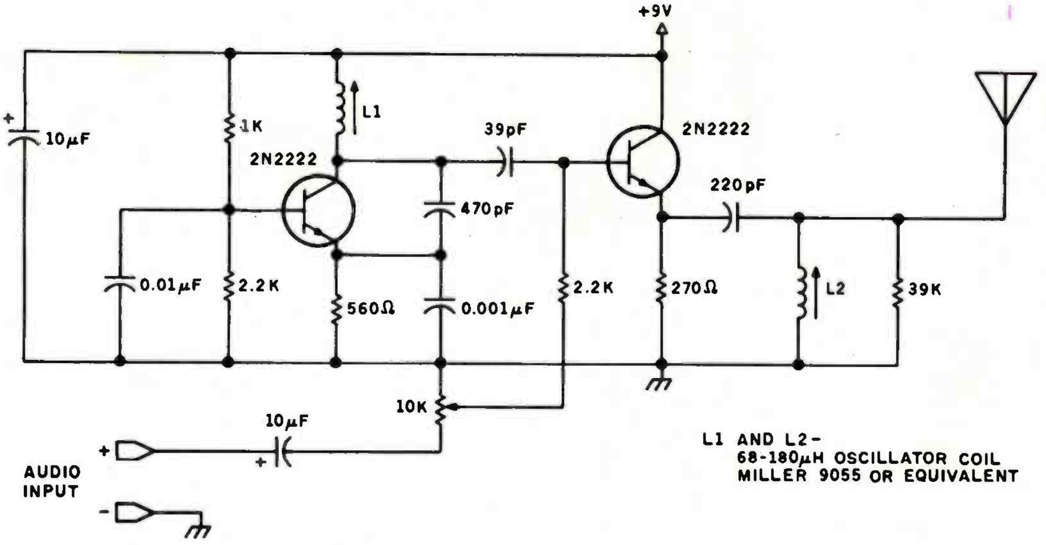

Figure 11a: *Schematic diagram of a low-power AM (amplitude modulation) radio transmitter, which can be used with the Sweet Talker voice synthesizer to create an automatic weather radio station.*

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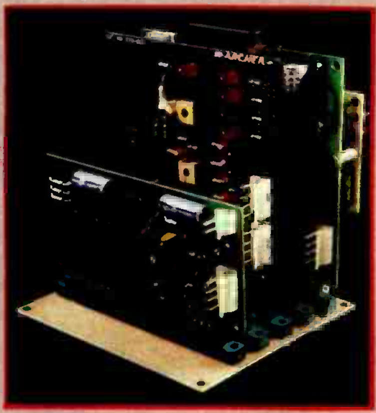

Photo 8: *The complete talking, broadcasting weather station is made up of the Z8-BASIC Microcomputer/controller board, in back, the input-conditioning and temperature board, in the center, and the Sweet Talker voice-synthesizer board, in front. The Z8-BASIC Microcomputer is based on the Zilog Z8 microcomputer-on-a-chip, and the Sweet Talker employs the Votrax SC-01.*

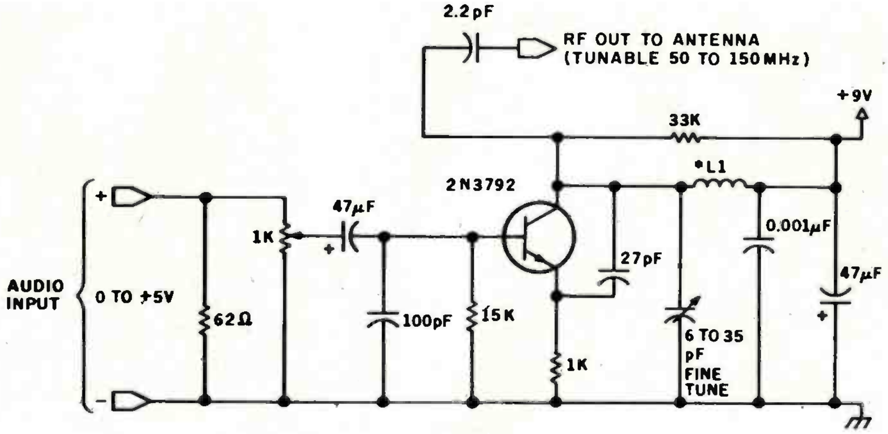

Figure 11b: *Diagram of a low-power FM (frequency modulation) radio transmitter, for use with the Sweet Talker voice synthesizer.*

tion you could easily configure your own custom weather station.

I think I'll listen to my voice-synthesized weatherman for a while before making modifications to the system. My only regret is that I won't be able to observe the expression on my neighbor's face the first time he tunes his radio across the dial. And I may never install a windmill after analyzing the accumulated data, but I will have the most personal weather reports in Connecticut.

Next Month:

One of my ambitions is to put together a computer speech-recognition system. The first step is to analyze the audible components of spoken words. In March, my project will be a circuit that helps perform this analysis. ■

Continued on page 68

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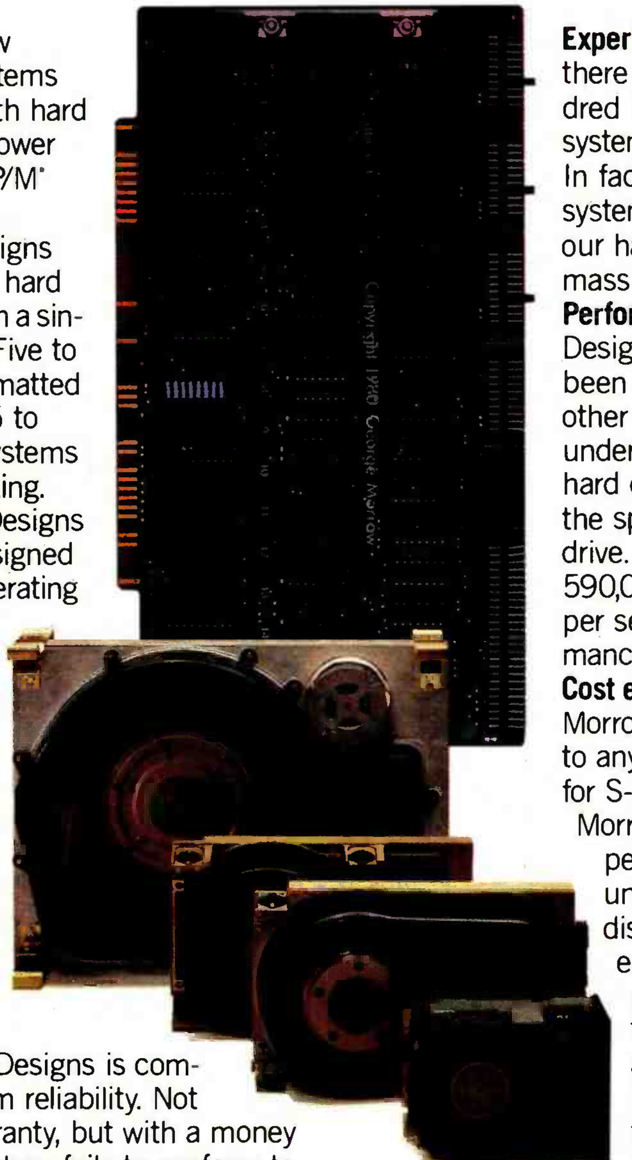

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Special thanks to Bill Curlew for his help in writing the software for the Z8 processor.

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, 70 Main St., Peterborough, NH 03458.* 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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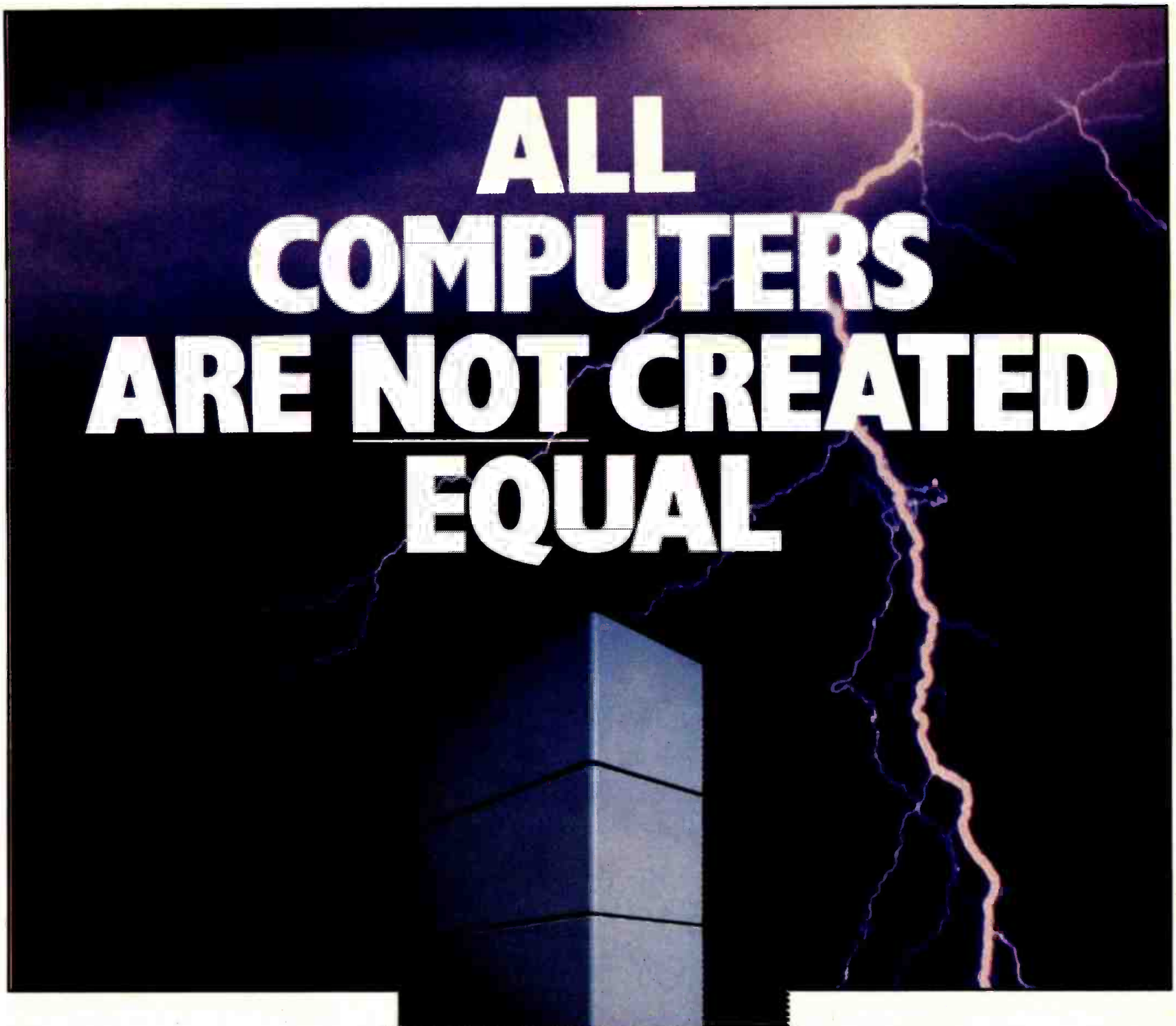
To receive a complete list of Ciarcia Circuit Cellar kits available from The Micro-Mint, circle 100 on the inquiry card.



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A Homebrew Graphics Digitizer

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For the past six years, coauthor Enrique Castro-Cid has been developing a new art form that combines art, computers, and mathematics. In particular, it uses branches of mathematics called conformal mapping and complex variables. Castro-Cid's technique is related to such topics as relativity and black holes in space. Images of giant objects the size of the earth are transformed to canvas size through a process that involves converting a drawing to coordinates and transforming the coordinates using mathematical functions to new points plotted and painted on canvas. Although the early work was done completely by hand, the use of computers for this process was a natural evolution.

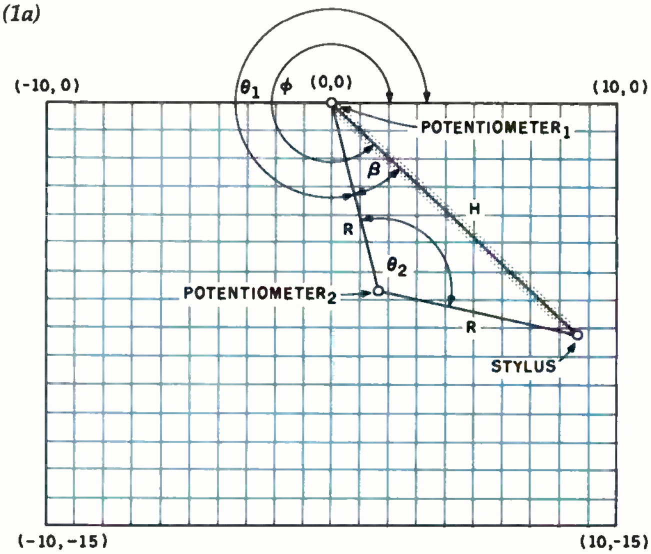
This article describes a device that, when used with a computer, converts a drawing to its Cartesian coordinates (see photo 1). This graphics tablet is inexpensive and easy to build using the most elementary tools, yet it provides a high degree of accuracy. It can be implemented on most microcomputers that have two A/D (analog to digital) input channels. It can also replace the paddles or joysticks found on some computers.

Child's Play

We considered several designs for this graphics tablet. The simplest scheme to implement mathematically is a Cartesian-coordinate device having two linear potentiometers, one for the *X* direction and one for the *Y* direction. This idea is similar to the way the child's toy Etch-A-Sketch works. The disadvantage of such a device is the user must turn two knobs. If the two potentiometers are somehow connected, the mechanical linkage becomes quite difficult to fabricate, requiring either a rack-and-pinion gear or a string drive. A second design is based on polar coordinates, where the angle and radius are measured. The device to measure the angle can be easily built using a potentiometer, but the varying radius is still difficult to measure.

However, the human anatomy provides a very workable solution to this problem. A person's shoulder and elbow are able to cover a wide area without actually changing the length of his arm. Using the human arm as a model, a two-section mechanical arm, having pivots analogous to the shoulder and elbow joints (see figure 1) can be built. Such a design is easily fabricated using two fixed-length members and two potentiometers. The mathematics becomes more involved than in the other designs, but the use of a computer makes construction a simple task.

(1a)



(1b)

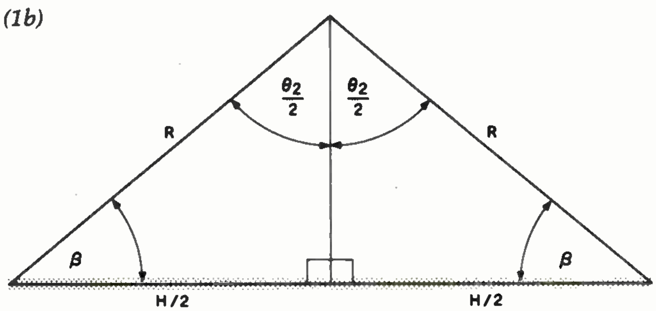


Figure 1: *Trigonometric conception of the graphics digitizer. Figure 1a shows the physical arrangement of the potentiometers on the arms. Figure 1b is labeled with the variables used to represent measurements made by the device.*

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Geometry and Formulas

To find the coordinates X, Y of the stylus, given any voltages V_1, V_2 provided from two potentiometers, the voltages are converted to angles using the following equations:

$$\theta_1 = scale_1 \times V_1 + trans_1$$
$$\theta_2 = scale_2 \times V_2 + trans_2$$

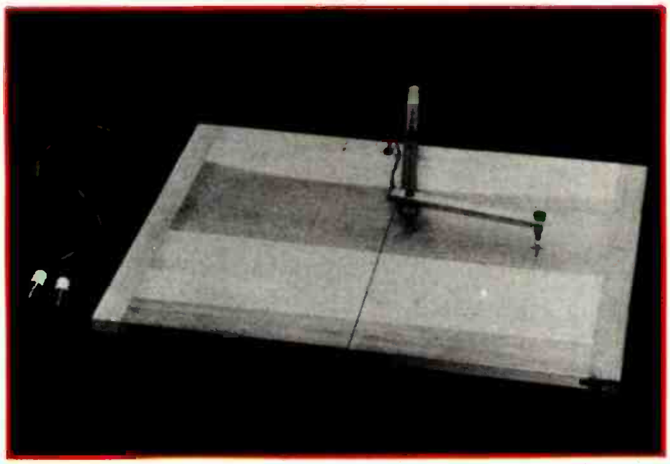
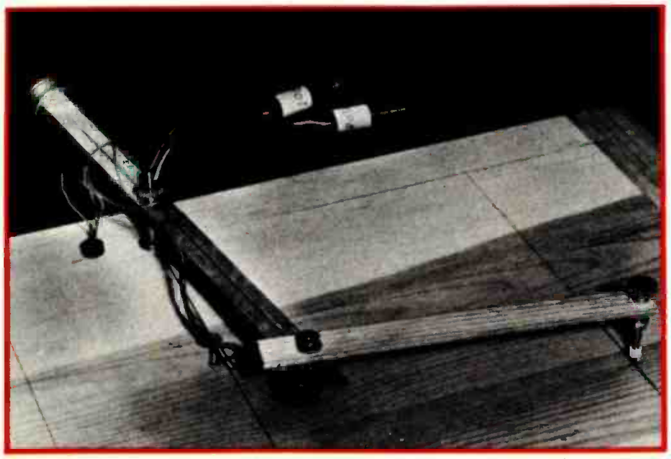


Photo 1: *The homebrew graphics-tablet digitizer, built from a standard drafting table.*

(2a)



(2b)

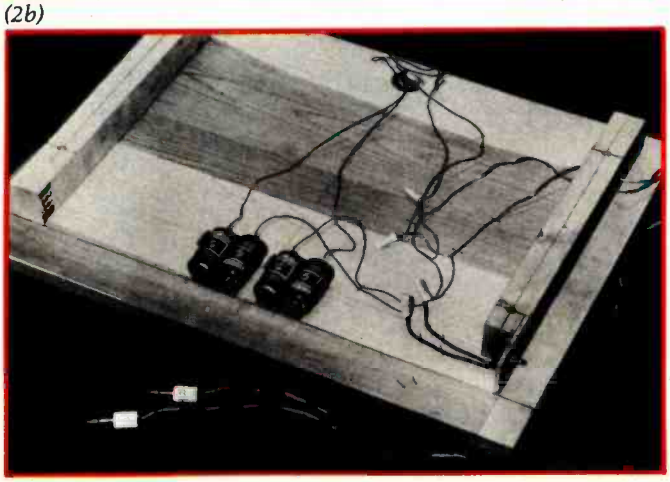


Photo 2: *Construction details of the graphics tablet. Photo 2a shows the arrangement of the potentiometers on the table and the arms. Note the stylus holder borrowed from a commercial pantograph. Photo 2b shows how clearance was obtained for the batteries and the on/off switch.*

The isosceles triangle (see figure 1b) formed by the two equal, fixed-length arms R has a variable-length hypotenuse H. At its apex is the potentiometer that produces V_2. This voltage is converted to angle θ_2 using the equation above. Trigonometry relates the base angles β, and the lengths H and R, as follows:

$$\beta = 90 - \theta_2/2$$

and

$$H/2R = \sin(\theta_2/2)$$
$$H = 2R \sin(\theta_2/2)$$

Thus

$$\theta_2 = 2 \arcsin(H/2R)$$

The angle ϕ of the radius H is the sum of angle θ and angle β:

$$\phi = \theta_1 + \beta$$

Using the equation for β above:

$$\phi = \theta_1 + 90 - \theta_2/2$$

This provides a solution, expressed in polar coordinates, involving a radius of length H and angle ϕ as its only variables. This is easily transformed to Cartesian coordinates:

$$X = H \cos(\phi)$$

and

$$Y = H \sin(\phi)$$

The computational procedure is as follows: beginning with voltages V_1 and V_2, the angles θ_1 and θ_2 are computed. Radius H is found from angle θ_2 and R. Angle ϕ is found using angles θ_1 and θ_2. Finally, the coordinates X and Y are computed using H and ϕ.

Calibration

The device is calibrated by setting the stylus to two known test points (X_1, Y_1), (X_2, Y_2) on the table and sampling the corresponding voltages V_{ij}, where i is the potentiometer and j is the test point number. Then for each of the two positions:

$$\phi_j = \arctan(Y_j/X_j) \quad \text{and} \quad H_j = \sqrt{X^2 + Y^2}$$

Using earlier equations (remember that θ_{2j} refers to potentiometer 2 and θ_{1j} refers to potentiometer 1):

$$\theta_{2j} = 2 \arcsin(H_j/2R)$$
$$\theta_{1j} = \phi_j - 90 + \theta_{2j}/2$$
$$\theta_{i1} = scale_i \times V_{i1} + trans_i$$

for potentiometer i test point 1

$$\theta_{i2} = scale_i \times V_{i2} + trans_i$$

for potentiometer i test point 2

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For each potentiometer *i* there are two equations and two unknowns: *scale* and *trans*. However, θ and V are known. Therefore, the next step is to solve for the calibration factors:

$$del = V_{i1} - V_{i2}$$
$$scale_i = (\theta_{i1} - \theta_{i2})/del$$
$$trans_i = (V_{i1}\,\theta_{i2} - V_{i2}\,\theta_{i1})/del$$

The computational procedure is as follows: compute the angles θ for both potentiometers (i) at both positions (j). Then, compute the calibrating factors for potentiometer $i = 1$, and repeat for the second potentiometer.

Construction Details

The graphics tablet was constructed using materials readily available from most art or drafter's suppliers. The table is a standard 18-inch by 26-inch wooden drawing board, drilled and countersunk to accommodate potentiometer 1 (see photo 2a). Two 14-inch-long two-by-twos were screwed to the underside of the table, providing clearance for the batteries and the on/off switch (see photo 2b). The A/D converter accepts signals in the ±2.56-V range. Four D cells were selected as a power supply (see figure 2) because of their low cost and noise immunity. Also, due to the high resistance of the potentiometers and the A/D converter's high internal resistance, the battery drain is very low. The batteries provide ±3 V. If your A/D converter requires only a positive voltage, the two batteries on the negative side of ground can be eliminated. Batteries of other voltages can be substituted to meet other applications or completely omitted if you substitute the potentiometers for paddles or joysticks.

The graphics tablet operates by measuring angles; therefore, in order to achieve high degrees of accuracy, the potentiometers must have a very linear taper (response). At first we used inexpensive 10 percent tolerance potentiometers as shown in the photos. We found when a straight line was drawn, the digitized computer-graphics line had a slight waviness. However, a later model of the tablet was built using precision linear taper 0.5 percent potentiometers that greatly reduced this problem. They are mounted so that when the arms are at the middle of their range of motion, the shafts of the potentiometers are rotated approximately halfway. They must never be at their limit. Another condition affecting accuracy is mechanical rigidity; the arms must be free of play and torsion. The working arm length from potentiometer to potentiometer and from potentiometer to stylus is *exactly* 7 inches. This measurement is critical if the device is to be linear. Notice the longer arm is counterbalanced to prevent potentiometer 2 from dragging on the drawing surface. The counterweight consists of a number of metal washers mounted on a bolt. Some of the hardware, such as the knurled nuts and stylus holder, was borrowed from a pantograph (a device for enlarging drawings) that we purchased at the local art store.

Operation and Programming

The program in listing 1 was written in BASIC and can be easily modified for other systems. The main routine has two options: *Calibration* and *Draw*. During calibration, the computer asks the artist to place the stylus at position one, where $X = -4$ and $Y = 0$. The artist then enters the coordinates −4, 0, and the computer samples the voltages from both potentiometers. Then the process is repeated for position two, where $X = 8$ and $Y = -8$. We found the choice of test points not to be critical, but these two provide a good compromise for the physical placement of the stylus and the accuracy of the trigonometric functions. However, the measurement and perpendicularity of the points should be as exact as possible. The program now has all the information it requires to compute the calibrating factors *scale* and *trans*. Once the calibration procedure has been done, it does not have

Text continued on page 86

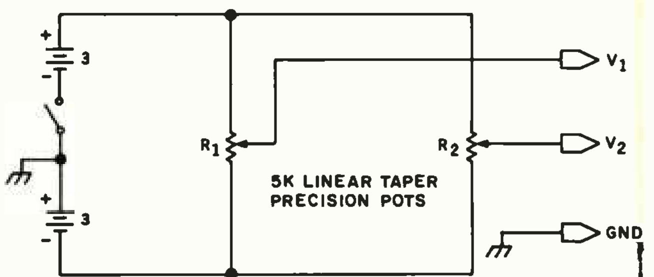

Figure 2: *A schematic diagram of the digitizer showing the simplicity of the device. The analog voltages provided by the potentiometers are stored in a computer after they are put through an analog-to-digital converter.*

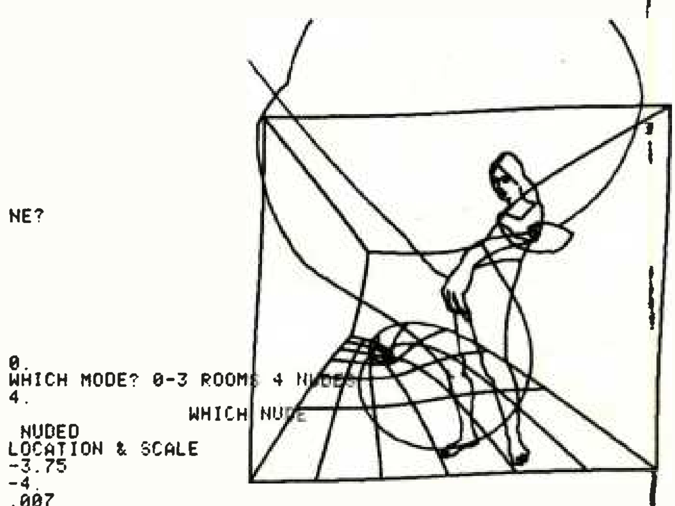

Figure 3: *A representation of an original drawing after it has been digitized and transformed according to a mathematical equation of the artist's choosing.*

Listing 1: *A BASIC program that allows calibration of the digitizer and storage of drawing information.*

```
100 REM *********
110 REM * ETCH *
120 REM *********
130 REM
140 REM
150 DIM X(200),Y(200),THETA(2,2),VCAL(2,2),SCALE(2),TRANS(2)
160 REM INITIALIZE
170 R       = 7.0
200 REM MAIN LOOP. READ USERS RESPONCE.
210 INPUT "CAL OR DRAW",ANS$
220    IF ANS$ = "CAL" THEN GOSUB 300
230    IF ANS$ = "DRAW" THEN GOSUB 600
240 GO TO 210
250 REM
260 REM
270 REM
280 REM
290 REM
300 REM ********
310 REM * CAL *
320 REM ********
330 FOR IPOSTN=1 TO 2
340    PRINT "SET THE ARMS TO POSITION",IPOSTN
350    INPUT "X POSITION IS",XCAL
360    INPUT "Y POSITION IS",YCAL
370 REM SAMPLE A/D CONVERTER AND GET V1, V2.
380    GOSUB 1000
390    VCAL(1,IPOSTN) = V1
400    VCAL(2,IPOSTN) = V2
410    H       = SQR( XCAL↑2 + YCAL↑2 )
420    PHI     = ATN( YCAL / XCAL )
430    IF XCAL < 0 AND YCAL >=0 THEN PHI = PI(1.0) + PHI
440    IF XCAL < 0 AND YCAL < 0 THEN PHI = PI(1.0) + PHI
450    IF XCAL > 0 AND YCAL < 0 THEN PHI = PI(2.0) + PHI
460    THETA(2,IPOSTN) = 2.0 * ASN( H / ( 2.0 * R ) )
470    THETA(1,IPOSTN) = PHI + ( THETA(2,IPOSTN) - PI(1.0) ) / 2.0
480 NEXT IPOSTN
490 FOR IPOT=1 TO 2
500    DENOM  = VCAL(IPOT,1) - VCAL(IPOT,2)
510    SCALE(IPOT) = ( THETA(IPOT,1) - THETA(IPOT,2) ) / DENOM
520    TRANS(IPOT) = ( V(IPOT,1) * THETA(IPOT,2)     ->
                     -V(IPOT,2) * THETA(IPOT,1) ) / DENOM
530 NEXT IPOT
540 RETURN
550 REM
560 REM
570 REM
580 REM
590 REM
600 REM *********
610 REM * DRAW *
620 REM *********
630 REM INITIALIZE BUFFER INDEX
640 I       = 0
650 REM SAMPLE A/D CONVERTER.  GET V1, V2.
```

Listing 1 continued on page 84

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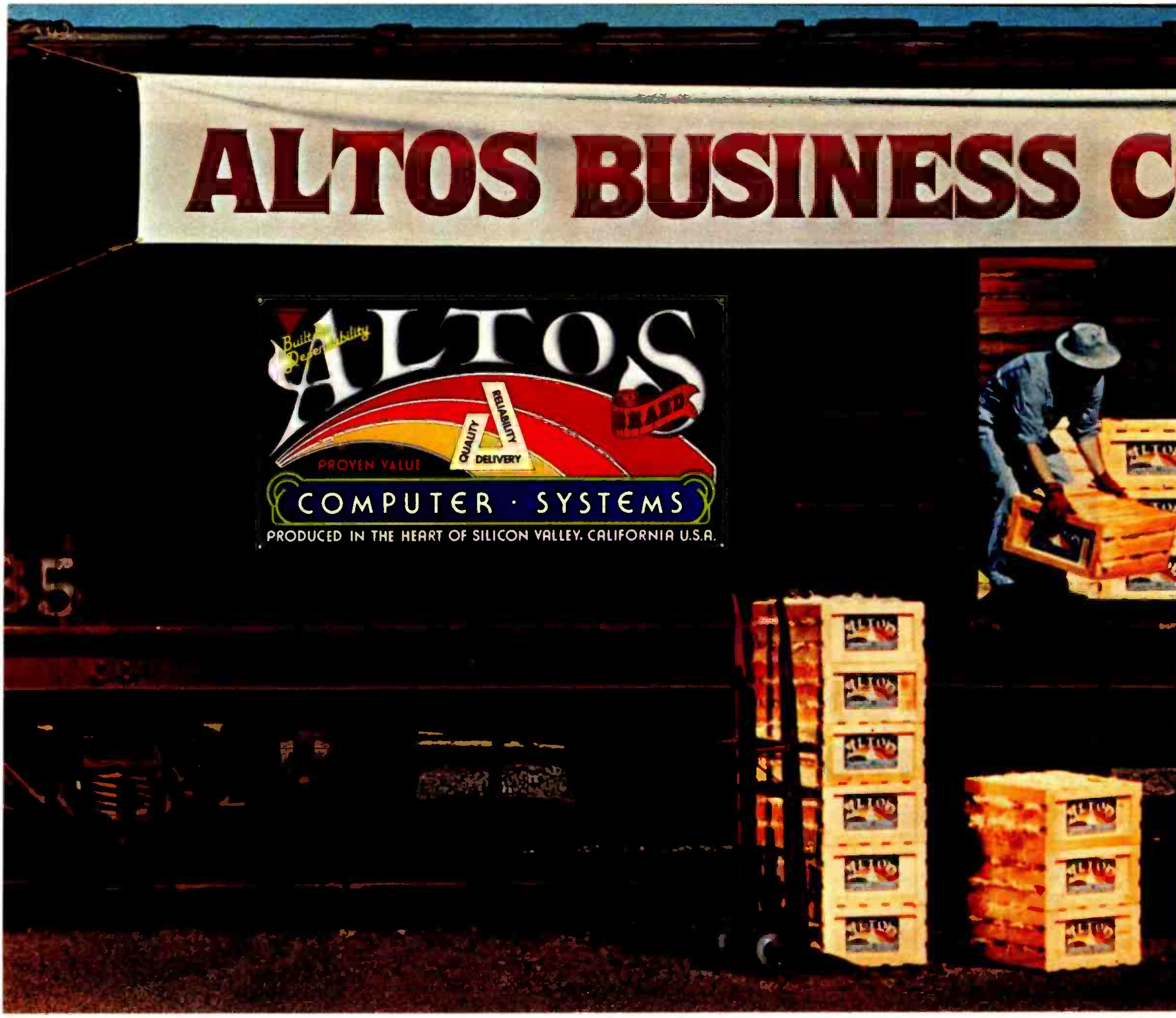

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Listing 1 continued:

```
660 GOSUB 1000
670 THETA1 = SCALE(1) * V1 + TRANS(1)
680 THETA2 = SCALE(2) * V2 + TRANS(2)
690 PHI    = ( PI(1.0) - THETA2 ) / 2.0 + THETA1
700 H      = 2.0 * R * SIN( THETA2 / 2.0 )
710 I      = I + 1
720 IF I>200 THEN DO
730    PRINT "****** BUFFER FULL ******"
740    RETURN
750 DOEND
760 X(I)   = H * COS(PHI)
770 Y(I)   = H * SIN(PHI)
780 REM CHECK IF KEY HAS BEEN STRUCK. GO TO SUBROUTINE "DONE".
790 GOSUB 2000
800 IF DONE=0 GOTO 660
807 REM
810 RETURN
820 REM
830 REM
840 REM
850 REM
860 REM
1000 REM *******
1010 REM * A/D *
1020 REM *******
1030 REM THIS ROUTINE IS COMPUTER DEPENDENT AND MUST BE WRITTEN
1040 REM BY THE PROGRAMMER.  EACH TIME IT IS CALLED IT SHOULD SAMPLE
1050 REM BOTH POTS, GIVING V1 AND V2.  2 TO 5 PAIRS PER SECOND IS AN
1060 REM APPROPRIATE SAMPLING RATE.
1070 REM *
1080 REM *
1090 REM *
1100 REM *
1110 REM *
1120 REM V1      = .............
1130 REM V2      = .........
1140 RETURN
1150 REM
1160 REM
1170 REM
1180 REM
1190 REM
2000 REM ********
2010 REM * DONE *
2020 REM ********
2030 REM THIS SUBROUTINE IS USED TO TERMINATE THE COLLECTION OF DATA.
2040 REM IT CHECKS IF THE USER HAS STRUCK A KEY WHICH INDICATES THE
2050 REM END OF COLLECTION.
2060 REM IF DONE = 0 THEN  CONTINUE SAMPLING.
2070 REM IF DONE NOT = 0 THEN STOP SAMPLING.
2080 REM THIS ROUTINE MUST BE SUPPLIED BY THE PROGRAMMER.
2090 REM *
2100 REM *
2110 REM *
2120 REM *
2130 REM DONE    = ..............
2140 RETURN
2150 STOP
```

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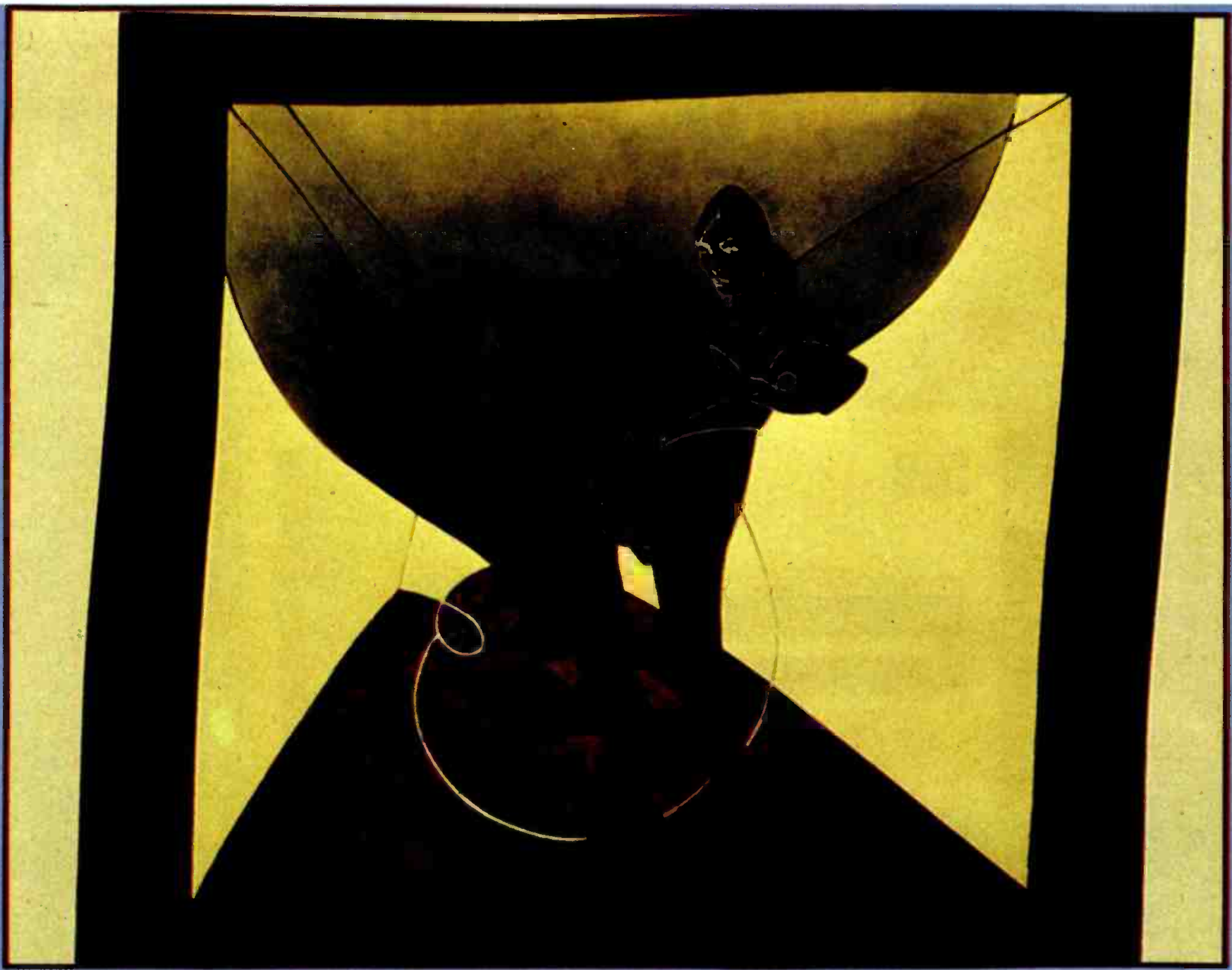


Photo 3: *The finished acrylic-on-canvas work.*

Text continued from page 78:

to be repeated unless the geometry or batteries are changed.

The *Draw* option collects and digitizes the voltages from the potentiometers as the artist draws a figure. A sampling rate of four points per second (a point consisting of two samples, V_1 and V_2) was found experimentally to be an appropriate rate for the A/D converter. The voltages are converted to the coordinates *X*, *Y*. The program continues in a loop, collecting data until one of two events occurs: the user strikes the return key (the program branches out of the loop through the subroutine DONE, which reads the key) or the buffer is full (the program branches out).

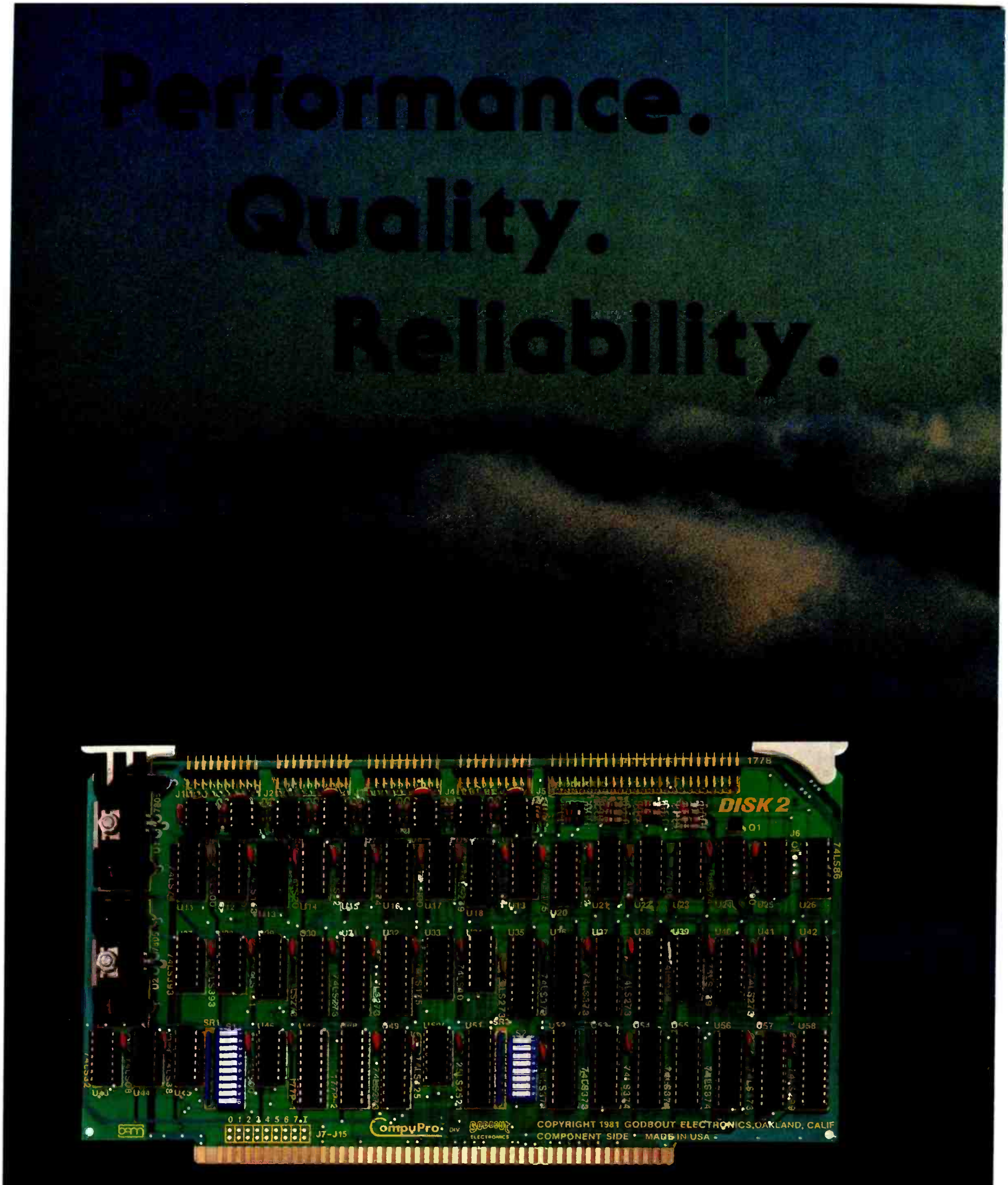
Remember that pivot 2, analogous to the human elbow, should not be extended beyond 180 degrees; to do so will cause erroneous results. However, this limitation will not cause any restriction in drawing.

The program in listing 1 is an example of how to program the graphics tablet; it is up to the programmer to decide how to use the coordinates. Most likely he will display them on the video terminal.

Results

Figure 3 shows a typical drawing produced using the graphics tablet. Enrique Castro-Cid drew the original figure by hand and then digitized the coordinates using the graphics tablet. Once the points were stored in the computer, the drawing was transformed using the mathematical function ($Z + i/Z$). The new coordinates were plotted on a Tektronix 4001 graphic terminal. The completed acrylic-on-canvas work is shown in photo 3.

We have found the graphics tablet has eliminated the bottleneck of digitizing our drawings. The system has developed into a good man-machine partnership, allowing each to do what it does best. ■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The Atari Tutorial

Part 6: Atari BASIC

Lane Winner
Atari Inc.
1265 Borregas Ave.
POB 427
Sunnyvale, CA 94086

Atari BASIC is like other BASIC languages in that it is interpreted, which means that programs can be run when they are entered without intermediate stages of compilation and linking. The Atari BASIC interpreter resides in an 8K-byte ROM (read-only memory) cartridge in the left slot of the computer. It encompasses addresses A000 through BFFF hexadecimal. You must have at least 8K bytes of RAM (random-access read/write memory) to use Atari BASIC.

Strengths and Weaknesses

To use Atari BASIC effectively, you must know its strengths and weaknesses. With this information, programs can be written that make good use of its assets and features.

The strengths of Atari BASIC are:

- It supports the operating system graphics. Simple BASIC statements can be used to display graphics information on the screen.
- It supports the hardware. BASIC statements such as SOUND, STICK, and PADDLE are simple interfaces to the hardware of the computer.
- It has a simple interface to assembly-language routines through the USR function.
- The BASIC interpreter is in ROM. This prevents accidental modification of the interpreter by the user program.
- It supports the Atari disk operating system (DOS). Specialized calls such as NOTE and POINT (in DOS 2.0S) allow the user to randomly access a disk through the disk operating system.
- It offers peripheral support. Any peripheral recognized by the operating system can be accessed from a BASIC program.

The weaknesses of Atari BASIC are:

- It gives no support of integers. All numbers are stored as 6-byte binary-coded-decimal (BCD) floating-point numbers.
- Mathematical operations are slow. Since all numbers are 6 bytes long, math operations become rather slow.
- It does not allow string arrays. Only one-dimensional strings can be created.

How Atari BASIC Works

The workings of the BASIC interpreter are summarized as follows:

1. BASIC gets a line of input from the user and converts it into a tokenized form.
2. It then puts this line into a token program.
3. This program is then available for execution.

The details of these operations are discussed in the following four sections:

- The Tokenizing Process
- The Token File Structure
- The Program Execution Process
- System Interaction

The Tokenizing Process

In simple terms, the tokenization of

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a line of code in BASIC looks like this:

1. BASIC gets a line of input.
2. It then checks for legal syntax.
3. During syntax checking, the line is tokenized.
4. The tokenized line is moved into the token program.
5. If the line is in immediate mode, it is executed.

To better understand the tokenizing process, some terms must first be defined:

Token—An 8-bit byte containing a value that corresponds to a BASIC keyword or element of syntax.

Statement—A complete "sentence" of tokens that causes BASIC to perform a meaningful task. When listed on the same line, statements are separated by colons.

Line—One or more statements preceded either by a line number in the range of 0 to 32,767, or an immediate-mode line with no line number.

Command—The first executable token of a statement that tells BASIC to interpret the tokens that follow in a particular way.

Variable—A token that is an indirect pointer to its actual value; this is done so that the value can be changed without changing the token.

Constant—A 6-byte BCD value preceded by a special token. This value remains unchanged throughout program execution.

Operator—Any one of 46 tokens that in some way move or modify the values that follow them.

Function—A token that returns a value to the program when executed.

EOL—An end-of-line character that has the value 9B hexadecimal.

BCD—Binary-coded decimal. This refers to a number that uses the 6502 microprocessor's decimal mode.

BASIC begins the tokenizing process by getting a line of input. This input will be obtained from one of the handlers of the operating system. Normally, it is from the screen editor; however, with the ENTER command (which merges new program lines with an existing program), any device can be specified. The call BASIC issues is a GET RECORD command, and the data returned are ATASCII information terminated by an EOL. (ATASCII is a modified ASCII code used to represent characters and symbols within the Atari computers.) These data are stored by a part of the Atari operating system called the central I/O utility (CIO) into the BASIC input line buffer from locations 580 to 5FF hexadecimal.

After the record is returned, the syntax-checking and tokenizing processes begin. First, BASIC looks for a line number. If one is found, it is converted into a 2-byte integer. If no line number is present, the computer is assumed to be in immediate mode and the line number 8000 hexadecimal is assigned to it. These are the first two tokens of the tokenized line. This line is built in the token output buffer, which is 256 bytes long, and resides at the end of the reserved operating system RAM.

The next token is a dummy byte reserved for the byte count (or *offset*) from the start of this line to the start of the next line. Following this is another dummy byte for the count of the start of this line to the start of the next *statement*. These values are set when tokenization is complete for the line and the statement, respectively. The use of these values is discussed later in the program execution process section.

BASIC now looks for the command of the first statement of the input line. A check is made to determine if this is a valid command by scanning a list of legal commands in ROM. If a match is found, the next byte in the token line becomes the number of the entry in the ROM list that matched.

If at any time an error is found, a syntax error token is assigned to that byte and BASIC stops tokenizing,

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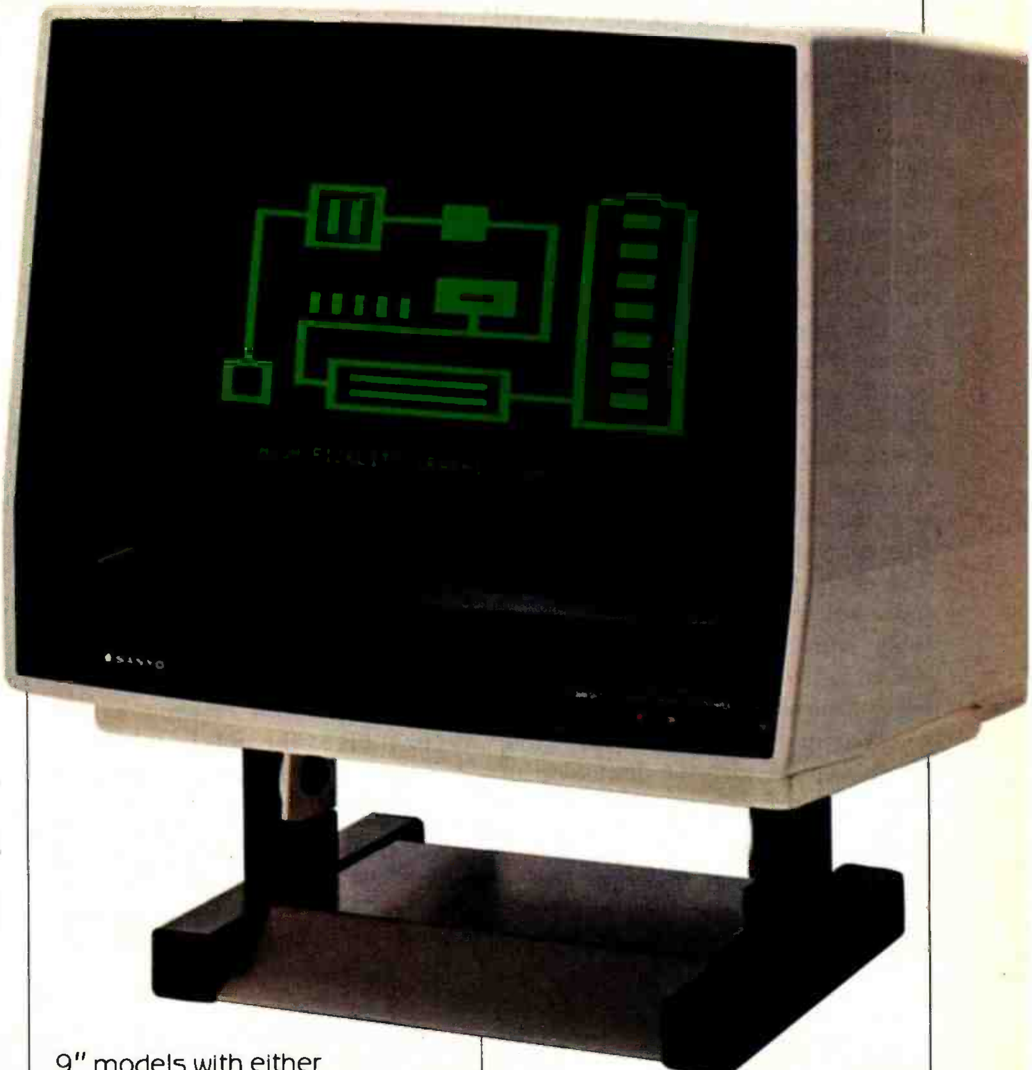

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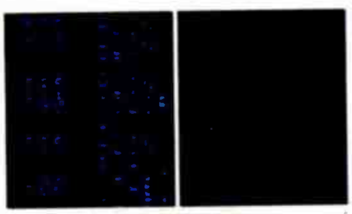

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copies the rest of the input buffer in ATASCII format to the token output buffer, and prints the error line.

Assuming a good line, one of seven items can follow the command: a variable, a constant, an operator, a function, a double quote, another statement, or an EOL. BASIC tests to see if the next input character is numeric. If not, it compares that character and those following against the entries of the variable name table. If this is the first line of code entered in the program, no match will be found. The characters are then compared against the function and operator tables. If no match is found there, BASIC assumes that this is a new variable name. Since this is the first variable, it will be assigned the first entry in the variable name table. The characters are copied out of the input buffer and stored into the name table with the most significant bit (MSB) set to a logical 1 on the last byte of the name. Eight bytes are then reserved in the variable value table for this entry. (See the discussion of the variable value table in the next section.)

The token that ends up in the tokenized line is the variable number minus one with the MSB set. Thus, the token of the first variable entered would be hexadecimal 80, the second would be hexadecimal 81, and so on up to hexadecimal FF, for a total of 128 unique variable numbers.

If a function is found, its entry number in the operator function table is assigned to the token. Functions require certain sequences of parameters; these are contained in syntax tables. If they are not matched, a syntax error will result.

If an operator is found, a token is given its table entry number. Since operators can follow each other in a rather complex fashion (such as multiple parentheses), the syntax checking of them is a bit complicated.

In the case of the double quotes, BASIC assumes that a character string is following, assigns a hexadecimal 0F to the output token, and reserves a dummy byte for the string length. The characters are moved from the input buffer into the output buffer until the second set of quotes is found. The string-length byte is then set to the character count.

If the next characters in the input buffer are numeric, BASIC converts them into a 6-byte BCD constant. A hexadecimal 0E token is put in the output buffer, followed by the 6-byte constant.

When a colon is encountered, a hexadecimal 14 token is inserted in the output buffer, and the offset from the start of the line is stored in the dummy byte that was reserved for the count to the start of the next statement. At this point, another dummy byte is reserved and the process goes back to get a command.

When the EOL is found, a hexadecimal 16 token is stored and the offset from the start of the line is put in the dummy byte for the line offset. At this point, tokenization is complete and BASIC moves the token line into the token program. First, it searches the program for that line number. If

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the same number is found, the computer replaces the old line with the new one. If it is not found, the computer inserts the new line in the correct numerical sequence. In both cases, the data following the line are moved either up or down in memory to allow for an expanding and contracting program size.

BASIC now checks to see if the tokenized line is an immediate-mode line. If so, that line is executed according to the methods described in the interpretive process; if not, BASIC goes back to get another line of input.

If at any time during the tokenizing process the length of the token line exceeds 256 bytes, an Error 14 message (line too long) is sent to the screen and BASIC goes back to get the next line of input.

An example line of input and its token form are shown in figure 1. Table 1 shows the token values for Atari BASIC.

The Token File Structure

The token file contains two major segments: a group of zero-page pointers that point into the token file, and the actual token file itself. The zero-page pointers are 2-byte values that point to various sections of the token file. There are nine 2-byte pointers in locations 80 to 91 hexadecimal. The textbox on page 112 gives a list of the pointers and the sections of the token file they reference.

The Program Execution Process

Executing a line of code involves reading the tokens created during the tokenization process. Each token has a particular meaning that causes BASIC to execute a specific series of operations. The method of doing this requires BASIC to get one token at a time from the token program and process it. Since the token is an index into a jump table of routines, a PRINT token points indirectly to a PRINT processing routine. When that processing is complete, BASIC returns to get the next token. The pointer used to fetch each token is called STMCUR and is at locations 8A and 8B hexadecimal.

The first line of code executed in a program is the immediate-mode line. This is usually a RUN or GOTO. In the case of the RUN, BASIC gets the first line of tokens from the statement table (tokenized program) and processes it. If all the code is in-line, BASIC merely executes consecutive lines.

If a GOTO is encountered, the line to go to must be found. The statement table contains a partially linked list of line numbers and statements. The lowest line number is first, followed by increasing line numbers up to the largest. If a line somewhere in the middle of the table is needed, the following process occurs.

The address of the first line is found in the STMTAB pointer at hexadecimal 88 and 89. This is stored in a temporary pointer. The first 2 bytes of the first line are its line number. This number is compared to the requested line number. If the first number is less, BASIC gets the next line by adding the third byte of the first line to the temporary pointer.

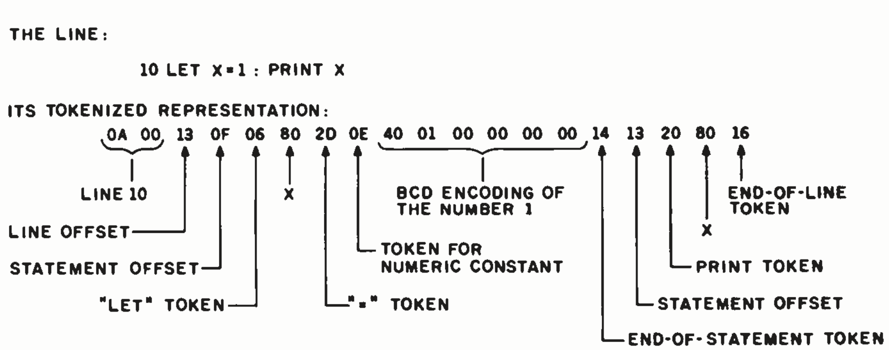

Figure 1: *A line of Atari BASIC in tokenized form. The tokenized form of the line is the one stored in memory.*

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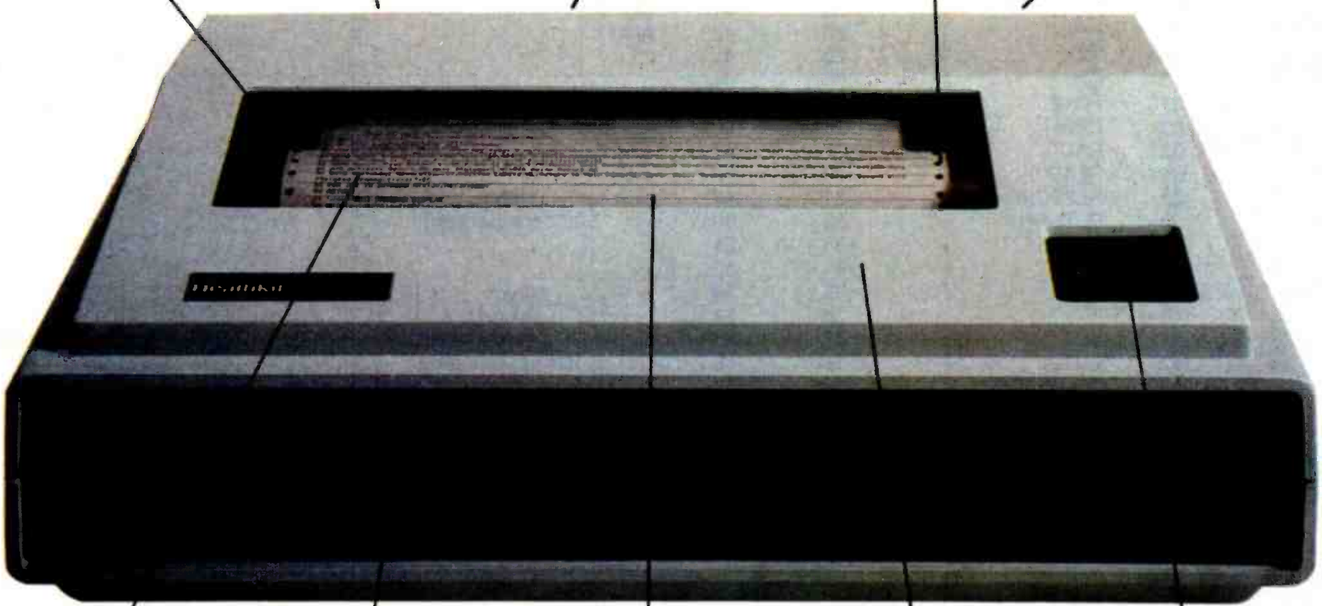

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CP-204A

(a) Commands

Hexadecimal	Decimal	Meaning
00	0	REM
01	1	DATA
02	2	INPUT
03	3	COLOR
04	4	LIST
05	5	ENTER
06	6	LET
07	7	IF
08	8	FOR
09	9	NEXT
0A	10	GOTO
0B	11	GO TO
0C	12	GOSUB
0D	13	TRAP
0E	14	BYE
0F	15	CONT
10	16	COM
11	17	CLOSE
12	18	CLR
13	19	DEG
14	20	DIM
15	21	END
16	22	NEW
17	23	OPEN
18	24	LOAD
19	25	SAVE
1A	26	STATUS
1B	27	NOTE
1C	28	POINT
1D	29	XIO
1E	30	ON
1F	31	POKE
20	32	PRINT
21	33	RAD
22	34	READ
23	35	RESTORE
24	36	RETURN
25	37	RUN
26	38	STOP
27	39	POP
28	40	?
29	41	GET
2A	42	PUT
2B	43	GRAPHICS
2C	44	PLOT
2D	45	POSITION
2E	46	DOS
2F	47	DRAWTO
30	48	SETCOLOR
31	49	LOCATE
32	50	SOUND
33	51	LPRINT
34	52	CSAVE
35	53	CLOAD
36	54	[IMPLIED LET]
37	55	ERROR—[SYNTAX]

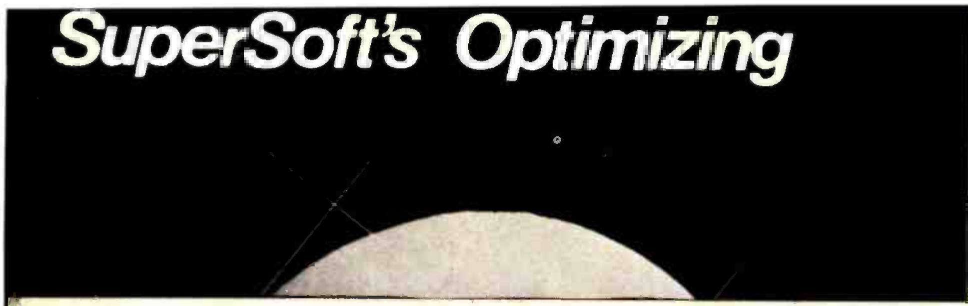
(b) Operators

Hexadecimal	Decimal	Meaning	
0E	14	[numeric constant]	
0F	15	[string constant]	
10	16	[not used]	
11	17	[not used]	
12	18	,	
13	19	$	
14	20	: [statement end]	
15	21	;	
16	22	[line end]	
17	23	GOTO	
18	24	GOSUB	
19	25	TO	
1A	26	STEP	
1B	27	THEN	
1C	28	#	
1D	29	< =	
1E	30	< >	
1F	31	> =	[numeric comparison]
20	32	<	
21	33	>	
22	34	=	
23	35	^	
24	36	*	
25	37	+	
26	38	−	
27	39	/	
28	40	NOT	
29	41	OR	
2A	42	AND	
2B	43	(	
2C	44	)	
2D	45	= [arithmetic assignment]	
2E	46	= [string assignment]	
2F	47	< =	
30	48	< >	
31	49	> =	[string comparison]
32	50	<	
33	51	>	
34	52	=	
35	53	+	[unary operators]
36	54	−	
37	55	([string left parenthesis]	
38	56	([array left parenthesis]	
39	57	([DIM array left parenthesis]	
3A	58	([function left parenthesis]	
3B	59	([DIM string left parenthesis]	
3C	60	, [array comma]	

(c) Functions

Hexadecimal	Decimal	Meaning
3D	61	STR$
3E	62	CHR$
3F	63	USR
40	64	ASC
41	65	VAL
42	66	LEN
43	67	ADR
44	68	ATN
45	69	COS
46	70	PEEK
47	71	SIN
48	72	RND
49	73	FRE
4A	74	EXP
4B	75	LOG
4C	76	CLOG
4D	77	SQR
4E	78	SGN
4F	79	ABS
50	80	INT
51	81	PADDLE
52	82	STICK
53	83	PTRIG
54	84	STRIG

Table 1: *A table of token values for Atari BASIC. Table 1a shows the interpretation of a given value as a BASIC command token. Table 1b shows the interpretation of a value as a BASIC operator token. Table 1c shows the interpretation of a value as a BASIC function token. The interpretation of a token value varies with its position in the line.*



The temporary pointer will be pointing to the second line. Again, the first 2 bytes of this new line are compared to the requested line. If they are less, the third byte is added to the pointer. If a line number does match, the con-

BASIC Command	Operating System IOCB Parameters
OPEN #1,12,0,"E:"	IOCB = 1 Command = 3 (OPEN) Aux1 = 12 (Input/Output) Aux2 = 0 Buffer Address = ADR("E:")
GET #1,X	IOCB = 1 Command = 7 (Get Characters) Buffer Length = 0 Character returned in accumulator
PUT #1,X	IOCB = 1 Command = 11 (Put Characters) Buffer Length = 0 Character output through accumulator
INPUT #1,A$	IOCB = 1 Command = 5 (Get Record) Buffer Length = Length of A$ (not over 256) Buffer Address = Input Line Buffer
PRINT #1, A$	IOCB = 1 BASIC uses a special put byte vector in the IOCB to talk directly to the handler.
XIO 18,#6,12,0,"S:"	IOCB = 6 Command = 18 (Special—Fill) Aux1 = 12 Aux2 = 0

Table 2: *Examples of BASIC I/O commands and the corresponding parameters that are passed to the operating system IOCBs (input/output control blocks).*

order in which the operators are put onto the stack can either be implied, in which case BASIC looks up the operator's precedence from a ROM table, or the order can be explicitly stated by the placement of parentheses.

Pressing the BREAK key at any time causes the operating system to set a flag to indicate this occurrence. BASIC checks this flag after each token is processed. If it finds it has been set, it stores the line number at which this occurred, prints a "STOPPED AT LINE XXXX" message, clears the BREAK flag, and waits for user input. At this point, the user could type CONT and program execution would continue at the next line.

System Interaction

BASIC communicates with the operating system primarily through the use of I/O calls to the central I/O utility. Table 2 gives a list of user BASIC calls and the corresponding operating system IOCBs. (IOCB stands for "input/output control block." An IOCB is a table of information used to control information flow between the computer and either a disk file or I/O device.)

When a BASIC token program is SAVEd or CSAVEd to a device, two blocks of information are written. The first block consists of seven of the nine zero-page pointers that BASIC uses to maintain the token file. These are LOMEM through STARP (see textbox). One change is made to these pointers when they are written out: the value of LOMEM is subtracted from each of the 2-byte pointers, and these new values are written to the device. Thus, the first 2 bytes written are 0,0.

The second block of information written consists of the following token file sections: the variable name table, the variable value table, the token program, and the immediate-mode line.

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pointers are placed back on page zero. The values of RUNSTK and MEMTOP are then set to the value in STARP. (See figure 2 for the locations of these and other pointers.)

Next, 256 bytes are reserved in memory above the value of MEMLO to allocate space for the token output buffer. Then, the token file information, consisting of the variable name table through the immediate-mode line, is read in. These data are placed in memory immediately following the token output buffer.

Improving Program Performance

Program performance can be improved in two ways. First, the execution time can be decreased (it will run faster); second, the amount of space required can be decreased, allowing it to use less RAM. To attain these two goals, the following lists can be used as guidelines. The methods of improvement in each list are primarily arranged in order of decreasing effectiveness. Therefore, the method at the top of a list will have more impact than one at the bottom.

The following methods will help speed up a BASIC program:

- Recode—Because BASIC is not a structured language, the code written in it tends to be inefficient. After many revisions, it becomes even worse. Thus, the time spent to restructure the code is worthwhile.
- Check algorithm logic—Make sure that the code to execute a process is as efficient as possible.
- Put frequently called subroutines and FOR/NEXT loops at the start of the program—Since BASIC starts at the beginning of a program to look for a line number, any line references near the end take longer to reach.
- For frequently called operations within a loop, use in-line code rather than subroutines—The program speed can be improved here since BASIC spends time adding and removing entries from the run-time stack.
- Make the most frequently changing loop of a nested set the deepest—In this way, the run-time stack will be altered the fewest number of times.
- Simplify floating-point calculations within the loop—If a result is obtained by multiplying a constant by a counter, time can be saved by changing the operation to the addition of a constant.
- Set up loops as multiple statements on one line—In this way, the BASIC interpreter will not have to get the next line to continue the loop.
- Disable the screen display—If visual information is not important for a period of time, up to a 30-percent time savings can be made with a POKE 559,0. Save the previous value in location 559 so you can later restore the video output.
- Use a coarser graphics mode or a short display list—If a full screen display is not necessary, up to a 25-percent time savings can be made by causing the computer to spend less time on video display.
- Use assembly code—Time savings can be made by encoding loops in assembly language and using the USR function.

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• Recode—As mentioned previously, restructuring the program makes it more efficient. It also saves space.

• Remove remarks—Remarks are stored as ATASCII data and merely take up space in the running program.

• Replace a constant used three times or more with a variable—BASIC allocates 7 bytes for a constant, but only 1 for a variable reference. Therefore, 6 bytes can be saved each time a constant is replaced with a variable assigned to that constant's value.

• Initialize variables with a READ statement—A data statement is stored in ATASCII code, 1 byte per character, whereas an assignment statement requires 7 bytes for one constant.

• Try to convert numbers used only once and twice to arithmetic combinations of predefined variables—An example is to define Z1 to equal 1 and Z2 to equal 2; if the number 3 is required, replace it with the expression Z1 + Z2.

• Set frequently used line numbers (in GOSUB and GOTO) to predefined variables—If the line 100 is used in 50 different places, approximately 300 bytes can be saved by equating Z100 to 100 and referencing Z100.

• Keep the number of variables to a minimum—Each new variable entry requires 8 more bytes in the variable value table and a few bytes for its name.

• Clean up the value and name tables—Because the variable value and name tables are normally saved with the BASIC program, variable entries continue to take up space even

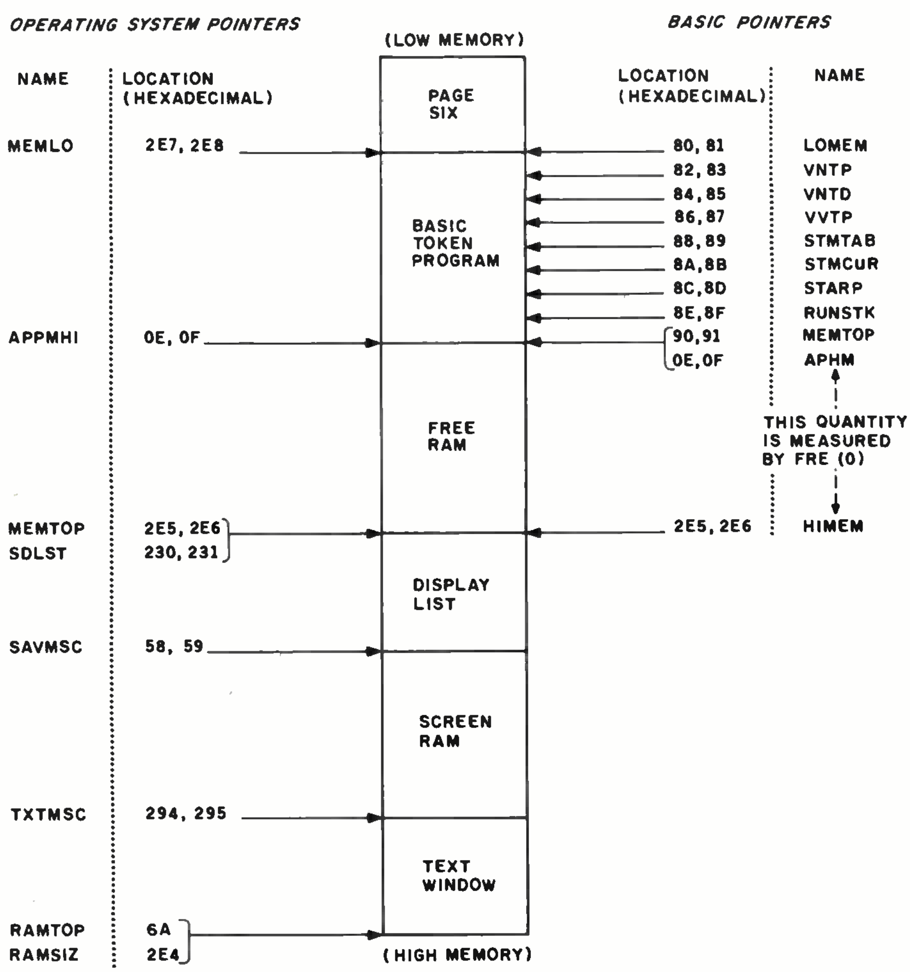

Figure 2: *A list of pointers used by BASIC and the Atari operating system to keep track of memory usage. These pointers are described in greater detail in the operating system section of the* Atari Personal Computer System Operating System User's Manual *and* Hardware Manual.

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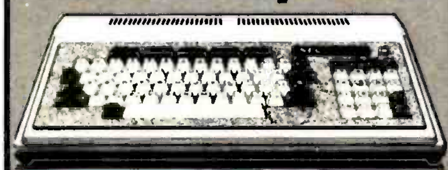

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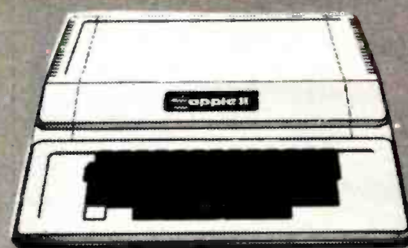

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after all references to them are removed from the program. To delete the entries, LIST the program to disk or cassette, type NEW, and ENTER the program. (Unlike SAVE or CSAVE, LIST stores the program as a file of characters and ENTER reads the program in as if it had been typed in from the keyboard.)

- Keep variable names as short as possible—Each variable name is stored in the name table as ATASCII information. The shorter the names, the shorter the table.
- Replace text used repeatedly with strings—On screens with a lot of text, space can be saved by assigning a string to a commonly used set of characters.
- Initialize strings with assignment statements—An assignment of a string with data in quotes requires less space than a READ statement and a CHR$ function.
- Concatenate lines into multiple statements—Three bytes can be saved each time two lines are converted into two statements on one line.
- Replace once-used subroutines with in-line code—The GOSUB and RETURN statements waste bytes if used only once.
- Replace integer numeric arrays with strings if the data values fall between 0 and 255 (or if the data can be scaled to that range)—Numeric array entries require 6 bytes each. However, each number can be reduced to one character by using the CHR$ function; it can later be restored with the ASC function.
- Replace SETCOLOR statements with POKE commands—This saves 8 bytes per occurrence.
- Use cursor-control characters rather than POSITION statements—The POSITION statement requires 15 bytes for the x and y parameters, whereas the cursor-editing characters are 1 byte each.
- Delete lines of code via program control—See the next section on advanced programming techniques.
- Modify the string/array pointer to load predefined data—SAVE and CSAVE save the part of the token file from VNTP up to STARP. By changing the value in STARP to point to the *end* of the data, string and array information can be saved.
- Small assembly-language routines can be stored in USR calls—An example would be:

X=USR(ADR("hhh$\boxed{*}$LV$\boxed{d}$"),16)

(The boxes represent inverse video characters.) Eight bytes are saved by not placing the string in a named string variable.

- Chain programs—An example would be an initialization routine that is run first, then loads and runs the main program.

Advanced Applications

An understanding of the fundamentals of Atari BASIC makes it possible to write some interesting applications. These can be strictly BASIC operations, or they can also involve features of the operating system. The following paragraphs give examples of three such techniques.

String initialization—The program in listing 1 sets all the bytes of a string of any length to the same value. BASIC copies the first byte of the

Text continued on page 118

Listing 1: *Quick string manipulation using the Atari BASIC substring function. This program will initialize every character of the string A$ to the value "A".*

```
10 REM STRING INITIALIZATION
20 DIM A$(1000)
30 A$(1)="A":A$(1000)="A"
40 A$(2)=A$
```

Listing 2: *Modification of an Atari BASIC program under program control. By using a special "forced read" mode, information on the screen can be automatically read into BASIC without user intervention. In this program, this ability is used to delete lines 70 through 90 while the program is being run.*

```
10 REM DELETE LINE EXAMPLE
20 GRAPHICS 0:POSITION 2,4
30 ? 70:? 80:? 90:? "CONT"
40 POSITION 2,0
50 POKE 842,13:STOP
60 POKE 842,12
70 REM THESE LINES
80 REM WILL BE
90 REM DELETED
```

Atari BASIC Zero-Page Pointers

Name	Pointer Location (hex)	Part of Token File Pointed To
LOMEM	80,81	*Token output buffer—The buffer BASIC uses to tokenize one line of code. It is 256 bytes long and resides at the end of the operating system's allocated RAM.*
VNTP	82,83	*Variable name table—A list of all the variable names that have been entered in the program. They are stored as ATASCII characters, each new name stored in the order it was entered. Three types of name entries exist:* *1. Scalar variables—MSB (most significant bit) set on last character in name.* *2. String variables—last character is a "$" with the MSB set.* *3. Array variables—last character is a "(" with the MSB set.*
VNTD	84,85	*Dummy end of the variable name table—BASIC uses this pointer to indicate the end of the name table. When there are less than 128 variables, this normally points to a dummy zero byte. When 128 variables are present, this points to the last byte of the last variable name.*
VVTP	86,87	*Variable value table—This table contains current information on each variable. For each variable in the name table, 8 bytes are reserved in the value table. The information for each variable type is:*

Byte Number	1	2	3	4	5	6	7	8
Scalar	00	Var#	6-byte BCD constant					
Array (explicitly dimensioned)	41	Var#	Offset from STARP(8C,8D)		first DIM + 1		second DIM + 1	
(undimensioned)	40							
String (explicitly dimensioned)	81	Var#	Offset from STARP(8C,8D)		Length		DIM	
(undimensioned)	80							

A scalar variable contains a numeric value. An example is X=1. The scalar is X and its value is 1, stored in 6-byte BCD format. An array is composed of numeric elements stored in the string/array area and has one entry in the value table. A string, composed of character elements in the string/array area, also has one entry in the table.

The first byte of each value entry indicates the type of variable: 00 for a scalar, 40 for an array, and 80 for a string. If the array or string has been dimensioned, the least significant bit (LSB) is set on the first byte.

The second byte contains the variable number. The first variable entry is number zero. If 128 variables were present, the last would be hexadecimal 7F.

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In the case of the scalar variable, the third through eighth bytes contain the 6-byte BCD number that has currently been assigned to it.

For arrays and strings, the third and fourth bytes contain an offset from the start of the string/array area (described below) to the beginning of the data.

The fifth and sixth bytes of an array contain its first dimension. The quantity is a 16-bit integer, and its value is 1 greater than the limit the user entered. The seventh and eighth bytes are the second dimension, also a value of 1 greater.

The fifth and sixth bytes of a string are a 16-bit integer that contains its current length. The seventh and eighth bytes are its dimension (up to 32,767 bytes in size).

STMTAB	**88,89**	*Statement table—This block of data includes all the lines of code entered by the user and tokenized by BASIC. It also includes the immediate-mode line. The format of these lines is described in figure 1.*
STMCUR	**8A,8B**	*Current statement—This pointer is used by BASIC to reference particular tokens within a line of the statement table. When BASIC is waiting for input, this pointer is set to the beginning of the immediate-mode line.*
STARP	**8C,8D**	*String/Array area—This block contains all the string and array data. String characters are stored as 1-byte ATASCII entries. Therefore, a string of 20 characters will require 20 bytes. Arrays are stored with 6-byte BCD numbers for each element. A 10-element array requires 60 bytes.* *This area is allocated and subsequently enlarged by each dimension statement encountered, the amount being equal to the size of a string dimension or six times the size of an array dimension.*
RUNSTK	**8E,8F**	*Run-time stack—This software stack contains GOSUB and FOR/NEXT entries. The GOSUB entry consists of 4 bytes. The first is a 0 byte indicating GOSUB, followed by the 2-byte integer line number on which the call occurred. This is followed by the offset into that line so that the RETURN can come back and execute the next statement.* *The FOR/NEXT entry contains 16 bytes. The first is the limit the counter variable can reach. The second byte is the step or counter increment. Each of these quantities is in 6-byte BCD format. The thirteenth byte is the counter variable number with the MSB set. The fourteenth and fifteenth bytes are the line number; the sixteenth is the line offset to the FOR statement.*
MEMTOP	**90,91**	*Top of application RAM—This is the end of the user program. Program expansion can occur from this point to the end of free RAM, which is defined by the start of the display list. The FRE function in BASIC returns the amount of free RAM by subtracting MEMTOP from HIMEM (pointed to by locations hexadecimal 2E5 and 2E6). Note that the BASIC MEMTOP is not the same as the OS variable called MEMTOP.*

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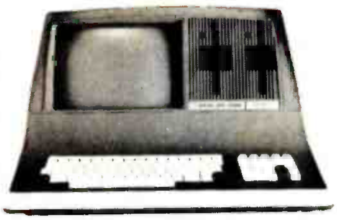

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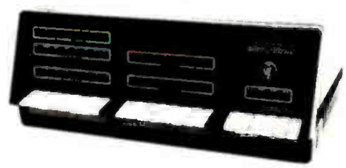

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Listing 3: *Quick manipulation of a graphics player within Atari BASIC. By setting a string variable to point to the 512-byte area reserved for a player and manipulating that string, a player can be moved around the screen faster than is otherwise possible in BASIC. This program creates a small rectangle that glides across the video screen, changing direction when it nears the boundary of the video display.*

```
100 REM PLAYER/MISSILE EXAMPLE
110 DIM A$(512),B$(20)
120 X=X+1:READ A:IF A<>-1 THEN B$(X,X)=CHR$(A):GOTO 120
130 DATA 0,255,129,129,129,129,129,129,129,129,255,0,-1
140 REM B$ CONTAINS PATTERN FOR PLAYER SHAPED LIKE SMALL BOX
2000 POKE 559,62:POKE 704,88
2020 I=PEEK(106)-16:POKE 54279,I
2030 POKE 53277,3:POKE 710,224
2040 VTAB=PEEK(134)+PEEK(135)*256:REM VALUE OF VVTP POINTER
2050 ATAB=PEEK(140)+PEEK(141)*256:REM VALUE OF STARP POINTER
2060 OFFS=I*256+1024-ATAB
2070 HI=INT(OFFS/256):LO=OFFS-HI*256
2090 POKE VTAB+2,LO:POKE VTAB+3,HI:REM A$ POINTS TO P/M AREA
3000 Y=60:Z=100:V=1:H=1
4000 A$(Y,Y+11)=B$:POKE 53248,Z:REM VERT AND HORIZ POSITION CHANGED
4010 Y=Y+V:Z=Z+H
4020 IF Y>213 OR Y<33 THEN V=-V
4030 IF Z>206 OR Z<49 THEN H=-H
4420 GOTO 4000
```

Text continued from page 110:

source string into the first byte of the destination string, then the second, third, and so on. By making the destination string the second byte of the source (A$(2) refers to the substring of A$ from its second through its last character), the same character can be stored throughout the entire string.

Delete lines of code—By using a feature of the operating system, a program such as listing 2 can delete or modify lines of code within itself. The screen editor can be set to accept data from the screen without user input. The POKE in line 50 causes the Atari screen editor device to do a "forced read" of the information on the screen, while the POKE in line 60 restores control of the computer to the keyboard. (For more information, see the section on the screen editor within the "I/O Subsystem" chapter of the *Atari Personal Computer System Operating System User's Manual and Hardware Manual.*) Thus, by first setting up the screen, positioning the cursor to the top, and then stopping the program, BASIC gets the commands that have been printed on the screen.

Player/missile graphics with strings—A fast way to move player/missile graphics data is shown in listing 3. This program places a small box on the screen (a player) and causes it to bounce around the screen. A dimensioned string A$ has its string/array area offset value changed to point to the player/missile graphics area. Writing to this string with an assignment statement now writes data into the player/missile area at assembly-language rates.

In particular, the first statement in line 4000 moves the player image in string B$ up or down the vertical "strip" that the player occupies. The second statement changes the horizontal position of the "strip." When the box reaches the vertical limits of 33 or 213 (line 4020) or the horizontal limits of 49 or 206 (line 4030), the direction of the box movement is reversed.

Next Month

We will next take a look at the sound-generating capabilities of the Atari 400 and 800 computers. ■

More detailed information on several of the subjects discussed here is contained in the Atari Personal Computer System Operating System User's Manual and Hardware Manual. *This manual (part C016555) can be ordered for $27 plus $3 shipping and handling from Atari Customer Service, 1346 Bordeaux Dr., Sunnyvale, CA 94086. California residents must add 6½% sales tax.*

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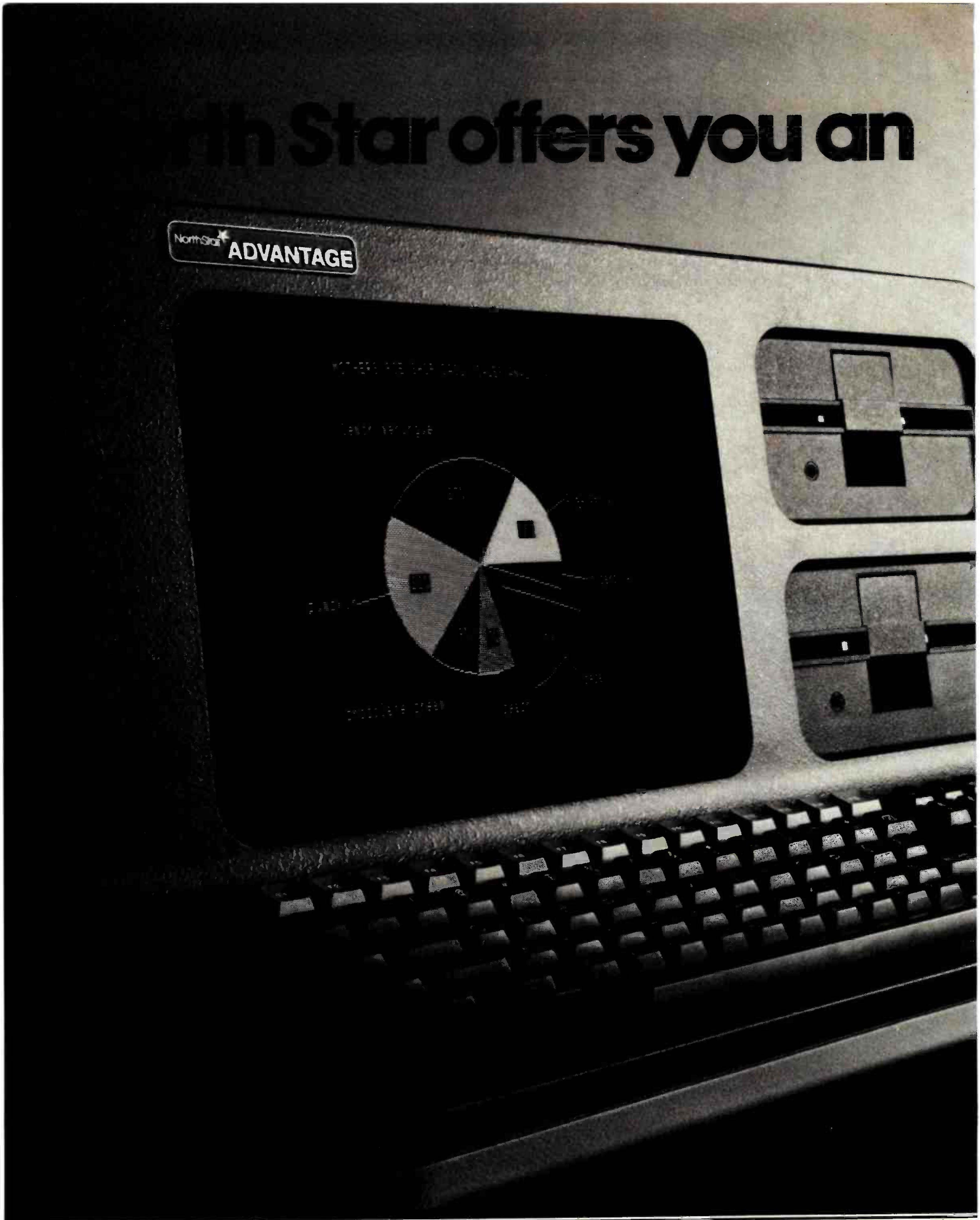
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Source: Dataquest and Manufacturer's Literature, November 1981.

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The Input/Output Primer

Part 1: What Is I/O?

Steve Leibson
Auto-trol Technology Corporation
12500 North Washington St.
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A modern computer can process incredible amounts of information or make thousands of decisions each second. Without communication to the outside world, however, the computer's work is of little use. Here's where input/output comes in; it links the computer to operators or processes that require its problem-solving powers.

Input/Output (I/O) is the term used to describe communication with the outside world. To describe the various means used to effect these communications, I'll start with the core of the system, the computer itself, then work outward toward the rest of the world.

A general-purpose computer has two main components: processor and memory. The processor, the system's engine, follows sequences of instructions that cause it to process data. Instructions and data are stored in memory for the processor's use.

Three sets of electrical lines, called *buses*, link the processor and memory: the address bus, the data bus, and the control bus. Computer memory is organized into thousands of locations, each with a unique address and the capability of storing one piece of data or one instruction in a sequence. The processor differentiates between instructions and data.

The processor can access information in memory by placing the proper signals on the address bus. These signals represent an address that specifies the memory location of interest to the processor. The processor must also signify whether it wishes to extract information from the selected location (to read) or to place information in it (to write).

The advantage of memory-mapped I/O: existing processor instructions serve the dual purpose of interfacing to memory and to I/O devices.

This signaling is performed on the control bus, which also contains signal lines that synchronize the processor and memory. In read and write operations, information passes between memory and processor over a data bus.

Since data *and* instructions pass over the data bus, the processor must correctly interpret the information. The processor's internal timing cycles enable it to distinguish data from instructions. To obtain its next instruction, the processor performs an *instruction fetch*. Then the processor performs operations necessary to execute the instruction.

The location currently being accessed for instructions is held in a register or *program counter* within the processor. The instruction addressed by the program counter may cause the processor to access memory again, this time to obtain data or to place data in memory. Such operations result from execution of *memory reference instructions*.

We've now described all the computer operations needed to run a program: the computer can obtain instructions from memory, access memory for data, process data, and place processed data back into memory. Two questions now arise: how do the program and data get into the memory, and how does the operator obtain the results of the processing? The answer: through the input/output devices.

A complete computer system, such as a Hewlett-Packard desktop computer, is not composed of a processor and memory alone. Making a system requires adding peripheral devices such as a keyboard, display, printer, and magnetic tape unit. These peripheral devices connect the computer to the outside world. The keyboard, display, and printer allow communications with a human operator, while the tape storage device provides storage and retrieval of programs and data.

How are peripheral devices connected to the processor/memory combination inside the computer? Two methods are currently in use. The first places these devices on the memory bus already discussed; peripheral devices thus "appear" to the processor as memory locations. The processor can send data to, or obtain data from, the peripherals by using memory-reference instructions. This approach is called *memory-mapped I/O* because it allocates some

This article is the first in Steve Leibson's six-part series, The Input/Output Primer. *The series will explain the way in which computers talk with the world. Upcoming articles will discuss interrupts and direct memory access; parallel and HPIB (GPIB) interfaces; BCD and serial interfaces; character codes; interrupts, buffers, grounds, and signal degradation. "An I/O Glossary," which follows this article, is a valuable reference for the entire series.*

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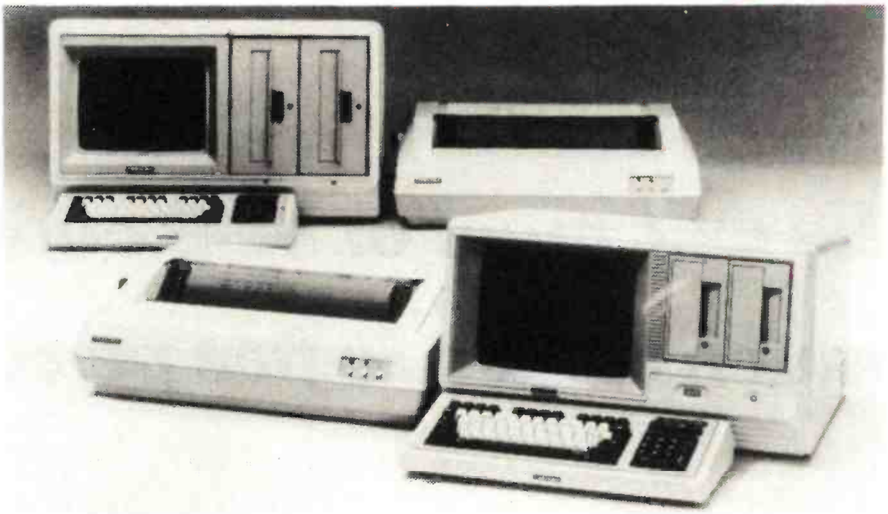

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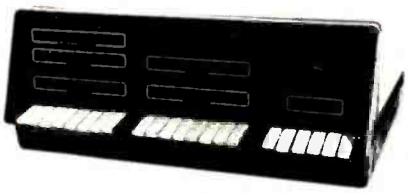

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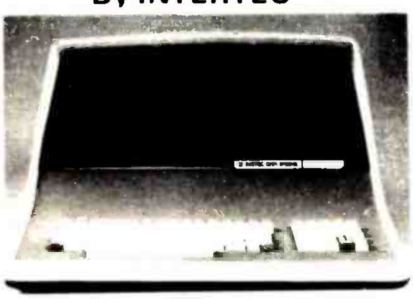

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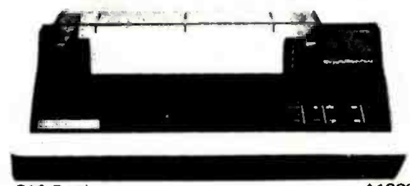

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portion of computer memory space to peripheral devices. The Motorola 6800 and 68000 microprocessors use memory-mapped I/O.

The advantage of memory-mapped I/O is that existing processor instructions serve the dual purpose of interfacing to memory and to I/O devices. The disadvantage is that the full range of memory is not available for program and data storage. In other words, memory-mapped I/O reduces the computer's maximum memory size. For 8-bit microprocessors with only about 64,000 possible memory locations, this loss of available memory can be a real limitation.

The Intel 8080 and Zilog Z80 microprocessors use a slightly different scheme. I/O devices are connected to the processor by the memory data bus, but special I/O instructions and signals on the control bus are used for the I/O process. Full memory capacity is available to the processor because special I/O addressing is used. Though the I/O devices are on the memory bus, they are in I/O space rather than in memory space. Figure 1 illustrates how I/O devices are connected to processors on the memory bus.

The second method of implementing I/O in a computer is to create a totally new bus, the I/O bus, which resembles the memory bus. The I/O bus has an address bus (called the *peripheral-address bus* to differentiate it from the *memory-address bus*), a second set of data lines, and a peripheral-control bus. The signals on the I/O bus may or may not resemble those of the memory bus. This system has the advantage of full memory capability but pays the price of creating a new set of instructions, called *I/O instructions*, and a second bus, the I/O bus. Figure 2 shows an I/O bus system.

Let's briefly discuss instructions before continuing. The memory-reference and I/O instructions belong to a class of instructions called *processor* or *machine* instructions. This class of instructions controls computer operations at the very lowest level. Each instruction can initiate only the simplest tasks, such as obtaining one piece of information from memory or dispatching one character to a peripheral device.

Programmers would face a tremendous task if they had to solve all problems by writing programs at this level of complexity. Therefore, the computer supplier usually provides a systems program or operating system which, in effect, provides a new set of instructions with far greater power. The new set of instructions is called a *high-level language* because the instructions, now referred to as *statements*, allow programming at a much higher level of complexity.

Digital Signals

We've briefly discussed the sets of lines called buses and have stated that the processor and other systems components send signals along these buses. Buses, of course, consist of metallic carriers upon which voltages may be impressed and currents made to flow.

The simplest signal that might travel along such a conductor is the presence or absence of voltage or current flow. This is a *binary* signal because it can assume only two states: present or absent. With a voltage-related signal, the voltage either is or isn't there: the voltage is either k volts or zero volts. Voltages are measured with reference to a zero point, usually called *ground*, which is often a heavy conductor interconnecting all components in a computer system.

Binary signals are the primary means of communication in computer systems because the circuitry required to generate and detect mere presence or absence of a signal is much simpler to construct than circuits concerned with "how much" signal is present. Simplified circuitry allows construction of highly complex processors because binary circuits require much less space than other types. This is the key to construction of LSI (large-scale integrated) circuitry, which incorporates thousands of circuits on a small silicon chip.

Buses are simply sets of parallel conductors upon which binary signals can be impressed. The most common binary signal at present is the TTL level set. TTL (transistor-transistor logic) is a family of integrated circuits which constitute the building blocks for many of today's computers. These digital circuits not only define presence or absence of signal as valid binary signals but also define regions of voltage for proper levels. Those regions are:

High region = 2 to 5 volts
Undefined region = 0.8 to 2 volts
Low region = 0 to 0.8 volts

Voltages in the undefined region mean neither high nor low.

As long as the circuits that send and receive signals agree on the levels to be used, we have a hardware system for transmitting signals. We will see that one of the tasks of I/O circuits is to convert signal levels used by one portion of the system to those used in another. Unfortunately, not all peripheral devices use TTL levels. All the computer buses that we will discuss do use these levels.

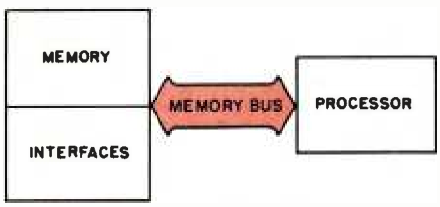

Figure 1: *A computer system with memory-mapped I/O (input/output). The I/O interfaces communicate with the processor over its memory bus. As a result, the processor has less memory space available for its own use, but there's no need for I/O instructions in its instruction set.*

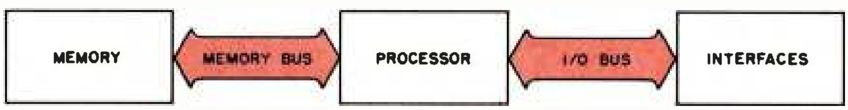

Figure 2: *A computer system with an I/O bus in addition to a memory bus. Building in a separate I/O bus frees all the memory-address space for the processor's own use.*

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Data Representation

After establishing signal levels, we must reach an agreement on what the various signals represent. What will be the digital representation of the character "A" or the number "123"? The alphabet can assume any of 26 values. Numerals can assume an infinite number of values. How can two levels—on and off—represent all these values?

The answer is to use more than one signal line, thus creating a bus. If we use eight lines, each of which can assume one of two levels, then we can represent 2 raised to the eighth power or 256 values. This is sufficient to represent all of the characters in the alphabet (both uppercase and lowercase) and the other printable characters and punctuation marks on a typewriter, along with a few special characters.

Communication is possible with eight lines as long as the sender and receiver agree on what each of the 256 values represents. The second task of I/O is to assure agreement between sender and receiver or at least to convert from one set of values to another.

In addition, not all devices communicate on the same number of lines. Some use a single wire (plus ground) and send one bit (binary digit) of information at a time. The receiver reassembles these sequential bits of information into a "parallel" representation (e.g., eight bits of data stored on eight parallel data lines). Some devices need only send numerals, which can be represented with ten values and require only four digital signal wires (because binary 1010, which has four bits, is decimal 10). Other forms of representation may require 16, 24, 32, or 64 lines, complicating interconnection. Interfacing among these devices must somehow adapt one system of representation to another.

The I/O Bus

We've just discussed several basic concepts relating to computer systems and I/O. Now we can give the programmer a means of questioning the computer and the computer a means of answering those questions.

The first step is to create an I/O bus leading from the processor to the outside. As stated earlier, the I/O bus is a set of conductors carrying signals that represent the information the computer is trying to transmit from the processor to the peripheral.

In addition, several conductors carry control signals that let the computer signal the recipient that the data on the bus is valid and should be accepted. The recipient must have some signals to notify the processor of the recipient's readiness to accept data and of its operational status. Finally, since we want the computer to be able to receive and transmit data, a signal is needed to dictate the direction of the data flow on the I/O bus.

The I/O bus shown in figure 3 has a number of connections. The topmost connection, with arrowheads at both ends, represents a group of 16 data lines. This connection is the data bus; the arrowheads indicate that the data bus can carry data in either direction, depending on the processor's immediate need. Beneath the data lines is a single wire labeled "strobe." The strobe is the bus synchronizer; the computer uses the strobe to indicate that data is ready to be accepted.

The next wire in figure 3 is labeled "I/O" and controls the direction of the data on the data bus. The I/O wire is the traffic cop of the I/O bus, allowing bidirectional data flow in only one direction at a time. The peripheral signals the computer on wires labeled "status" and "flag." Status is a simple signal indicating presence or absence of a peripheral to receive data. After all, a computer can't communicate with a device that's not there.

Flag is a more complex signal. To understand flag, we need to study speed. Computer processors are very fast; the only moving parts inside them are the speedy electrons carrying digital signals. On the other hand, devices with which computers communicate are often mechanical. Disk and tape mechanisms, printers, and plotters all have moving parts that

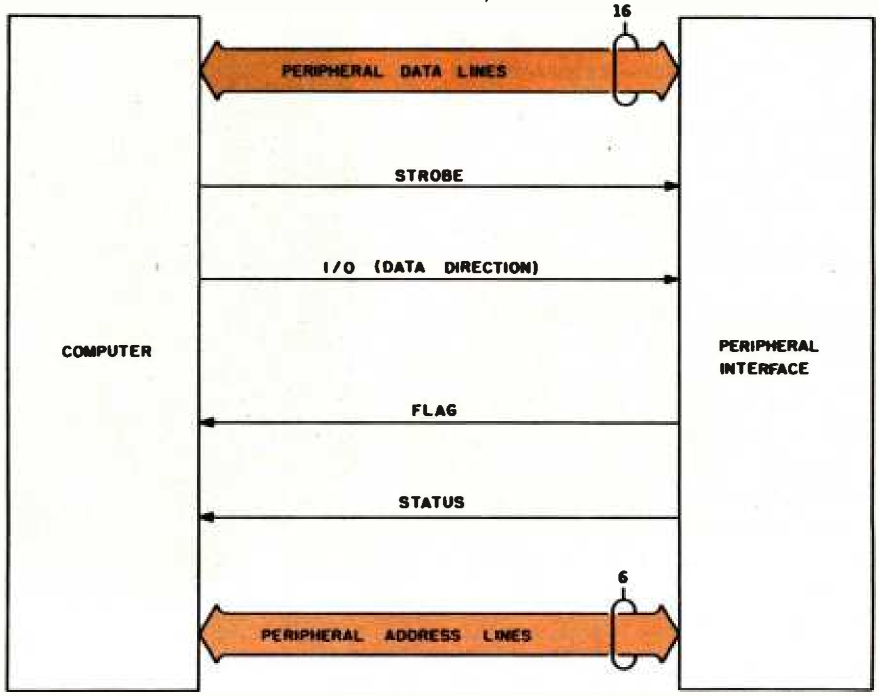

Figure 3: *An I/O bus like that used by Hewlett-Packard. The bidirectional data lines carry information between the computer and the peripheral-device interface. The computer uses the strobe line to tell the peripheral device that data is ready to be accepted. The I/O line informs the peripheral of the direction of data transfer. The peripheral device uses the flag line to ask the computer to delay sending more data. The status line tells the computer whether or not the peripheral device is attached.*

take relatively long periods of time to perform their assigned tasks.

Take a printer for example. Let's study an interchange between a computer and a piece of paper. The computer first addresses the printer interface using the last set of wires in the I/O bus diagram, the *peripheral-address lines*. If there's a device at that address, it will respond by signaling the computer on the status line. If the response is positive, the computer sets the I/O line to "output" (direction is always from the processor's perspective), places data on the data lines, and causes the strobe line to indicate the data's availability. If the printer is working, it accepts and prints the data.

A serial impact printer, much like a typewriter, must select the proper character, activate some mechanism to strike the paper, and then move to the next character position.

These steps may take 10 milliseconds (0.01 seconds) or so to perform. That may not seem like a long time, but the processor takes about one microsecond (0.000001 seconds) to send the command to print. From the processor's perspective, the printer takes forever.

Fortunately, computers are patient and will obey if told to wait. In our example, the computer will not send another character until the printer has printed the current one. The flag line carries the printer's signal asking the processor to wait.

That completes our discussion of computer input/output. As we've seen, the computer remains firmly in control of the entire process. Next month, we'll look at those cases in which the I/O peripheral takes control of the computer: interrupts and direct memory access. ■

An I/O Glossary

Learning the terminology and jargon is one of the most difficult problems encountered when entering a new technical field. Every discipline has its own unique vocabulary, and the world of computer input/output is no exception. This glossary should help the reader who is unfamiliar with the computer terms in the I/O Primer, although the glossary is not comprehensive and its definitions are not necessarily universal.

accumulator: a register inside the computer processor that stores operands and receives the results of operations. A computer may have several accumulators.

alphanumeric: representing letters and numbers.

ASCII (American Standard Code for Information Interchange): a 7-bit code capable of representing letters, numbers, punctuation marks, and control codes in a form acceptable to machines.

analog: varying continuously rather than in steps. Contrast this with **digital**. A rheostat is an analog device; an on-off switch is digital.

analog-to-digital conversion (also

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A to D, ADC, or A/D): the conversion of continuously varying phenomena (e.g., voltages) into discretely varying or "stepped" phenomena.
APL: a high-level computer language considered by many to be the strongest language for mathematical procedures and algorithms. APL uses specially developed arithmetic operators.
assembly language: a low-level computer language for implementing higher-level functions. One assembler statement produces one machine instruction.
asynchronous device: a unit that operates at a speed not associated with any particular portion of the system to which it is connected; it therefore is not a time-critical component. Not to be confused with the asynchronous serial interfaces which are synchronous devices.
asynchronous data communications: a serial I/O protocol in which each byte transmitted is self-sufficient and bears no exact time relationship to preceding or succeeding bytes.
background program: that portion of the resident computer program that is run when the system has no other needs for the processor. Found only in multitasking systems.
base: the radix or number of characters in a particular number system. The decimal number system is base 10, since 10 numerals (0 through 9) are used.
BASIC (Beginners All-purpose Symbolic Instruction Code): a high-level language that is particularly easy to learn. Although this is the native language of most microcomputers today, there are many incompatible dialects.
baud rate: term often used to mean *bit rate* or *data rate*, the rate in bits per second at which information is transmitted over a serial link. In data transmission over analog channels such as the phone line, the baud and data rates may not be the same.
BCD (binary-coded decimal): a 4-bit system of coding the numerals 0 through 9. The 6 most significant codes of the 4-bit system are unused because 4 bits can represent 16 different numbers.
benchmark: a test program used to compare a feature, usually speed, of two or more systems.
bidirectional lines: lines that may carry information in either direction but not in both simultaneously.
binary: the base-2 number system, which uses only the numerals 0 and 1.
bipolar: an integrated-circuit technology characterized by high speed, medium power requirements, and wide availability.
bisync (binary synchronous): a synchronous, serial data-communications protocol that is byte-oriented. Created by IBM.
bit (binary digit or binary integer): a single digit of a binary number.
bit rate: see **baud rate**.
bus (plural buses): a group of hardware signal wires used to interconnect several devices for communication.
byte: a group of 8 bits.
character: a pattern which is meaningful in a semantic system and which does not consist of smaller meaningful units; an "atom" of meaning.
character set: a group of characters that, taken as a whole, can express all the information desired in a particular system.
checksum: a quantity used in several error-checking schemes. The checksum usually follows a string of characters.
chip (also integrated circuit): an electronic component made up of many basic devices, such as transistors, all combined on a single piece of silicon.
CMOS (complementary metal-oxide semiconductor): a logic family of integrated circuits characterized by extremely low power requirements, medium speed, wide availability, and susceptibility to static discharge.
clock: a periodic signal used throughout a system for timing and synchronization.
compiler: a program that takes a high-level language as its input and produces machine code for output.
compute-bound: adjective describing a program that is speed-limited by the computations being performed rather than by the I/O taking place.
control character: a character that produces some action in a device other than the printing or displaying of a character. A normal character may become a control character in some systems by being prefixed with a control character or characters.
controller: the device that dictates the sequence of events in a system.
control line: a signal line used to sequence the flow of information over a data link.
CRT (cathode-ray tube): a term often used synonymously with *video-display terminal*, of which the CRT is a part; a popular display device used to show multiple lines of text and/or graphics.
data bus: a set of signal wires that carries data or characters between devices in a system.
data communications: generally taken to mean serial data I/O but may include any I/O between digital devices.
data set: Bell Telephone's name for a modem. Used to transmit digital data over voice telephone lines.
data terminal: a class of devices with keyboards and video displays, a video-display terminal.
decimal: pertaining to the base-10 number system.
digital: a method of representing information with discrete numbers.
digital-to-analog (also D to A, or DAC, or D/A) conversion: a technique for converting a digital representation into a simulated analog signal.
DMA (direct memory access): an I/O technique for transferring data between a device and memory without the aid of the computer processor. A very high-speed method that requires special hardware to control memory.
DTL (diode-transistor logic): a

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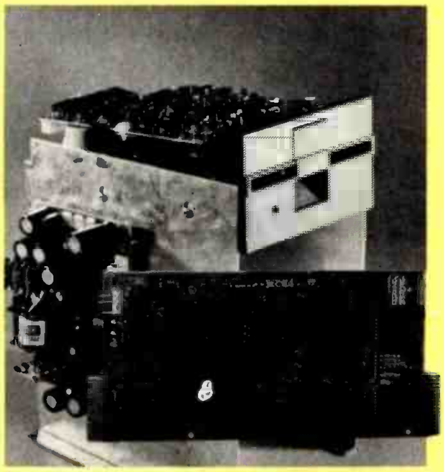

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EBCDIC (extended binary-coded decimal interchange code): a special IBM character set seldom used in microcomputers.

emulator: a program or circuit that imitates another program or circuit in real time. Usually, the emulator provides testing and monitoring capabilities beyond those of the program or circuit being emulated.

erasable programmable read-only memory (also EPROM): an integrated circuit that can store programs or data which can later be erased. Information is stored, with or without power, until the erase procedure is activated. There are two types of EPROM: ultraviolet-erasable EPROM, and electrically erasable programmable ROM (EEPROM). EPROMs are common in development work because they can be reused.

exponent: the power of 10 of a number expressed in scientific notation. The exponent of the number

$$1.245 \times 10^{15}$$

is 15.

fan in: the electrical load a logic circuit places on a signal line.

fan out: a measure of the drive capability of a logic circuit.

firmware: a program (software) placed in ROM. Many microcomputers have firmware operating systems and language interpreters.

flag line: a signal line used in a data link to signal the status of a device connected to the data link.

foreground job: a program that has the highest priority and runs on the computer processor whenever possible. Found only in multitasking systems.

full duplex: (in a communication channel) capable of simultaneous transmission in both directions. The term is also used (incorrectly) to describe data terminals that do not "self-echo" on their screens the characters they send, relying instead on the remote terminal to echo each character sent. Contrast

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executes a high-level language.

interrupt: a disruption in a process's normal flow.

inverter: a logic element or gate that outputs a 1 for a 0 input and a 0 for a 1 input. Also called a NOT gate.

I/O-bound: adjective describing a program whose speed is limited by the information interchange between devices in a system rather than by the computation being done.

K: abbreviation for 1024, typically used to specify memory size because 1024 is a power of 2.

k: abbreviation for 1000, typically used to specify resistor values and computer prices.

kluge: a concoction of hardware and software, usually extensively patched together and not easily manufactured. Most commercial computers have several kluges.

latch: a logic device that transfers input data to output during a clock-signal transition and holds the data after the clock transition, regardless of whether or not the input data changes; used for memory.

LCD (liquid-crystal display): a display device characterized by high visibility in high light levels and no visibility in darkness.

LED (light-emitting diode): a display characterized by high visibility in darkness and less visibility at higher light levels.

logic: a group of circuits that performs Boolean arithmetic and memory functions.

logic ground: the reference level for all the digital signals in a system. Not necessarily connected to, or at the same potential as, the earth ground.

LSI (large-scale integration): highly dense logic circuits on single chips. Microprocessors are LSI devices.

machine code: the instructions directly executed by the processor.

mainframe: term originating in large data-processing installations where sometimes small, remote processors are connected to a large, central "mainframe" computer. Often used now to refer to the central control and interface unit of any computer, not including devices attached by external cabling.

mantissa: the significant digits of a number expressed in scientific notation. The mantissa of the number

$$1.245 \times 10^{15}$$

is 1.245.

mass storage: a device for storing large amounts of data or programs in a readily retrievable, nonvolatile form.

MOS (metal-oxide semiconductor): an integrated circuit technology characterized by high density, medium speed, and medium power consumption. Two types of MOS exist: NMOS and PMOS, in addition to the related CMOS technology.

modem: see **data set**.

multitasking: a mode of computer operation in which several processes seem to take place simultaneously. In a multiprocessor system, simultaneous operation is truly possible. In a single-processor system, the processes timeshare the processor, and, although they appear to be happening simultaneously, they are actually occurring in a sequential manner. Multitasking operation allows a computer to make computations while waiting for slower I/O processes to take place. Also called *overlap*.

negative-true logic: a logic system in which a low voltage represents a logic 1 and a higher voltage represents a logic 0.

network: a term used in serial data communications to describe devices that have varying amounts of intelligence interconnected to form a large system.

noise: in a communication system or circuit, a disturbance which conveys no information and may interfere with the flow of information or meaningful signals.

nonvolatile: capable of retaining information even when a device is switched off; ROMs, disks, and tapes are nonvolatile.

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nybble: half a byte or 4 bits. BCD data is packed into nybbles.

object code: a program in machine code. The ultimate form a program must take to run on a processor.

octal: a base-8 number system using the numerals 0 through 7. Applied in the creation of machine-code programs and helpful in visualizing bit patterns.

one's complement: the inversion of each bit of a binary number. All 1s become 0s and all 0s become 1s.

one's-complement arithmetic: a binary arithmetic system in which negative numbers are created by inverting individual bits in the corresponding positive-number representation. There are two 0s: all binary 0s (+0) and all binary 1s (−0).

open collector: a type of output structure found in certain bipolar logic families. The device has a transistor that enables it to output to a low-voltage level only. When the device is inactive, an external resistor holds the device's output at a high-voltage level. Open collector devices are useful when several devices are to drive a single bus line (such as the IEEE-488 bus).

operating system: the software that controls and coordinates all the hardware elements in a computer system.

output: transfer of information from a computer to another device.

overlap: see **multitasking**.

packed data information that has been compressed to make optimal use of data storage. Four BCD digits may be packed in one 16-bit word.

paper tape: one of the oldest, slowest, and cheapest methods of storing information in a computer system. Data is stored in punched-hole sequences on a paper tape. Still the only universal medium of interchange between computer systems.

parallel I/O: the fastest, simplest method of interconnecting two devices; requires the least circuitry. Data is transferred in bit-parallel format, with the width of the interconnect bus generally equal to the word size of the processor or the peripheral. Eight-bit parallel interfaces are common and ideal for character transmission.

parity: an error-detection method used in I/O in which noise is a possible problem. Parity is determined by counting the number of 1s in a data word. If the number of 1s is odd, the word has odd parity; if the number of 1s is even, the word has even parity.

Pascal: a computer language that is popular for its structure and data types but has relatively primitive I/O statements.

peripheral: a device connected to a computer for providing data to, or accepting data from, the external environment.

peripheral processor: an auxilliary processor used to interface to external devices. Generally provided to increase system performance by allowing simultaneous computation by the main processor and I/O by the peripheral processor.

polling: a technique that discerns which of several devices on an I/O connection is trying to get the processor's attention. In a simple form, the processor may periodically interrogate each peripheral device to determine its status.

positive-true logic: a logic system in which a logic 0 is represented by a low voltage and a logic 1 by a higher voltage.

priority interrupt: an interrupt structure in which devices with higher priority may interrupt the servicing of devices with lower priority. In other systems, priority may only be used in the arbitration of simultaneous interrupts, disallowing interruption of an in-process interrupt-service routine.

program: a series of statements defining a process or procedure in a form that can be executed by a computer.

programmable read-only memory (PROM): a logic circuit that may be programmed once in a PROM programmer; stores data and/or instructions that are unlikely to need change. Also comes in erasable models (EPROMs).

protocol: a set of conventions for transfer of information between devices. The simplest protocols define only the hardware configuration. More complex protocols define timings, data formats, error-detection and correction techniques, and software structures for running the interface. The most powerful protocols define each level of the transfer process as a layer separate from the rest, so that some layers, such as the interconnecting hardware, may be changed without affecting the other layers.

queue: a list of processes to be executed in sequential order or of information blocks to be processed in sequential order.

random-access memory (also RAM): read/write memory in which the time needed to write in or read out data is independent of the data's location, usually refers to volatile semiconductor memory.

read-only memory (also ROM): memory devices in which the memory locations are set to fixed patterns when the device is manufactured. Used for invariant programs and data.

read/write memory: memory that can store information on a temporary basis. Usually, the information disappears when the power is turned off.

real-time clock: a device that continually measures time in a computer system without respect to what tasks the computer is performing.

real-time operation: computing at a speed sufficient to perform the required tasks during a related physical process so that results of the computations can help control the process. A program that closes the flood gates after the town is under water is not running in real time.

register: a device used for temporarily holding a piece of information to be processed or transferred.

schematic: a drawing that shows the interconnections of circuitry to form a device. Generally needed when interfacing two devices that are not plug-to-plug compatible and sometimes when interfacing those that are.

SDLC (synchronous data-link control): a protocol specifying a layered, bit-oriented approach to serial data communications.

serial I/O: a type of interconnection in which information is transferred one bit at a time. The most common serial I/O hardware schemes are the RS-232 standard and the 20-mA current loop. Both are pseudo-standards because most devices using them work similarly but are not plug-to-plug compatible.

simplex: a unidirectional implementation of an I/O protocol.

simulator: a circuit or program that imitates another circuit or program but not at the same speed.

software buffer: a location or set of locations in memory given a name by the resident program and used to hold information until needed.

software driver: a program or routine that transmits information to a device by using a device-dependent protocol.

software interrupt: interruption of a user-level program in response to the acknowledgment of a hardware interrupt by the operating system. In high-level language programs, software interrupts can safely occur only at the end of a program line.

status: information about a device's current state.

status line: a simple method of representing some state of a device in an interconnection scheme.

string: a set of characters ordered in some manner.

strobe: a control signal for information transfers at the hardware level.

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synchronous data communication: a serial I/O protocol in which the transmitter and receiver are synchronized to a common clock signal.

synchronous device: a device that transfers information at its own rate, not at the convenience of any other interconnected device. Synchronous devices, such as disks, must be serviced when they request service, or data is usually lost.

synchronous transfer: an I/O transfer that takes place in a certain amount of time without regard to feedback from the receiving device. The receiver must always be faster than the transmitter for such transfers to work properly.

threshold: the point of transition between two logic states. For example, 4.5 V might be a threshold for low/high transitions.

transceiver: a circuit or device capable of transmitting *and* receiving.

transistor-transistor logic (TTL): a logic family characterized by high speeds, medium power requirements, and wide use.

Tristate (or three-state; Tristate is a trademark of National Semiconductor Corporation): an output configuration, found in several logic families, capable of assuming three states: logic high, logic low, and high-impedance. Useful for interconnecting many devices on the same set of wires in such a way that only one device at a time controls the levels on the lines while the other devices are in the high-impedance state.

two's complement: a one's complement to which 1 is added.

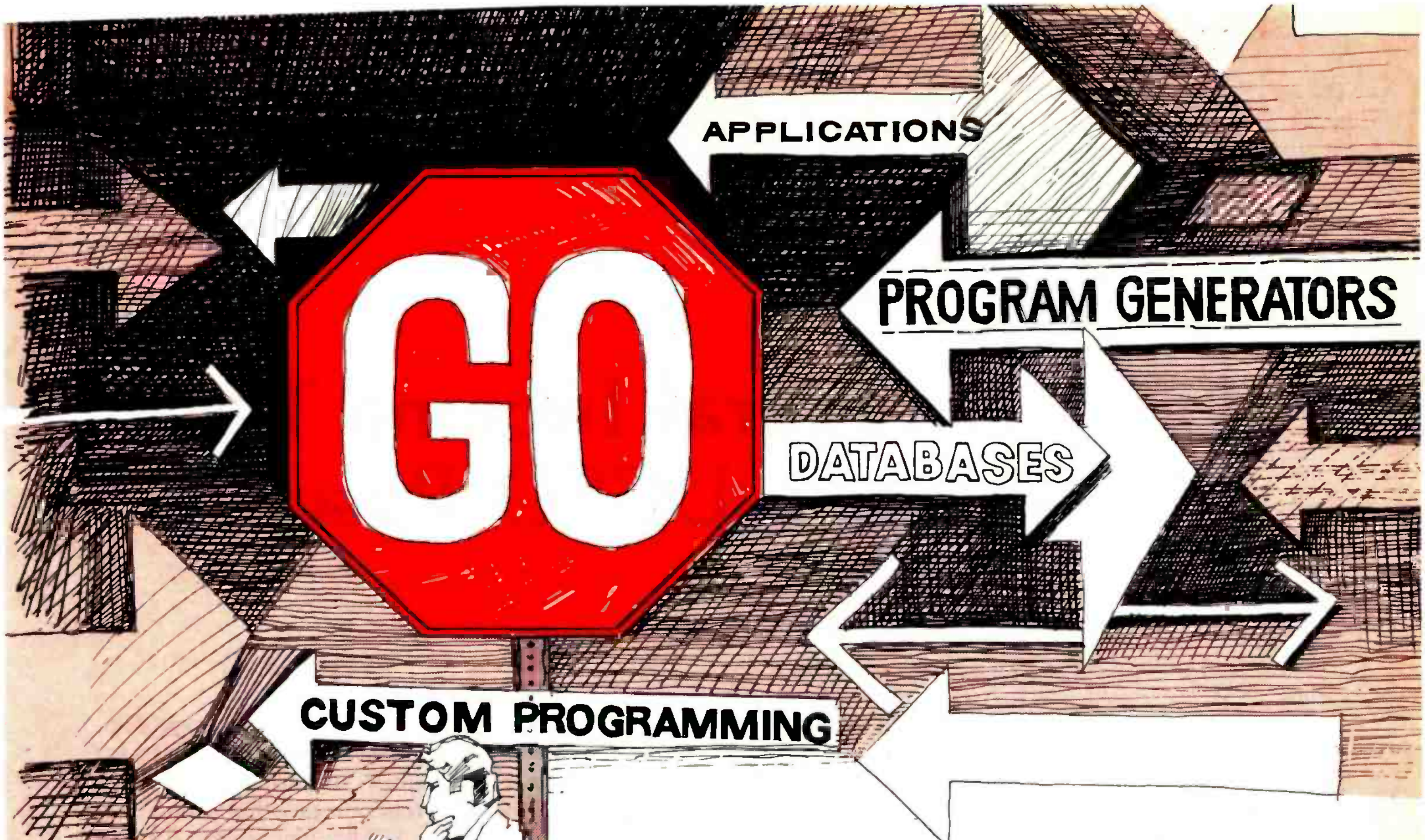
universal asynchronous receiver/transmitter (UART): a logic device used to convert from parallel to serial and serial to parallel in the asynchronous serial data communications format.

universal synchronous/asynchronous receiver/transmitter (USART): a UART with additional capability for synchronous serial data communications.

vectored interrupt: an interrupt scheme in which each interrupting device causes the operating system to branch to a different interrupt routine, thus saving the time otherwise required for a poll to determine the interrupting device's identity. The Zilog Z80 has an advanced vectored-interrupt scheme.

voice channel: a transmission channel originally designed for voice transmission, such as the telephone line. Modems can transmit digital information over these channels for long-distance data communications.

word: the smallest unit of information that may be handled conveniently ("addressed") by a computer. Most microprocessors use 8-bit words called bytes. Some of the latest microprocessors, however, use 16-bit words. Usually, the larger the word size, the faster data may be processed. ■



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FIT—A Federal Income Tax Program in UCSD Pascal

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Does Uncle Sam withhold too much from your paychecks all year and then send you a refund without paying you interest on the excess amount withheld? Do you miss deductions when you make out your tax forms because you forget some items or fail to keep records in a way that makes deductions easy to find? Do you miss other tax breaks by choosing investment strategies without analyzing the tax consequences?

If you have access to a computer that runs UCSD Pascal, FIT, my federal income tax program, can help you with these problems. First, FIT will estimate your correct tax during the year. This will enable you to adjust the amount of withholding in order to increase your take-home pay, minimize your refund, and earn interest on income that Uncle Sam would routinely withhold. If interest rates are 15 percent, your loss during the year from excess withholding is about (.15)×(9/12)×(REFUND). A $1000 refund means you lose $112.50 in interest—almost enough for a new board, a modem, or some useful software.

FIT also provides a convenient way to collect tax data as they arise. With April 15 swiftly approaching, you won't have to spend hours searching for and organizing data. Also, since FIT makes calculating your taxes easy, you can use it to see how different kinds of investments would affect your obligations to Uncle Sam.

What FIT Does

FIT lets you enter tax data for all the lines on form 1040 and Schedules A and B. (Schedule A is for itemized deductions; Schedule B for dividends and interest income.) At your option, you can enter data sequentially without entering the line numbers, or you can type a line number to enter data for a single line or to correct an entry. FIT permits multiple entries for each line. That saves you the trouble of adding totals for each line before entering data. For joint returns, FIT lets you assign a data entry to either the husband or wife.

FIT then processes the data, consolidating Schedules A and B in form 1040, making all adjustments, and calculating the tax according to your filing status and number of dependents. FIT makes calculations for individuals, married persons filing separately, or married persons filing jointly.

FIT displays data on either the console or the printer. The program stores data in disk files for retrieval. It will also store multiple files under different names so that you can save tax data for different years, taxpayers, or scenarios. The ability to store multiple files is what makes FIT a good tool for analyzing the tax consequences of different investment strategies.

BYTE has made no independent evaluation of the accounting sufficiency of FIT. We also note that future changes in the tax laws should be reviewed for changed data and computational requirements.

How to Use FIT

FIT starts by displaying the following prompt:

```
FIT COMMAND--> P)rint E)dit C)alculate R)ead
                     W)rite Q)uit
```

The ")" indicates that the preceding letter is typed to invoke the desired command. Unless you are using the program with data previously stored in a disk file, you should begin with the Edit command. Just type E.

Editing

Typing E after the main prompt brings the editing prompt:

```
EDIT COMMAND--> A)sched A B)sched B Z)Form
            1040 F)Filing Status Q)Quit
```

Listing 1: *Sample data for line 8 of form 1040 as produced by FIT, a federal income tax program. The line at the top presents options to the user. Pressing <ESC> accepts the data, pressing control D deletes them, and pressing N, A, or W permits change of the name, amount, or assignment (to husband or wife).*

```
COMMAND -->  <ESC> to continue   ^D)elete   Change --> N)ame  A)mount  W)hose

LINE NUMBER  8              WAGES,SALARIES,ETC

GF INDUST

HUSBAND

AMOUNT      24590.00
```

To enter the taxpayer's name, the tax year, the filing status, and the number of dependents, type F. After you complete the entries under filing status, the EDIT COMMAND prompt line reappears. Choosing A, B, or Z brings the prompt:

EDIT COMMAND--> S)equentially I)ndividual lines Q)uit

Sequential editing lets you enter data for one line at a time, skipping the lines that represent calculations based on data from other lines. FIT automatically fills in the calculated values later. If you choose I for editing individual lines, this prompt appears:

ENTER LINE NUMBER TO BE CHANGED 0) for help

Entering 0 causes the display of a list of the names and numbers of the lines on the form you are using. When you enter a line number, FIT displays each current entry for that line. You will see the prompt:

COMMAND--> ESC to continue ∧ D)elete Change— N)ame A)mount W)hose

The screen also shows:

- the number and description of the line
- the name of the previous entry
- to whom the entry was assigned (husband or wife)
- the amount

You can accept the entry by pressing ESCAPE, delete the entry by pressing control D, or change the name, amount, or assignment of the entry by pressing N, A, or W. If the filing status is other than married, FIT won't show assignment of the item to husband or wife. Listing 1 shows an example of data displayed for line number 8.

When no data have been previously entered for a line, or when all the entries have been displayed, FIT asks:

DO YOU WANT TO ADD AN ITEM Y/N

Answering Y results in a prompt to input data. Answering N brings a display like the one in listing 2, which shows a summary of the data for the current line. If you are doing sequential editing, the program proceeds to the next line number. If you are editing individual items, the screen asks whether you want to continue editing or quit.

The Edit mode takes you from form to form until you have had an opportunity to fill in all the items. Whether doing sequential editing or individual-line editing, you leave the Edit mode by typing Q for Quit.

When you leave the Edit mode, you again see FIT's main prompt line:

FIT COMMAND--> P)rint E)dit C)alculate R)ead W)rite Q)uit

Calculating

To calculate the taxes for an individual, just press C at the main prompt. If the filing status is "married," however, FIT asks whether to calculate your taxes for a married couple filing jointly, a married couple filing separately, or two unmarried individuals. (The law doesn't give married couples the option to file as two unmarried individuals, but a couple may want to see what their taxes would be if they were single.)

FIT does all the calculations for Schedules A and B and enters the results in form 1040. Then it does the calculations for form 1040 itself. The tax is calculated using the correct tax table for the filing status entered. The calculation takes only about 1.5 seconds and then you return to FIT's main prompt.

Printing

Typing P at the main prompt brings the prompt:

PRINTER COMMAND--> A)schedule A B)schedule B Z)Form 1040 #)for detail

You can print any of the three forms, with totals for each line, by pressing the letter indicated. If you want to see all the data entries for each line in addition to the totals, you press # (for detail) *before* selecting a form. Whether or not you choose detail, you are asked to direct the output to the printer or the console screen.

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Listing 2: *A summary of the FIT data for line 8 of form 1040. FIT is running in the individual-line editing mode. Typing Q takes the user out of the Edit mode. If the user chooses to continue, FIT asks for the number of another line to edit.*

```
                  DO YOU WANT TO -->  C)ontinue   Q)uit

           LINE NUMBER  8           WAGES,SALARIES,ETC

                       HUSBAND           24590.00

                          WIFE           18500.00

                         TOTAL           43090.00
```

Listing 3 shows a sample printout for form 1040, listing 4 shows a printout for Schedule A, and listing 5 shows a printout for Schedule B. Listings 3 and 4 show totals only, but listing 5 was produced with the # option to show detailed entries for each item. FIT's printout of form 1040 adds a line at the end, MAXIMUM TAX BRACKET, to tell you the percentage used to calculate the last dollar of tax.

Reading and Writing

We've now seen all the commands in FIT's main prompt except for the Read and Write commands. If you want to read in a file of data or write a file, FIT asks for a file name (8 characters in the primary name; no extension required). If you use the Write command and enter the name of an existing file, FIT lets you choose a different file name or overwrite the existing file.

How FIT Works: Data Structures

The best way to learn how a program works is to look at the data structures first. Pascal conveniently puts them at the beginning of a program or procedure. FIT's main data structure is a record—a collection of a fixed number of related data items—named TLINE. TLINE, declared on the first page of listing 6, is a record of type variant. Records of type variant may contain variables that differ in the number and type of their components. The most important variant in the record TLINE is variant 1. It contains three long integers: one for amounts assigned to the husband, one for amounts assigned to the wife, and one for amounts assigned to the total for husband and wife. Variant 1 also contains a *pointer* to a data type called ITEM (these are discussed later).

Variant 2 holds data on the filing status, and variant 3 holds the name of the taxpayer.

FIT has one TLINE record for each line in form 1040, Schedule A, and Schedule B. An array called TLINES contains all the TLINE records. I put all the records for the three forms in a single array in order to speed access to data on disk. The index of the array—the number used to reference items in the array—is an integer between 1 and maxline. Here is how the TLINE records are stored in the TLINES array:

Form 1040	INDEX IN [1 TO 66]
Schedule A	INDEX IN [66+1 to 66+41]
Schedule B	INDEX IN [107+1 to 107+8]

I wanted the program to let me enter individual data items for each line, rather than make me sum all the individual data items myself and then enter the sum. One way to provide this multiple-entry feature is to construct an array for each line number to hold all its data items. This approach would require placing a reasonable limit on the number of data items per line, and then reserving memory space for that number of items for each line. If I set a maximum of 20 data items per line, the program

Text continued on page 162

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"This compiler is presently an incomplete implementation of the Ada programming language. It is intended that this compiler will be further developed to enable implementation of the complete Ada programming language, and then to be submitted to the Ada Joint Program Office for validation."

*Ada is a trademark of the Department of Defense (Ada Joint Program Office)
*CP/M is a registered trademark of Digital Research

Listing 3: *A sample FIT printout of federal income tax form 1040.*

```
*****************************************************************************
MARY & JOE MICRO                    TAX YEAR 1980                  FORM 1040
FILING STATUS 2              EXEMPTIONS 3                          6 Mar 1981
*****************************************************************************
                                             HUSBAND       WIFE       TOTAL
 8   WAGES,SALARIES,ETC                     24590.00   18500.00    43090.00
 9   INTEREST INCOME                          622.50     150.00      772.50
10   DIVIDENDS                                375.50     575.50      951.00
11   INCOME TAX REFUNDS                            0     125.25      125.25
12   ALIMONY RECEIVED                              0    2000.00     2000.00
13   BUSINESS INCOME                        -2385.00          0    -2385.00
14   CAPITAL GAIN                            -250.00     150.00     -100.00
15   CAPITAL GAIN DIST                             0          0           0
16   SUPPLEMENTAL GAINS                            0          0           0
17   TAXABLE PENSIONS & ANNUITIES                  0          0           0
18   PENSIONS,RENTS,ROYS,PARTNER              560.00          0      560.00
19   FARM INCOME                                   0          0           0
20   UNEMPLOYMENT                                  0          0           0
21   OTHER INCOME                                  0          0           0
                                          ----------  ----------  ----------
22   TOTAL INCOME                           23513.00   21500.75    45013.75
=============================================================================
23   MOVING EXPENSE                                0          0           0
24   EMP BUSINESS EXPENSE                          0          0           0
25   PAYMENTS TO IRA                               0          0           0
26   PAYMENTS TO KEOGH                             0          0           0
27   INTEREST PENALTY                         125.00          0      125.00
28   ALIMONY PAID                            4000.00          0     4000.00
29   DISABILITY INCOME                             0          0           0
                                          ----------  ----------  ----------
30   TOTAL ADJUSTMENTS                       4125.00          0     4125.00
=============================================================================
31   ADJUSTED GROSS INCOME                  19388.00   21500.75    40888.75
32   ADJUSTED GROSS INCOME                  19388.00   21500.75    40888.75
33   DEDUCTIONS                              6025.15     261.70     6286.85
                                          ----------  ----------  ----------
34   32-33                                  13362.85   21239.05    34601.90
35   TAX                                     2272.34    5215.77     6830.37
36   ADDITIONAL TAXES                              0          0           0
                                          ----------  ----------  ----------
37   TOTAL TAXES                             2272.34    5215.77     6830.37
=============================================================================

*****************************************************************************
MARY & JOE MICRO                    TAX YEAR 1980                  FORM 1040
FILING STATUS 2              EXEMPTIONS 3                          6 Mar 1981
*****************************************************************************
                                             HUSBAND       WIFE       TOTAL
38   POLITICAL CONTRIBUTIONS                   50.00      50.00      100.00
39   CREDIT FOR ELDERLY                            0          0           0
40   CHILD AND DEPENDENT                           0          0           0
41   INVESTMENT CREDIT                             0          0           0
42   FOREIGN TAX CREDIT                            0          0           0
43   WORK INCENTIVE                                0          0           0
44   JOBS CREDIT                                   0          0           0
45   ENERGY CREDITS                           175.80          0      175.80
                                          ----------  ----------  ----------
46   TOTAL CREDITS (lines 38 to 45)           225.80      50.00      275.80
                                          ----------  ----------  ----------
47   BALANCE (line 37 - line 46)             2046.54    5165.77     6554.57
```

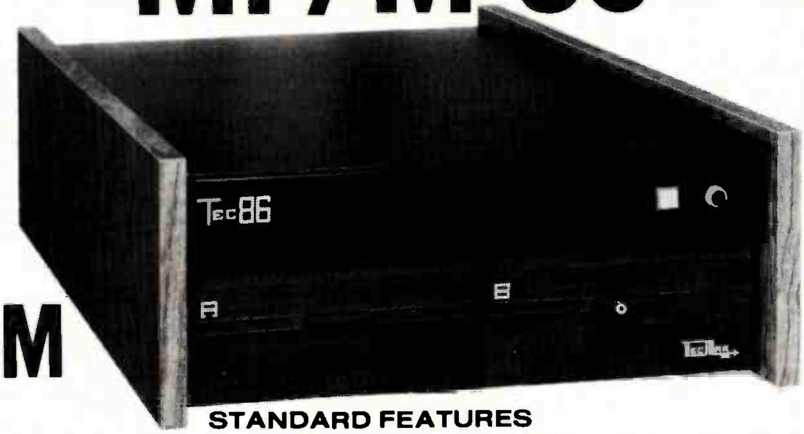
Listing 3 continued on page 159

16 Bit 8086 Multi-User Microcomputer System

FOR MP/M-86™

$7595
FOUR USER SYSTEM

ONLY $1899* PER USER



THE TEC 86M

1/2 MEGABYTE OF MEMORY

TWO 8 INCH D.D. FLOPPY DISKS

STANDARD FEATURES

16 BIT 8086 CPU - Processor performance is the most critical element in a Multi-User System. Speed, power and the increased throughput of our 16 Bit 8086 CPU are just a few of the reasons why our TEC 86M Multi-User Systems really perform.

1/2 MEGABYTE OF MEMORY - The second most important factor which affects system performance is available user memory. Our 1/2 Megabyte, four user system gives each user well over 100K Bytes of memory, eliminating program size compromises which lead to poor Multi-User system performance.

MP/M-86™ COMPATIBILITY - The TEC 86M includes a ROM Boot for MP/M-86™ and is designed to provide optimal support for MP/M-86™. The MP/M-86™ Operating System is available separately from Tecmar for $600. See Software Options listed below for important MP/M-86™ features.

FULLY INTERRUPT DRIVEN - The TEC 86M provides terminal and disk I/O interrupts to MP/M-86™, allowing for maximum system performance in Multi-User operation.

TWO 8 INCH DOUBLE DENSITY FLOPPY DISK DRIVES - The two Double Density floppy disks total 1.2 Megabytes of storage. Options include double sided floppy disk drives and Winchester drives.

FOUR SERIAL USER PORTS - Four serial user ports are provided. Each port can be independently set for speeds from 50 to 19200 Baud.

MULTIPLE PARALLEL PORTS - Parallel ports are provided for operating printers as well as other parallel devices.

EASILY EXPANDABLE - The modular design of the Tec 86 and Tec 86M assures you of continued system expandibility. All options are easily field installable. Available options include: Memory 64K and 256K, additional users, double sided floppy disks, Winchester 31 Megabyte hard disk, terminals, and printers.

ATTRACTIVE DESKTOP ENCLOSURE - Tecmar Single and Multi-User systems come in your choice of an attractive desk top enclosure with wood grained side panels to blend nicely into your office surroundings, or an industrial quality cabinet for more hostile environments. Rack mount enclosures are available as options.

ONE YEAR WARRANTY - Tecmar Systems are fully assembled and thoroughly tested. All Tecmar Components carry a full One Year Warranty.

SOFTWARE OPTIONS

MP/M-86™ - Multi-User interrupt driven Operating System for the 16 Bit 8086 TEC 86M Microcomputer System. FILE PASSWORD PROTECTION - Access to user files can be restricted to require proper passwords prior to access. CONCURRENT FILE ACCESS -Files may be accessed by multiple users, each reading and/or writing the same file, with protection provided at both the file and the record level. FILE TIME AND DATE STAMPING - Files contain creation, and modification Times and Dates for ease and accuracy in determining the latest or most useful file versions. PRINT SPOOLER - Files may be submitted to the System Spool file for printing. This frees the user terminal to continue operation during the independent printing function.

LANGUAGES - BASIC-86™ FORTRAN-86™ PASCAL-86™ CBASIC/86™ CIS-COBOL™ PASCAL/M86™ FORTH

*NOT INCLUDING MP/M-86 and User Terminals.

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ANALOG to DIGITAL CONVERTERS (12, 14, 16 bit accuracy; 30, 40, 100, 125 KHz Conversion rates; 16 to 256 Channels; programmable gain; timer/counters). **DIGITAL to ANALOG CONVERTERS** (12 bit accuracy, 3 microsecond conversion rate). 8086 CPU Board, I/O Boards 64K/256K Memory Boards, Real-time Video Digitizer and Display. Complete Systems also available for Data Acquisition, Video Digitization, and General Purpose Applications.

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Micro Printer Marketing

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VISA MasterCard

Listing 3 continued:

```
==============================================================================
48  SELF EMPLOYMENT TAX                         0          0          0
49  MINIMUM TAX                                 0          0          0
50  TAX FROM PRIOR YEAR INV-CREDIT              0          0          0
51  FICA AND RRTA TAXES                         0          0          0
52  TAX ON IRA                                  0          0          0
53  ADVANCE EIC PAYMTS RECEIVED                 0          0          0
                                       ---------- ---------- ----------
54  BALANCE (lines 47 to 53)              2046.54    5165.77    6554.57
==============================================================================
55  TOTAL FICA WITHHELD                   3590.00    3010.25    6600.25
56  1980 ESTIMATED TAX PAYMENTS                 0          0          0
57  EARNED INCOME CREDIT                        0          0          0
58  AMOUNT PAID WITH FORM 4868                  0          0          0
59  EXCESS FICA AND RRTA TAX PAID               0          0          0
60  CREDIT FOR FED TAX ON SP FUEL               0          0          0
61  REGULATED INVESTMENT CO CREDIT              0          0          0
                                       ---------- ---------- ----------
62  TOTAL (line 55 to 61)                 3590.00    3010.25    6600.25
==============================================================================
63  OVERPAID                              1543.46          0      45.68
64  TO BE REFUNDED TO YOU                       0          0          0
65  APPLIED TO EST 1981 TAX                     0          0          0
66  BALANCE DUE                                 0    2155.52          0
==============================================================================
  MAXIMUM TAX BRACKET                             32         43         37
```

Listing 4: *A sample FIT printout of Schedule A, itemized deductions.*

```
******************************************************************************
MARY & JOE MICRO                    TAX YEAR 1980                 SCHEDULE A
FILING STATUS 2              EXEMPTIONS 3                          6 Mar 1981
******************************************************************************
                                          HUSBAND       WIFE       TOTAL
 1  50 % OF MEDICAL INS PREMS               85.00          0       85.00
 2  MEDICINE AND DRUGS                      92.95      78.75      171.70
 3  1% OF LINE 31 FORM 1040                193.88     215.00      408.88
                                       ---------- ---------- ----------
 4  SUB TOTAL line 3-line 2                     0          0          0
 5  BALANCE OF INS PREMS                    85.00          0       85.00
 6  OTHER MEDICAL AND DENTAL               250.50     517.70      768.20
                                       ---------- ---------- ----------
 7  TOTAL (lines 4 to 6)                   335.50     517.70      853.20
 8  3% OF LINE 31 FORM 1040                581.64     645.00     1226.64
 9  LINE 7 - LINE 8                             0          0          0
                                       ---------- ---------- ----------
10  TOTAL MED & DENTAL                      85.00          0       85.00
==============================================================================
11  STATE & LOCAL INCOME TAX               458.85     480.45      939.30
12  REAL ESTATE TAXES                     1840.90          0     1840.90
13  GENERAL SALES TAXES                    150.90     250.50      401.40
14  PERSONAL PROPERTY TAXES                     0          0          0
15  OTHER TAXES                                 0          0          0
                                       ---------- ---------- ----------
16  TOTAL TAXES lines 11 to 15            2450.65     730.95     3181.60
==============================================================================
17  HOME MORTGAGE INTEREST                3650.00          0     3650.00
18  CREDIT & CHARGE CARDS                  225.50     350.75      576.25
19  OTHER INTEREST                              0          0          0
                                       ---------- ---------- ----------
20  TOTAL INT (lines 17 to 19)            3875.50     350.75     4226.25
```

Listing 4 continued on page 160

Listing 4 continued:

```
==========================================================================
21  CASH CONTRIBUTIONS                  659.00      770.00      1429.00
22  OTHER CASH CONTRIBUTIONS                 0           0            0
23  CARRYOVER                                0           0            0
                                    ----------  ----------  ----------
24  TOTAL CONTRIBUTIONS                 659.00      770.00      1429.00
==========================================================================
25  LOSS BEFORE INSURANCE              1500.00           0      1500.00
26  INSURANCE REIMBURSEMENT             895.00           0       895.00
                                    ----------  ----------  ----------
27  LINE 25 - LINE 26                   605.00           0       605.00
28  $100 OR LINE 27                     100.00           0       100.00
                                    ----------  ----------  ----------
29  TOTAL CASUALTY  OR THEFT            505.00           0       505.00
==========================================================================
30  UNION DUES                               0      110.00       110.00
31  OTHER MISC DEDUCTIONS               150.00           0       150.00
                                    ----------  ----------  ----------
32  TOTAL MISCELLANEOUS                 150.00      110.00       260.00
==========================================================================
33  TOTAL MEDICAL & DENTAL               85.00           0        85.00
34  TOTAL TAXES                        2450.65      730.95      3181.60
35  TOTAL INTEREST                     3875.50      350.75      4226.25
36  TOTAL CONTRIBUTIONS                 659.00      770.00      1429.00
37  TOTAL CASUALTY OR THEFT             505.00           0       505.00
38  TOTAL MISCELLANEOUS                 150.00      110.00       260.00
39  SUM (lines 33 to 38)               7725.15     1961.70      9686.85
40  ADJUSTMENT                         1700.00     1700.00      3400.00
                                    ----------  ----------  ----------
41  LINE 39 - LINE 40                  6025.15      261.70      6286.85
==========================================================================
```


Circle 10 on inquiry card. →


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Listing 5: *A sample FIT printout of Schedule B, interest and dividend income. To obtain this printout, which shows detailed entries rather than just totals, the user typed # before typing B on the printer command line.*

```
*************************************************************************************
MARY & JOE MICRO                        TAX YEAR 1980                    SCHEDULE B
FILING STATUS 2                   EXEMPTIONS 3                            6 Mar 1981
*************************************************************************************
                                                HUSBAND        WIFE          TOTAL
 1 INTEREST INCOME
LAST NAT               HUS                      125.85
LAST NAT               WIF                                     150.00
QW L I CO              HUS                       22.90
AS CRED U              HUS                      350.90
DFS INS CO             HUS                      122.85
TOTAL                                           622.50         150.00         772.50

 3 DIVIDEND INCOME
FG INDUST              HUS                      250.00
GF INDUST              WIF                                     450.00
AF MOTORS              HUS                      225.50
AF MOTORS              WIF                                     225.50
TOTAL                                           475.50         675.50        1151.00
```

Text continued from page 154:

would require about 35K bytes of random-access read/write memory (RAM) based on the calculation: 115 lines × 20 items × 15 bytes per item. Most of this memory space would be wasted because most lines would have only a few entries.

To conserve memory space, I decided to store data entries for each line in a linked list. I constructed the list as follows. I defined the structured data type ITEM as a *packed* record containing:

- the name of an item
- a 9-digit integer for the amount of the item
- the assignment of the item (to husband or wife)
- the line number associated with the item
- a pointer to the next item in the list

Defining a record as packed advises the compiler that you want it to store the data internally in a way that conserves memory space; you sacrifice some speed of access because of the time required for packing and unpacking the data.

A *pointer* is a variable that holds the storage address of a related item of data; the compiler doesn't assign memory space to these related data items once and for all, as the compiler does for other variables. The pointer in the record TLINE points to the first ITEM in the list of data ITEMs for each line number. The pointer in ITEM links the ITEMs in the list. Use of the pointers in this way assures that memory space will be consumed only when necessary.

FIT contains other important data structures. TITLES is a one-dimensional array of strings that holds the names of the lines on all three tax forms. TAXRAY is a three-dimensional array used to hold the four factors required to calculate the tax. These factors are:

- the lower income level for the bracket
- the upper income level for the bracket
- the minimum tax for the bracket
- the tax rate for income in excess of the lower level

There are 16 brackets. I defined the data type FACTORARRAY as a two-dimensional array of the 16 brackets × four factors. Since each filing status requires

Text continued on page 394

Listing 6: *The main FIT program, which also contains the support procedures. The support procedures perform basic tasks, such as handling input of string data, used in other procedures. The main body of FIT, at the end of the listing, calls the five segmented procedures START, EDIT, RW, PRINTER, and CALCULATE. The segmented procedures do most of the work of FIT.*

```
{$S++}

PROGRAM FIT;     {federal income tax program}
                 { by edward heyman          }
                 {    300 center hill rd     }
                 {    centreville de         }
                 {       19807               }


CONST
        MAXLINE = 115;  MAXTLINE = 66;  MINALINE = 67;  MAXALINE = 107;
        MINBLINE = 108; MAXBLINE = 115;
        ESC = 27;
TYPE
        LONGINT=INTEGER[9];
        FILENAME=STRING[15];
        INTSTR=STRING[12];
        NAMESTR=STRING[26];

        FILING_STATUS = 0..5;
        TLINE_NUM = 1..MAXLINE;
        TLINESET       = SET OF TLINE_NUM;
        OWNER          = (H_OWN,W_OWN,T_OWN);
        POINTER = ^ITEM;

        ITEM          = PACKED RECORD
                NPTR     : POINTER;
                NAME     : STRING[10];
                AMT      : INTEGER[9];
                WHOSE    : OWNER;
                TLNUM    : TLINE_NUM;
          END;

        TLINE          = PACKED RECORD
                CASE TAG : INTEGER OF

                 1      :   (IPTR     : POINTER;
                             HUS      : INTEGER[9];
                             WIF      : INTEGER[9];
                             TOT      : INTEGER[9]);

                 2      : (D1,D2,D3:INTEGER;
                             TAXYEAR : STRING[4];
                             FS : FILING_STATUS;
                             EXEM : INTEGER);

                 3      : (NAME : NAMESTR);

            END;
        TLS = PACKED ARRAY[1..MAXLINE] OF TLINE;

        TAXTABLE = (X,Y,YS,Z);
        TAXFACTORS = (LOWER,UPPER,BASE,PERCENT);
        FACTORARRAY = ARRAY [1..16,TAXFACTORS] OF LONGINT;

VAR
        CH : CHAR;
        TTABLE : TAXTABLE;
        FSTAT : FILING_STATUS;
        SCREEN,SINGLE,SAME,QUIT : BOOLEAN;
```

Listing 6 continued on page 166

If you don't know a baud from a floppy...

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```
        DAY, MONTH, YEAR: INTEGER;
        SPECSET,DLINESET,SLINESET,SPAGESET,CALCSET : TLINESET;
        TAXRAY : ARRAY [TAXTABLE] OF FACTORARRAY;
        TITLES : ARRAY [1..MAXLINE] OF STRING[30];
        TLINES : TLS;
        MAX_TAX : ARRAY [OWNER] OF LONGINT;
        P    : FILE OF CHAR;

PROCEDURE MEM;FORWARD;
FUNCTION  READINT (LEN:INTEGER) : INTEGER;FORWARD;
PROCEDURE CLEAR;FORWARD;
PROCEDURE ELINE;FORWARD;
PROCEDURE EEOL;FORWARD;
PROCEDURE EEOS;FORWARD;
PROCEDURE WAIT;FORWARD;
PROCEDURE PDOL(DOL : LONGINT;VAR  STDOL : INTSTR);FORWARD;
PROCEDURE CENTER (ST : STRING; SCREEN : BOOLEAN);FORWARD;
PROCEDURE READDOL (LEN:INTEGER;VAR DOLREAD:LONGINT);FORWARD;
PROCEDURE NAMER(TITLE : NAMESTR ; VAR ST : STRING ;L:INTEGER);FORWARD;
PROCEDURE LINE(CH:CHAR;LONG:INTEGER);FORWARD;


{$ITAXSTART.TEXT}
{$ITAXRW.TEXT}
{$ITAXPRINT.TEXT}
{$ITAXCALC.TEXT}
{$ITAXEDIT.TEXT}
PROCEDURE MEM;
  BEGIN
    WRITELN('MEMORY AVAILABLE ',MEMAVAIL)
  END;

PROCEDURE LINE{(CH:CHAR;LONG:INTEGER)};
  VAR
          J:INTEGER;
  BEGIN
    FOR J:=1 TO LONG DO WRITE(P,CH)
  END;{line}

PROCEDURE NAMER{(TITLE : NAMESTR ; VAR ST : STRING ;L:INTEGER)};
{used to permit string data input TITLE is a prompt ,L is the max length
                                                        of the returned string }
  BEGIN
    REPEAT
      GOTOXY(0,6);
      WRITE('ENTER ',TITLE,' -->  ');
      EEOL;
      READLN(ST);
      IF (LENGTH(ST)>L)
        THEN BEGIN
               WRITE('NAME CANNOT EXCEED ',L,' CHARACTERS');
               WAIT;
               GOTOXY(0,7);EEOL;
             END;
    UNTIL (LENGTH(ST)<=L);
    WRITELN;
  END;

FUNCTION READINT {(LEN:INTEGER) : INTEGER};
{ a long winded routine to allow input of an integer of LEN digits}
  CONST
```

Listing 6 continued on page 170

Hayes Stack
Microcomputer Component Systems

At Hayes, we don't believe in second best. Or planned obsolescence. We believe in taking the state of the art to the limit. Our new Smartmodem, for example, is the most sophisticated 300-baud originate/answer modem you can buy. And yet, it is perhaps the easiest-to-use modem ever.

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Completely Programmable. Smartmodem can be controlled using *any* programming language. Over 30 different commands can be written into your programs or entered directly from your keyboard.

Smartmodem also includes several switch-selectable features that let you tailor performance to your exact needs. You can "set it and forget it" for the ultimate in convenience.

Built-in Audio Monitor. Thanks to an internal speaker, you can actually listen to your connection being made. You'll know immediately if the line is busy or if you reached a wrong number — *and you don't even need a phone!*

Status at a Glance. Seven LED's indicate Smartmodem's current operating mode: auto-answer, carrier detect, off hook, receive data, send data, terminal ready and modem ready. You're never left in the dark!

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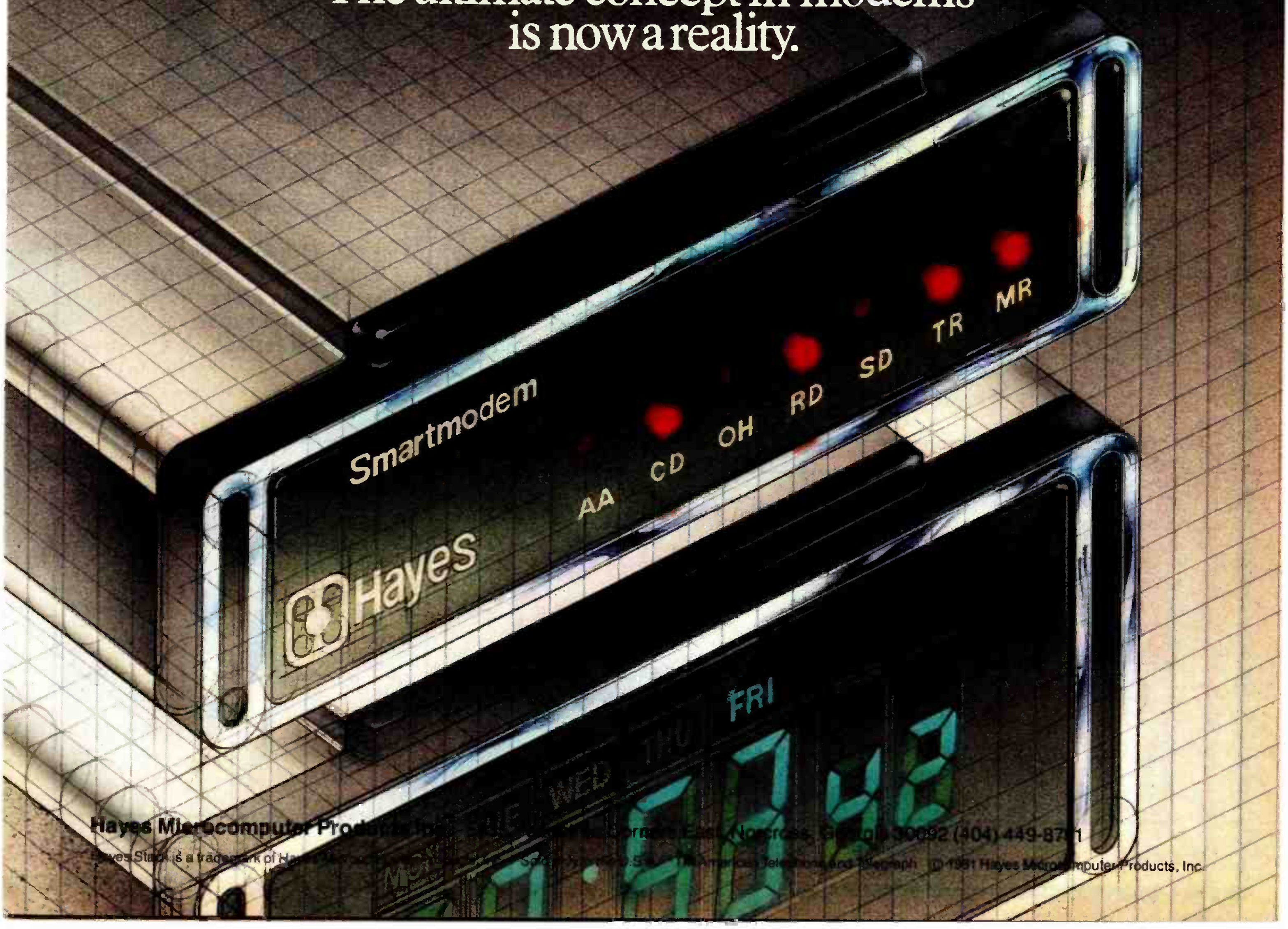

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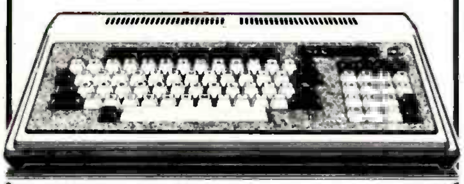

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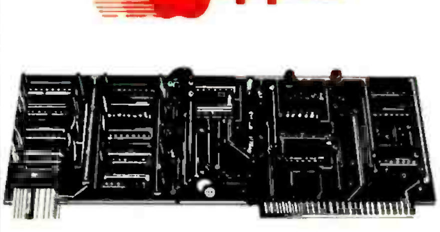

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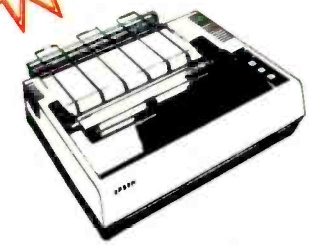

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```
          PERIOD='.';PLUS='+';MINUS='-';DOL='$';BS=8;LF=10;FF=12;CR=13;DEL=127;
          SPACE=32;EEOL=4;
VAR
          CHARRAY:ARRAY [1..10] OF CHAR;
          READINTEGER:INTEGER;
          POSITION:1..9;
          NEG:BOOLEAN;
          DIGITS: SET OF CHAR;
 BEGIN{READINT}
          DIGITS:=['0'..'9'];
          FOR POSITION:=1 TO LEN DO
                  WRITE('_');
          FOR POSITION:=1 TO LEN DO
                  WRITE(CHR(BS));
          POSITION:=1;
          WHILE POSITION = 1 DO
            BEGIN
              READ(KEYBOARD,CHARRAY[POSITION]);
              IF (CHARRAY[POSITION] IN DIGITS+[PLUS,MINUS]) THEN
                      BEGIN
                      WRITE(CHARRAY[POSITION]);
                      POSITION:=POSITION+1;
                      END;{if}
              END;{while}
          WHILE POSITION <= LEN DO
            BEGIN
              READ(KEYBOARD,CHARRAY[POSITION]);
              IF (CHARRAY[POSITION] IN DIGITS) THEN
                      BEGIN
                      WRITE(CHARRAY[POSITION]);
                      POSITION:=POSITION+1;
                      END
              ELSE
                      BEGIN
                      IF CHARRAY[POSITION]=CHR(BS) THEN
                              BEGIN
                              WRITE(CHR(BS));
                              POSITION:=POSITION-1;
                              END;{IF}
                      IF (CHARRAY[POSITION] IN [CHR(SPACE),CHR(CR)])
                              THEN LEN:=POSITION-1;
                      END;{else}
      END;{WHILE}
      READINTEGER:=0;
      IF CHARRAY[1]='-' THEN NEG:=TRUE elSE NEG:=FALSE;
      FOR POSITION:=1 TO LEN DO
           BEGIN
            IF (CHARRAY[POSITION] IN DIGITS) THEN
            READINTEGER:=10*READINTEGER+ORD(CHARRAY[POSITION])-ORD('0');
           END;{for}
      IF NEG
             THEN READINT:= -READINTEGER
             ELSE READINT:= READINTEGER;
 END;{READINT}

PROCEDURE EEOS;{erase to end of screen}
  BEGIN
    WRITE(CHR(2));
  END;{eeos}

PROCEDURE CLEAR;{clear the screen}
  BEGIN
```

Listing 6 continued on page 172

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Softlights

By Fred Huntington

There are several new exciting products this month for the Apple®.

We've got Amdek's super new monitors – the no-glare green/black and also the HIRES color monitor – all at special prices. Both of these are absolutely beautiful.

Write for information on the niftiest piece of business software to come out in a long time – VersaForm from Applied Software Technology. It's a business forms processor which is a sophisticated, yet simple to use transactional management program.

Speaking of monitors, check out the new Kaga 12" green/black monitor. I liked it so much I took the first one home and kept it for my personal use on my Apple®. Our special price is **$199.00.**

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Listing 6 continued:

```
      WRITE(CHR(12))
    END;

 PROCEDURE ELINE;{erase line}
    BEGIN
      WRITE(CHR(14))
    END;

 PROCEDURE EEOL;{erase to end of line}
    BEGIN
      WRITE(CHR(04))
    END;

PROCEDURE WAIT;
{routine used to halt program while user examines output}
    VAR     CH : CHAR;
    BEGIN
      GOTOXY(10,23);
      WRITE('ENTER <ESC> TO CONTINUE');
      REPEAT
        READ(CH)
      UNTIL CH = CHR(27)
    END;

PROCEDURE CENTER {(ST : STRING; SCREEN : BOOLEAN)};
{routine to print a string in the center of the line}
   VAR             X,Y : 0..132;
                   CH : CHAR;
   BEGIN
     CH := ' ';
     IF SCREEN THEN Y := 40 ELSE Y := 66;
     X := Y - (LENGTH(ST) DIV 2);
     WRITELN(CH:X,ST);
   END;


PROCEDURE PDOL {(DOL : LONGINT;VAR  STDOL : INTSTR)};
   BEGIN
     STR(DOL,STDOL);
     INSERT('.',STDOL,PRED(LENGTH(STDOL)));
   END;


PROCEDURE READDOL {(LEN:INTEGER;VAR DOLREAD:LONGINT)};
{routine to permit entry of long integer of LEN digits}
 CONST
        BS = 8; PLUS = '+';      MINUS = '-';
 VAR
         POSITION:1..10;
         NEG:BOOLEAN;
         ESC : CHAR;
         CHARRAY:ARRAY [1..10] OF CHAR;
         DIGITS:SET OF CHAR;

BEGIN{readdol}
        SAME := FALSE;
        QUIT := FALSE;
        ESC := CHR(27);
        DIGITS:=['0'..'9'];
        FOR POSITION:=1 TO LEN DO
                WRITE('_');
        FOR POSITION:=1 TO LEN DO
                WRITE(CHR(BS));
```

Listing 6 continued on page 174

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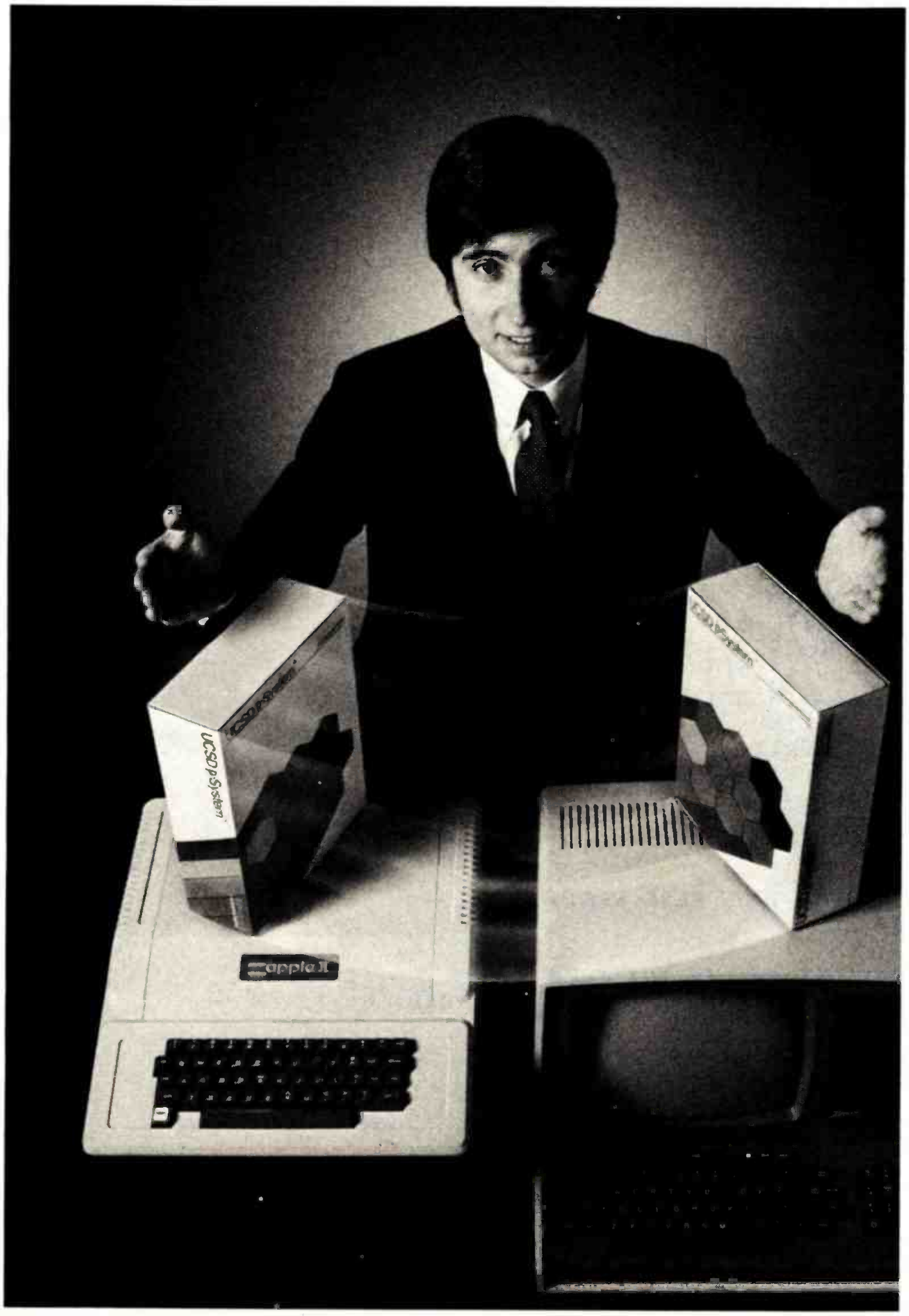

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```
        POSITION:=1;
        REPEAT
            READ(KEYBOARD,CHARRAY[POSITION]);
        UNTIL (CHARRAY[POSITION] IN DIGITS+[PLUS,MINUS,ESC,'Q','q']);
        IF (CHARRAY[POSITION] = ESC) OR (CHARRAY[POSITION] IN ['Q','q'])
          THEN IF (CHARRAY[POSITION] IN ['Q','q'])
            THEN BEGIN
                 QUIT := TRUE;
                 EXIT(READDOL);
               END
            ELSE BEGIN
                 SAME := TRUE;
                 EXIT(READDOL);
               END
          ELSE BEGIN
                 WRITE(CHARRAY[POSITION]);
                 POSITION:=POSITION+1;
                 END;{if}
        WHILE POSITION <= LEN DO
          BEGIN
            REPEAT
              READ(KEYBOARD,CHARRAY[POSITION]);
            UNTIL (CHARRAY[POSITION] IN (DIGITS + ['.',CHR(BS)]));
            IF (CHARRAY[POSITION] IN DIGITS ) THEN
                    BEGIN
                    WRITE(CHARRAY[POSITION]);
                    POSITION:=POSITION+1;
                    END
            ELSE
                    BEGIN
                    IF CHARRAY[POSITION]=CHR(BS) THEN
                            BEGIN
                            WRITE(CHR(BS));
                            POSITION:=POSITION-1;
                            END;{IF}
                    IF (CHARRAY[POSITION] = '.')THEN
                            BEGIN
                              WRITE('.');
                              LEN:=POSITION+1;
                            END;
                    END;{else}
    END;{WHILE}
    DOLREAD:=0;
    IF CHARRAY[1]='-' THEN NEG:=TRUE ELSE NEG:=FALSE;
    FOR POSITION:=1 TO LEN DO
         BEGIN
          IF (CHARRAY[POSITION] IN DIGITS) THEN
          DOLREAD:=10*DOLREAD+ORD(CHARRAY[POSITION])-ORD('0');
         END;{for}
    IF NEG THEN DOLREAD:= - DOLREAD;

 END;{readdol}


BEGIN{fit main}
  START;
  WRITELN;
  MEM;
  WAIT;
  REPEAT
    CLEAR;
```

Listing 6 continued on page 176

Amdek

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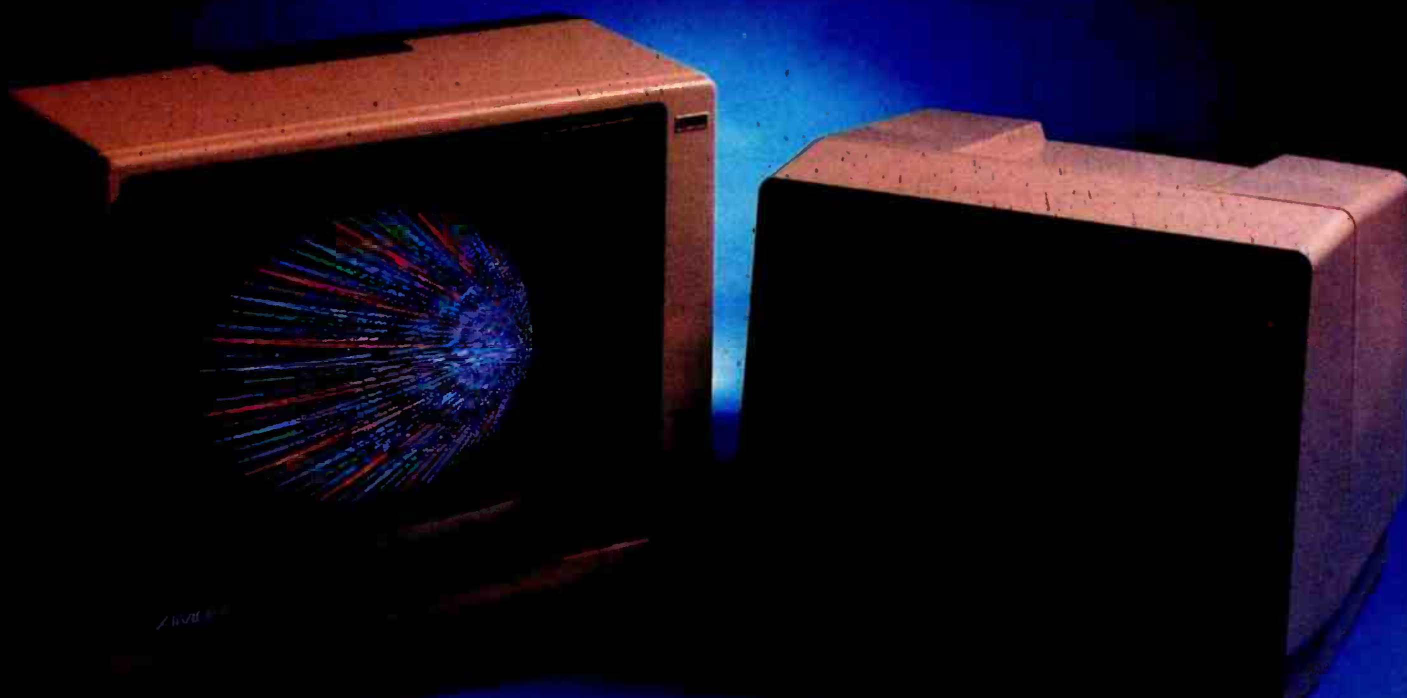

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Listing 6 continued:

```
    WRITE('FIT COMMAND --> P)rint E)dit C)alculate R)ead W)rite Q)uit ');
    REPEAT
      READ(CH)
    UNTIL (CH IN ['E','e','C','c','R','r','W','w','P','p','Q','q']);
    CASE CH OF

        'E','e' : EDIT;
        'R','r' : BEGIN
                    RW('R');
                    FSTAT := TLINES[7].FS;
                    IF FSTAT IN [2,3] THEN SINGLE := FALSE;
                  END;
        'W','w' : RW('W');
        'P','p' : PRINTER;
        'C','c' : CALCULATE;
      END;{case}
   UNTIL (CH IN ['Q','q']);
 END.{fit main}
```


Circle 266 on inquiry card.

Circle 154 on inquiry card.

Listing 7: *The FIT segment procedure START. This procedure sets up the variables used in other parts of FIT.*

```
SEGMENT PROCEDURE START;                     {sets up the variables}

  PROCEDURE INITIALIZE;
  {inserts nul values in TLINES}
    VAR
          I : 1..MAXLINE;
          EMPTY : TLINE;
    BEGIN
      WITH EMPTY DO
        BEGIN
          IPTR := NIL;
          HUS := 0;
          WIF := 0;
          TOT := 0;
        END;
      FOR I := 8 TO MAXLINE DO
              BEGIN
                TLINES[I] := EMPTY;
                TLINES[I].TAG := 1
              END;
      WITH TLINES[7] DO
        BEGIN
          D1 := 1;  D2:=1;  D3:=80;
          TAXYEAR := ' ';
          FS :=0; EXEM := 0;
        END;
      WITH TLINES[6] DO NAME := ' ';
    END;{initialize}

    PROCEDURE READFACTORS;
    {reads the tax factor file into the array TAXRAY}
      VAR           TFILE : FILE OF FACTORARRAY;
                    TTABLE : TAX_TABLE;
      BEGIN
        RESET(TFILE,'FACTORS.FTAX');
        FOR TTABLE := X TO Z DO
          BEGIN
            TAXRAY[TTABLE] := TFILE^;
            WRITE('.');
            GET(TFILE)
          END;
        CLOSE(TFILE);
      END;{readfactors}

    PROCEDURE READNAMES;
      {reads the line names into the array TITLES}
      TYPE          T=ARRAY[1..MAXLINE] OF STRING[30];
      VAR           TNAMES:FILE OF T;
      BEGIN
        RESET(TNAMES,'LINENAMS.FTAX');
        TITLES := TNAMES^;
      END;


    PROCEDURE GETDATE;
      {sets the date from the disk in drive 4}
        VAR
            DUMMY : PACKED ARRAY [1..22 ] OF CHAR;
            HIGH, LOW : INTEGER;
        BEGIN
```

Listing 7 continued on page 180

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```
          UNITREAD( 4, DUMMY, 24, 2);
          HIGH := ORD ( DUMMY [ 22 ] );
          LOW := ORD ( DUMMY [ 21 ] );
          DAY := ( HIGH MOD 2 ) * 16 + LOW DIV 16;
          MONTH := LOW MOD 16;
          YEAR := HIGH DIV 2;
       END;

BEGIN{start}
    GETDATE;
    {the following set contains line numbers of lines requiring calculation}
    CALCSET := [9,10,22,30,31,32,33,34,35,37,46,47,54,62,63,64,65,66,69,70,73,
               74,75,76,82,86,88,90,93,94,95,98,99,100,101,102,103,104,105,106,
               107,109,111,114,115];
    SINGLE := TRUE;        {needs a value to start}
    SCREEN := TRUE;        {most times it is}
    INITIALIZE;            {zero TLINES}
    READFACTORS;           {fill tax factor array}
    READNAMES;             {fill line number array}
END;{start}
```

Listing 8: *The FIT segment procedure EDIT. EDIT enables the user to enter and correct data for form 1040, Schedule A, and Schedule B. EDIT lets the user work on all lines sequentially (procedure ED-SEQUENT) or on an individual line requested by number (procedure ED-INDIVIDUAL). Both these procedures call the procedure EDIT-TLINE to do the real editing of any line.*

```
SEGMENT PROCEDURE EDIT;
 VAR              LN : TLINE_NUM;          {index to ARRAY TLINES}
                  INT : INTEGER;
                  EDIT_CHAR,CH : CHAR;


    PROCEDURE EDIT_SPEC;
    {enter taxpayers name,the tax year,filing status and number of dependents}
      VAR
                    H,W : INTEGER;
                    INT,EXEMPS : INTEGER;
                    LN : TLINE_NUM;
      PROCEDURE FILINGSTAT;
        BEGIN
          WITH TLINES[7] DO
          BEGIN
            GOTOXY(0,4);EEOS;
            WRITELN('   1) Single');WRITELN;
            WRITELN('   2) Married filing Jointly');WRITELN;
            WRITELN('   3) Married filing Separately');WRITELN;
            WRITELN('   4) Head of household');WRITELN;
            WRITELN('   5) Widow(er)');WRITELN;
            REPEAT
              INT := READINT(1)
            UNTIL INT IN [1..5];
            FS := INT;
            IF FS IN [2,3] THEN SINGLE := FALSE;
          END;{with}
        END;{filingstat}
```

Listing 8 continued on page 182

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Listing 8 continued:

```
  BEGIN
      LN := 7;
      CLEAR;GOTOXY(0,2);
      WITH TLINES[7] DO
        BEGIN
          CENTER(TITLES[5],SCREEN);WRITELN;
          NAMER('NAME',TLINES[6].NAME,26);
          NAMER('TAX YEAR',TAXYEAR,4);
          FILINGSTAT;
          EXEM := 0;
          CLEAR;GOTOXY(0,2);
          WRITE('ENTER CORRECT LETTER');
          GOTOXY(0,4);
          CENTER(TITLES[7],SCREEN);WRITELN;
          WRITELN('    Y)ourself');WRITELN;
          WRITELN('    O)ver sixtyfive');WRITELN;
          WRITELN('    B)lind');WRITELN;
          WRITELN('    T) over 65 and blind');
          REPEAT
            READ(CH)
          UNTIL CH IN ['Y','y','O','o','B','b'];
          CASE CH OF
           'Y','y'     : H := 1;
           'O','o'     : H := 2;
           'B','b'     : H := 2;
           'T','t'     : H := 3;
             END;{case}
          IF NOT SINGLE
            THEN BEGIN
                   CENTER(TITLES[LN],SCREEN);WRITELN;
                   GOTOXY(0,6);EEOS;
                   WRITELN('    S)pouse');WRITELN;
                   WRITELN('    O)ver sixtyfive');WRITELN;
                   WRITELN('    B)lind');WRITELN;
                   WRITELN('    T) over 65 and blind');
                   REPEAT
                     READ(CH)
                   UNTIL CH IN ['S','s','O','o','B','b'];
                   CASE CH OF
                    'S','s'  : W := 1;
                    'O','o'  : W := 2;
                    'B','b'  : W := 2;
                    'T','t'  : W := 3;
                      END;{case}
                 END{IF}
               ELSE W := 0;
          CLEAR;GOTOXY(0,6);
          WRITE('ENTER NUMBER OF OTHER DEPENDENTS ');
          EXEMPS := READINT(2);
          EXEM := H + W  + EXEMPS;
        END;{with}
  END;{editspec}


PROCEDURE EDIT_TLINE(LN : TLINE_NUM);
{main data input routine}
  VAR
              HSUM,WSUM,DOL : INTEGER[9];
              NEXTPTR,PTR,LASTPTR : POINTER;
              TL : BOOLEAN;
              CH : CHAR;
PROCEDURE VIEW;
{display contents of TLINES[LN]}
```

Listing 8 continued on page 186

The revolutionary Discovery multiprocessor is the only system that allows the total integration of powerful 16 bit 8086 processors with the more standard Z-80 user processors. The DISCOVERY system may be configured in any 8 bit/16 bit combination, or as a totally exclusive 16 bit system only to provide the ultimate in performance and flexibility in advanced micro systems.

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Listing 8 continued:

```
   VAR
              SCREEN : BOOLEAN;
                 OBJ : INTSTR;
   BEGIN
     SCREEN := TRUE;
     GOTOXY(0,3);
     EEOS;
     IF NOT SINGLE
       THEN BEGIN
              GOTOXY(0,8);
              PDOL(TLINES[LN].HUS,OBJ);
              WRITE('HUSBAND':20,OBJ:20);
              GOTOXY(0,10);
              PDOL(TLINES[LN].WIF,OBJ);
              WRITE('WIFE':20,OBJ:20);
            END;
     GOTOXY(0,12);
     PDOL(TLINES[LN].TOT,OBJ);
     WRITE('TOTAL':20,OBJ:20);
   END;

 PROCEDURE SUMS ;
 {add all ITEMs and place values in TLINES[LN]}
   BEGIN
     WITH TLINES[LN] DO
       BEGIN
        HUS := 0;
        WIF := 0;
        TOT := 0;
          IF IPTR<>NIL
            THEN BEGIN
              NEXTPTR := IPTR;
              REPEAT
               IF NEXTPTR^.WHOSE = H_OWN THEN HUS := HUS + NEXTPTR^.AMT
                                         ELSE WIF := WIF + NEXTPTR^.AMT;
               NEXTPTR := NEXTPTR^.NPTR
              UNTIL NEXTPTR = NIL;
              TOT := HUS + WIF
            END;{if}
       END;{with}
  END;{sums}

PROCEDURE WHO (PTR : POINTER);
{assign item to husband or wife}
  BEGIN
    WITH PTR^ DO
      BEGIN
        GOTOXY(0,12);
        WRITE('ASSIGN TO H)USBAND  W)IFE ');
        REPEAT
          READ(CH);
        UNTIL (CH IN ['H','h','W','w']);
        IF CH IN ['H','h'] THEN WHOSE := H_OWN
                 ELSE WHOSE := W_OWN;
```

```
BEGIN{viewitem}
  CLEAR;
  WRITE('COMMAND -->  <ESC> to continue   ^D)elete  ');
  WRITE(' Change --> N)ame  A)mount');
  IF NOT SINGLE THEN WRITE('  W)hose ');
  WITH PTR^ DO
    BEGIN
      VIEWITEM := NPTR;
      GOTOXY(0,4);
      WRITE('LINE NUMBER ');
      IF LN <= MAXTLINE
        THEN WRITE(LN : 2)
        ELSE IF LN <= MAXALINE THEN WRITE(LN-MINALINE+1 : 2)
                                ELSE IF LN <= MAXBLINE
                                       THEN WRITE(LN-MINBLINE+1 : 2);
      WRITELN('  ',TITLES[LN]:40);
      GOTOXY(0,6);
      WRITE(NAME);EEOS;
      GOTOXY(0,8);
      CASE WHOSE OF
        H_OWN : WRITE('HUSBAND');
        W_OWN : WRITE('WIFE');
        T_OWN : WRITE('TOTAL');
       END;{case}
      GOTOXY(0,10);
      PDOL(AMT,OBJ);
      WRITE('AMOUNT ',OBJ:12);
      REPEAT
        REPEAT
          GOTOXY(77,0);READ(CH);
          IF CH = CHR(4)         {delete routine}
            THEN BEGIN
                   IF TL         {if pointer was from TLINES[LN]}
                          THEN TLINES[LN].IPTR := NPTR
                          ELSE LASTPTR^.NPTR := NPTR;
                   EXIT(VIEWITEM);
                 END;
        UNTIL ( CH IN ['N','n','W','w','A','a',CHR(ESC)]);
        IF CH IN ['N','n','W','w','A','a']
              THEN BEGIN         {change a value in ITEM}
                     WITH PTR^ DO
                       BEGIN
                         CASE CH OF
                            'N','n'    : NAMER('NAME',PTR^.NAME,10);

                            'A','a'    : BEGIN
                                           GOTOXY(0,10);
                                           READDOL(9,AMT);
                                           WRITELN;
                                         END;

                            'W','w'    : WHO(PTR);
                          END;{CASE}
                         GOTOXY(77,0);    {return cursor to command line}
                       END;{WITH}
                   END;
              UNTIL CH = CHR(ESC);
      END;{with}
  TL := FALSE;  {parent of pointer is no longer TLINES[LN]}
  LASTPTR := PTR;
END{viewitem};
```

Listing 8 continued on page 190

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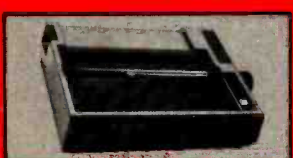

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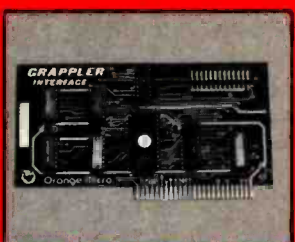

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Circle 259 on inquiry card.

Listing 8 continued:

```
BEGIN{edit_tline}
  HSUM := 0;
  WSUM := 0;
  WITH TLINES[LN] DO
    BEGIN
      IF IPTR <> NIL  {if any ITEMs exist}
        THEN BEGIN
               TL := TRUE;      {parent of pointer is TLINES[LN]}
               NEXTPTR := VIEWITEM(IPTR);      {get first ITEM}
                      {while an ITEM exists get it}
               WHILE (NEXTPTR <> NIL) DO NEXTPTR := VIEWITEM(NEXTPTR);
                      {no ITEMs left}
             END;{if}
  REPEAT                  {add ITEMs or leave}
    CLEAR;
    GOTOXY(0,2);
    WRITE('LINE NUMBER ');
    IF LN <= MAXTLINE
      THEN WRITE(LN : 2)

        ELSE IF LN <= MAXALINE THEN WRITE(LN-MINALINE+1 : 2)
                                ELSE IF LN <= MAXBLINE
                                    THEN WRITE(LN-MINBLINE+1 : 2);
      WRITELN('  ',TITLES[LN]:40);
      WRITE('DO YOU WANT TO ADD AN ITEM  Y/N');
      REPEAT
        READ(KEYBOARD,CH)
      UNTIL ( CH IN ['Y','y','N','n']);
      ELINE;
      IF CH IN ['N','n'] THEN BEGIN
                                  SUMS;{add the ITEMs and put in TLINE[LN]}
                                  VIEW;{display the contents of TLINES[LN]}
                                  EXIT(EDIT_TLINE);
                                END;
      NEW(PTR);            {begin the addition of a new ITEM}
      IF IPTR = NIL THEN IPTR := PTR     {if its the first ITEM of TLINES[LN]}
                    ELSE LASTPTR^.NPTR := PTR;
      LASTPTR := PTR;
      WITH PTR^ DO         {begin actual data entry}
        BEGIN
          NPTR := NIL;
          TLNUM := LN;
          NAMER('NAME',PTR^.NAME,10);
          GOTOXY(0,8);
          WRITE('ENTER AMOUNT  ');
          READDOL(9,AMT);
          IF SINGLE THEN WHOSE := H_OWN
                    ELSE WHO(PTR);
        END;{with PTR^}
   UNTIL (CH='Q');
  END;{with tlines[ln]}
END;{edit_lines}

FUNCTION EDIT_WHAT : CHAR;
{select a schedule to edit}
  VAR            CH : CHAR;
  BEGIN
    CLEAR;
    WRITE ('EDIT COMMAND --> A)schedule A     B)schedule B     Z)form 1040 ');
    WRITE ('    F)iling status  Q)uit ');
    REPEAT
      READ(CH)
    UNTIL ( CH IN ['A','a','B','b','Z','z','F','f','Q','q']);
```

Listing 8 continued on page 388

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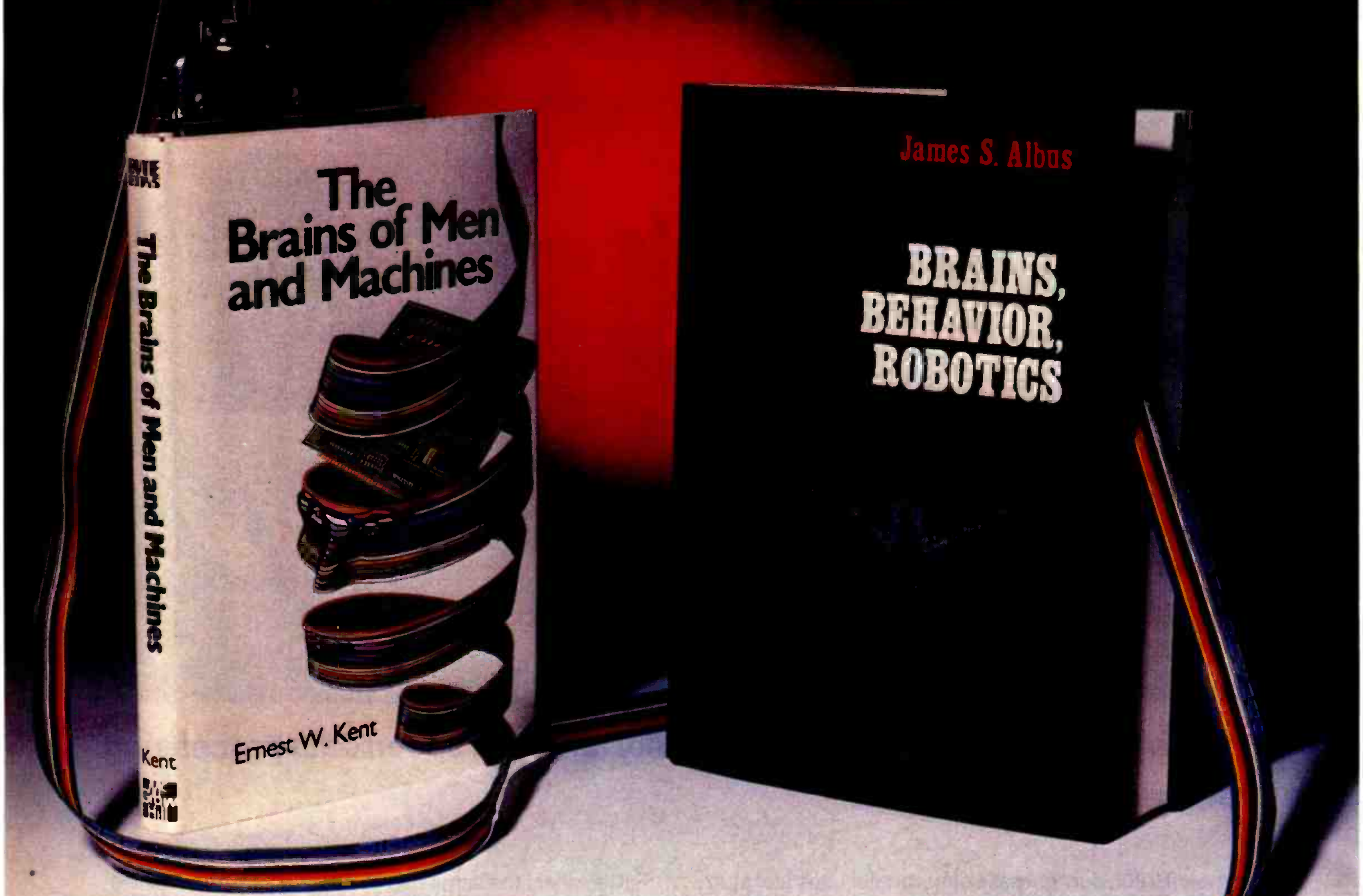

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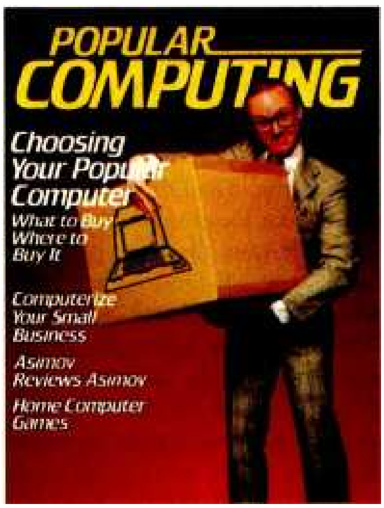

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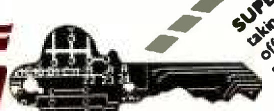

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Build an EPROM Emulator

Eric C. Rehnke
1067 Jadestone Lane
Corona, CA 91720

Remember the last time you developed a program, "burned" it into (stored it in) an EPROM (erasable programmable read-only memory), and then discovered one or two bugs? And then, as a result of fixing one of the bugs by burning the EPROM again, several more showed up? It's happened to me more than once. And since it takes quite a bit of time to erase and reprogram EPROMS, a whole evening can be wasted without accomplishing much. After several of these frustrating sessions, I decided that there had to be a better way. After all, aren't computers supposed to *save* time?

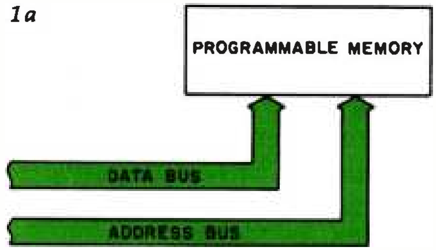
Clearly, a device was needed that would "look" like an EPROM to an EPROM socket and be quickly accessible from the program-development system. In this way, code could be verified before burning it into an EPROM. This becomes even more of a necessity if you're developing code for a small, dedicated controller and don't have any means of trying it before programming the EPROM.

About this time, I saw an ad for a Debug Memory Board (DBM-1) from Pragmatic Designs of Mountain View, California. The DBM-1 was exactly what I was looking for, but, unfortunately, it was meant to be used with an S-100 system. Since my system was 6502-based and didn't use the S-100 bus (there are a few of us out here), I ended up designing my own board. I call it an EPROM emulator because emulating is what it's doing.

Dual-Port Memory

The emulator gives my software-development system a "window" into whatever system the EPROM is normally plugged into. It does this bit of

1a



1b

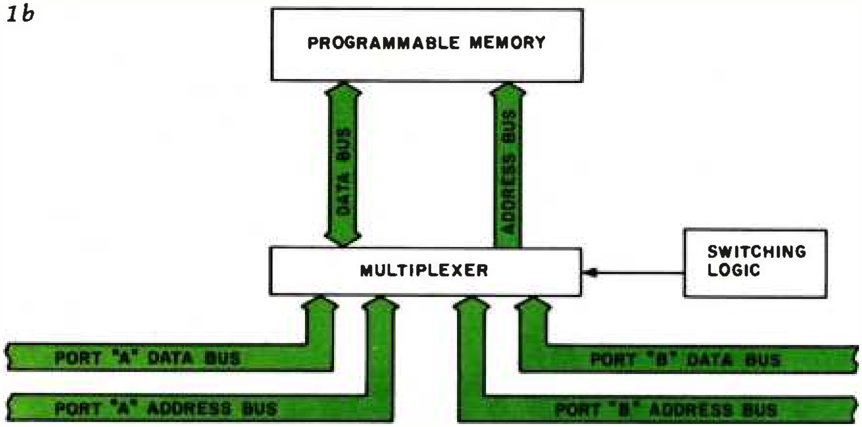


Figure 1: *Types of programmable memory. Figure 1a shows the common single-port memory, with a single set of data and address buses. Figure 1b is a block diagram of dual-port memory; it allows access by two separate sets of buses.*

TRS-80* COMPUTING EDITION

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Percom's DOUBLER II™ tolerates wide variations in media, drives

GARLAND, TEXAS — May 22, 1981 — Harold Mauch, president of Percom Data Company, announced here today that an improved version of the Company's innovative DOUBLER® adapter, a double-density plug-in module for TRS-80* Model I computers, is now available.

Reflecting design refinements based on both theoretical analyses and field testing, the DOUBLER II®, so named, permits even greater tolerance in variations among media and drives than the previous design.

Like the original DOUBLER, the DOUBLER II plugs into the drive controller IC socket of a TRS-80 Model I Expansion Interface and permits a user to run either single- or double-density diskettes on a Model I.

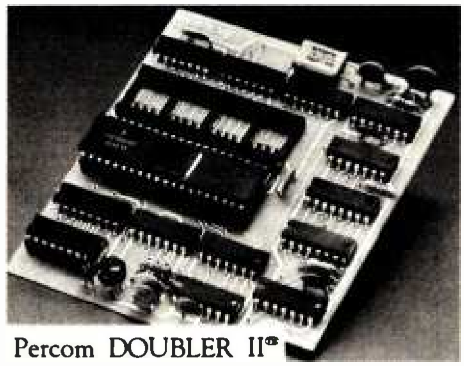
With a DOUBLER II installed, over four times more formatted data — as much as 364 Kbytes — can be stored on one side of a five-inch diskette than can be stored using a standard Tandy Model I drive system.

Moreover, a DOUBLER II equips a Model I with the hardware required to run Model III diskettes.

(*Ed. Note*: See "OS-80®: Bridging the TRS-80* software compatibility gap" elsewhere on this page.)

The critical clock-data separation circuitry of the DOUBLER II is a proprietary design *called a ROM-programmed digital phase-lock loop data separator*.

According to Mauch, this design is more tolerant of differences from diskette to diskette and drive to drive, and also provides *immunity to performance degradation caused by circuit component aging*.



Percom DOUBLER II®

Mauch said "A DOUBLER II will operate just as reliably two years after it is installed as it will two days after installation."

The digital phase-lock loop also *eliminates the need for trimmer adjustments typical of analog phase-lock loop circuits*.

"You plug in a Percom DOUBLER II and then forget it," he said.

The DOUBLER II also features a refined Write Precompensation circuit that more effectively minimizes the phenomena of bit- and peak-shifting, a reliability-impairing characteristic of magnetic data recording.

The DOUBLER II, which is fully software compatible with the previous DOUBLER, is supplied with DBLDOS®, a TRSDOS*-compatible disk operating system.

The DOUBLER II sells for ~~$219.95~~, including the DBLDOS diskette. NOW $169.95!

Owners of original DOUBLERs may purchase a DOUBLER II upgrade kit, without the disk controller IC, for $30.00. Proof of purchase of an original DOUBLER is required, and each DOUBLER owner may purchase only one DOUBLER II at the $30.00 price.

The Percom DOUBLER II is available from authorized Percom retailers, or may be ordered direct from the factory. The factory toll-free order number is 1-800-527-1222.

Ed. note: Opening the TRS-80 Expansion Interface may void the Tandy limited 90-day warranty. Circle 281 on inquiry card.

All that glitters is not gold

OS-80™ Bridging the TRS-80* software compatibility gap

Compatibility between TRS-80* Model I diskettes and the new Model III is about as genuine as a gold-plated lead Krugerrand.

True, Model I TRSDOS* diskettes can be *read* on a Model III. But first they must be converted and re-recorded for Model III operation.

And you *cannot write* to a Model I TRSDOS* diskette. Not with a Model III. You cannot add a file. Delete a file. Or in any way modify a Model I TRSDOS diskette with a Model III computer.

Furthermore, your converted TRSDOS diskettes cannot be converted *back* for Model I operation.

TRSDOS is a one-way street. And there's no retreating. A point to consider before switching the company's payroll to your new Model III.

Real software compatibility should allow the *direct, immediate* interchangeability of Model I and Model III diskettes. No read-only limitations, no conversion/re-recording steps and no chance to be left high and dry with Model III diskettes that can't be run on a Model I.

What's the answer? The answer is Percom's OS-80® family of TRS-80 disk operating systems.

OS-80 programs allow *direct, immediate* interchangeability of Model I and Model III diskettes.

You can run Model I single-density diskettes on a Model III; install Percom's plug-in DOUBLER® adapter in your Model I, and you can run double-density Model III diskettes on a Model I.

There's no conversion, no re-recording.

Slip an OS-80 diskette out of your Model I and insert it directly in a Model III.

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Just have the correct OS-80 disk operating system — OS-80, OS-80D or OS-80/III — in each computer.

Moreover, with OS-80 systems, you can add, delete, and update files. You can read *and write* diskettes regardless of the system of origin.

OS-80 is the original Percom TRS-80 DOS for BASIC programmers.

Even OS-80 utilities are written in BASIC.

OS-80 is the Percom system about which a user wrote, in Creative Computing magazine, ". . . the best $30.00 you will ever spend."†

Requiring only seven Kbytes of memory, OS-80 disk operating systems reside completely in RAM. There's no need to dedicate a drive exclusively for a system diskette.

And, unlike TRSDOS, you *can* work at the track sector level, defining and controlling data formats — in BASIC — to create simple or complex data structures that execute more quickly than TRSDOS files.

The Percom OS-80 DOS supports single-density operation of the Model I computer — price is $29.95; the OS-80D supports double-density operation of Model I computers equipped with a DOUBLER or DOUBLER II; and, OS-80/III — for the Model III of course — supports both single- and double-density operation. OS-80D and OS-80/III each sell for $49.95. Circle 282 on inquiry card.

Circuit misapplication causes diskette read, format problems.

High resolution key to reliable data separation

GARLAND, TEXAS — The Percom SEPARATOR® does very well for the Radio Shack TRS-80* Model I computer what the Tandy disk controller does poorly at best: *reliably* separates clock and data signals during disk-read operations.

Unreliable data-clock separation causes format verification failures and repeated read retries.

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The problem is most severe on high-number (high-density) inner file tracks.

As reported earlier, the clock-data separation problem was traced by Percom to misapplication of the internal separator of the 1771 drive controller IC used in the Model I.

The Percom Separator substitutes a *high-resolution* digital data separator circuit, one which operates at 16 megahertz, for the low-resolution one-megahertz circuit of the Tandy design.

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Not a kit — some vendors supply an untested separator kit of resistors, ICs and other paraphernalia that may be installed by modifying the computer — the Percom SEPARATOR is a fully assembled, fully tested plug-in module.

Installation involves merely plugging the SEPARATOR into the Model I EI disk controller chip socket, and plugging the controller chip into a socket on the SEPARATOR.

The SEPARATOR, which sells for only $29.95, may be purchased from authorized Percom retailers or ordered directly from the factory. The factory toll-free order number is 1-800-527-1222.

Ed. note: Opening the TRS-80 Expansion Interface may void the Tandy limited 90-day warranty. Circle 280 on inquiry card.

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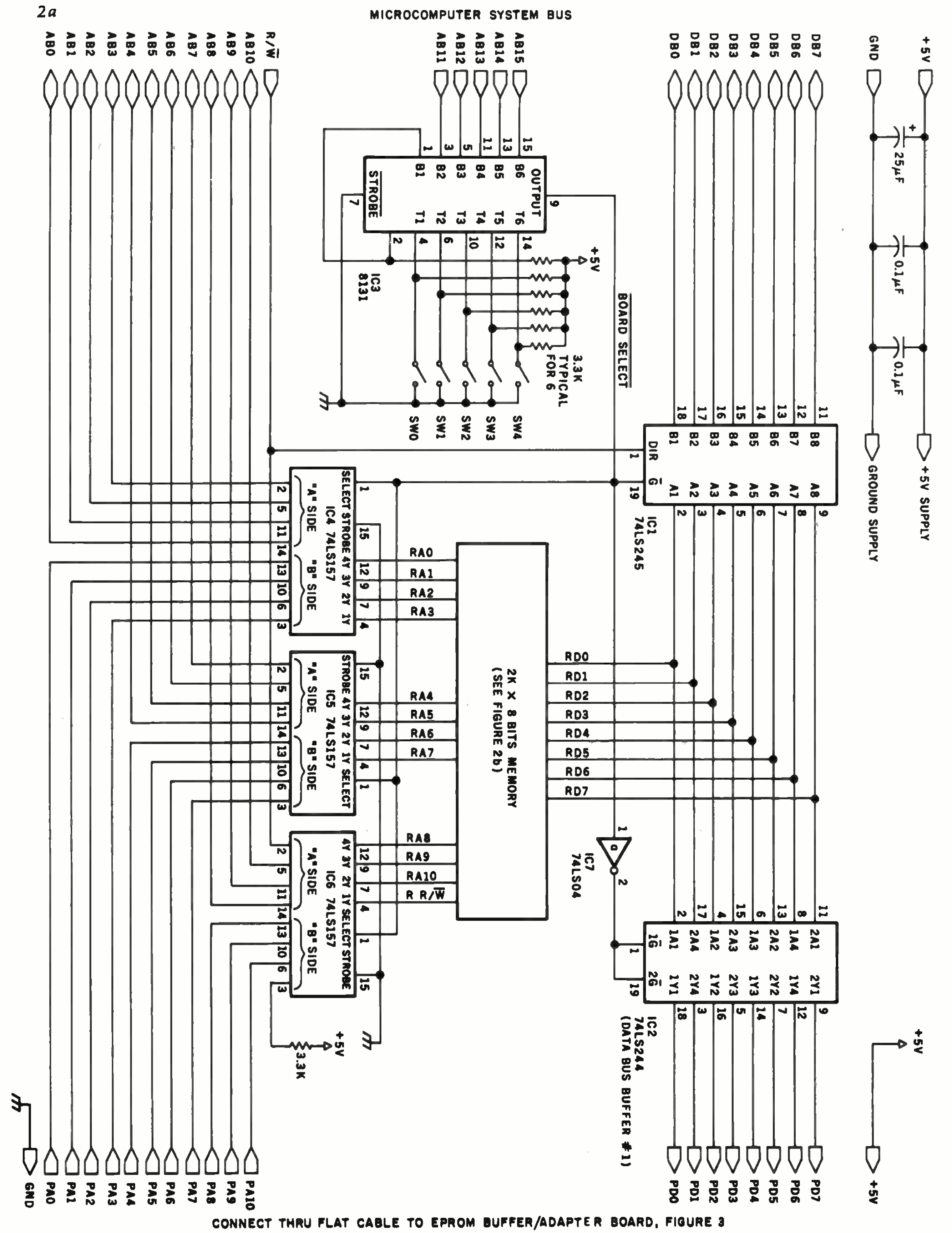

Figure 2a: *A schematic diagram of the logic section of the EPROM emulator dual-port memory circuit. The 8131 address comparator generates the signal* $\overline{\text{BOARD SELECT}}$, *used to allow either the development system or the EPROM socket access. See figure 2b for the programmable-memory portion of this circuit.*

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P.O. Box 1132 Ansonia Station New York, N.Y. 10023 (212) 799-1200 Telex 645 592 magic by using *dual-port memory*. This is a block of random-access memory that can be accessed from two separate system buses (or ports). Each port has its own address and data bus, and incorporates logic that switches control between the two ports.

Since normal programmable memory has a single address and data bus, it can be called a single-port device (see figure 1a). To turn that memory into a two-port device, it is necessary to multiplex another data and address bus in by adding some switching logic (see figure 1b).

Physically, the EPROM emulator consists of a circuit board containing the dual-port memory that plugs into the microcomputer development-system bus (see figure 2), and an umbilical cable that leads out to a buffer module and 24-pin header plug (see figure 3). The buffer module is located as close as possible to the 24-pin header plug that is installed in the EPROM socket because it is used to increase the drive capability of the signals between the EPROM socket and the development system. I haven't done any testing to determine what the maximum length of the cable should be before delays and signal degradation cause the system to malfunction. Mine worked fine with a 3-foot long cable. Therefore, I didn't try any other lengths.

As you may have already guessed, the development system hooks into one port of the dual-port memory; the EPROM socket gets connected to the other.

The development system can read from and write to this memory through its port without any idea that there is anything different about it; it appears to be just an ordinary block of programmable memory. Whenever the development system isn't accessing the dual-port memory board, control is passed to the address and data bus of the EPROM socket. Whenever the EPROM socket is accessed, data are read just as if they were in an EPROM plugged into that socket.

As the schematic diagrams of figure 2 and figure 3 show, the design is straightforward. The 8131 address comparator (IC3, figure 2a) can be considered the "brains" of the system because it switches control back and forth between the two ports. When AB15 through AB11 have the same bit pattern as switches SW4 through SW0, the $\overline{\text{BOARD SELECT}}$ line from pin 9 of the 8131 goes low and several things happen simultaneously. The 74LS245 system data-bus buffer (IC1,

Number	Type	+5 V	GND
IC1	74LS245	20	10
IC2	74LS244	20	10
IC3	8131	16	8
IC4	74LS157	16	8
IC5	74LS157	16	8
IC6	74LS157	16	8
IC7	74LS04	14	7
IC8	2114	18	9
IC9	2114	18	9
IC10	2114	18	9
IC11	2114	18	9

2b

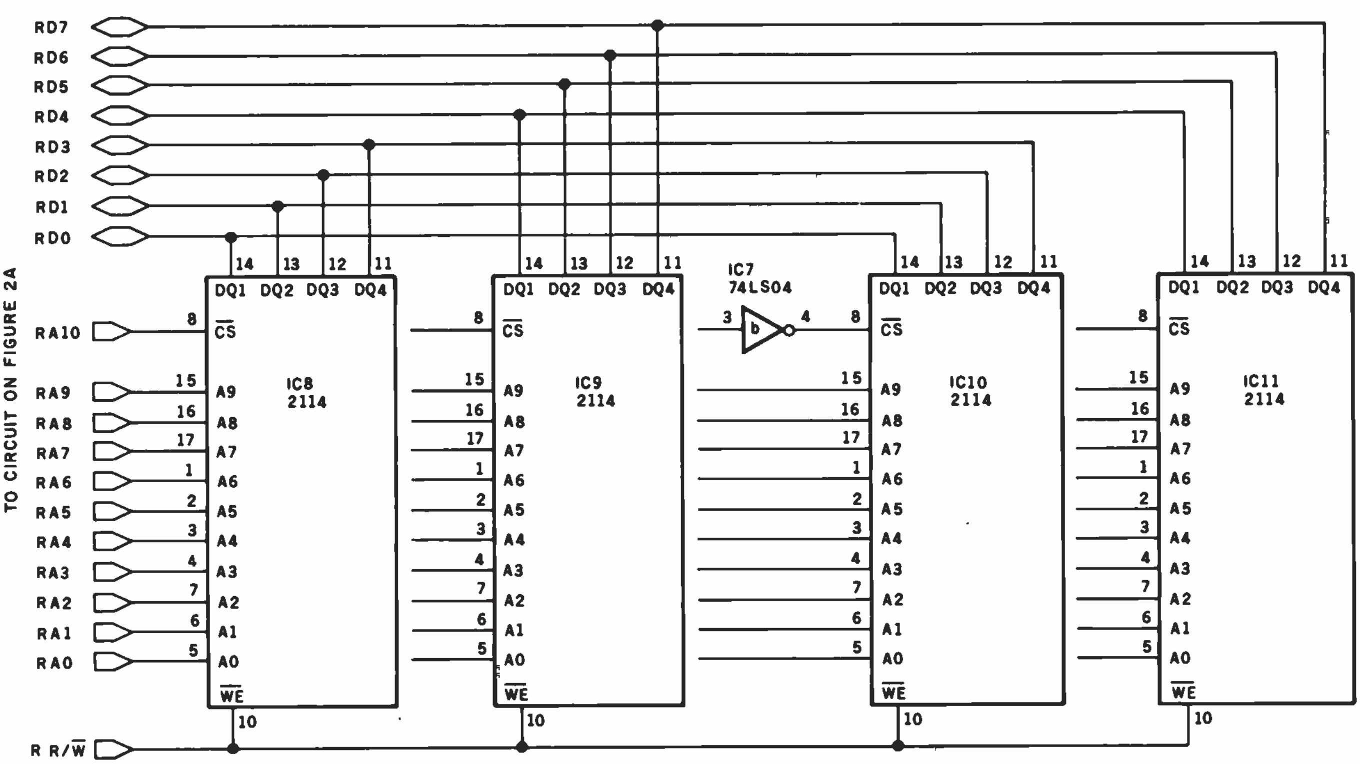

Figure 2b: *A schematic diagram of the programmable-memory portion of the EPROM emulator dual-port memory circuit. The entire circuit (figures 2a and 2b) is connected via ribbon cable to the buffer/adapter board of figure 3.*

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IC2	74LS244	20	10
IC3	74LS244	20	10
IC4	74LS32	14	7

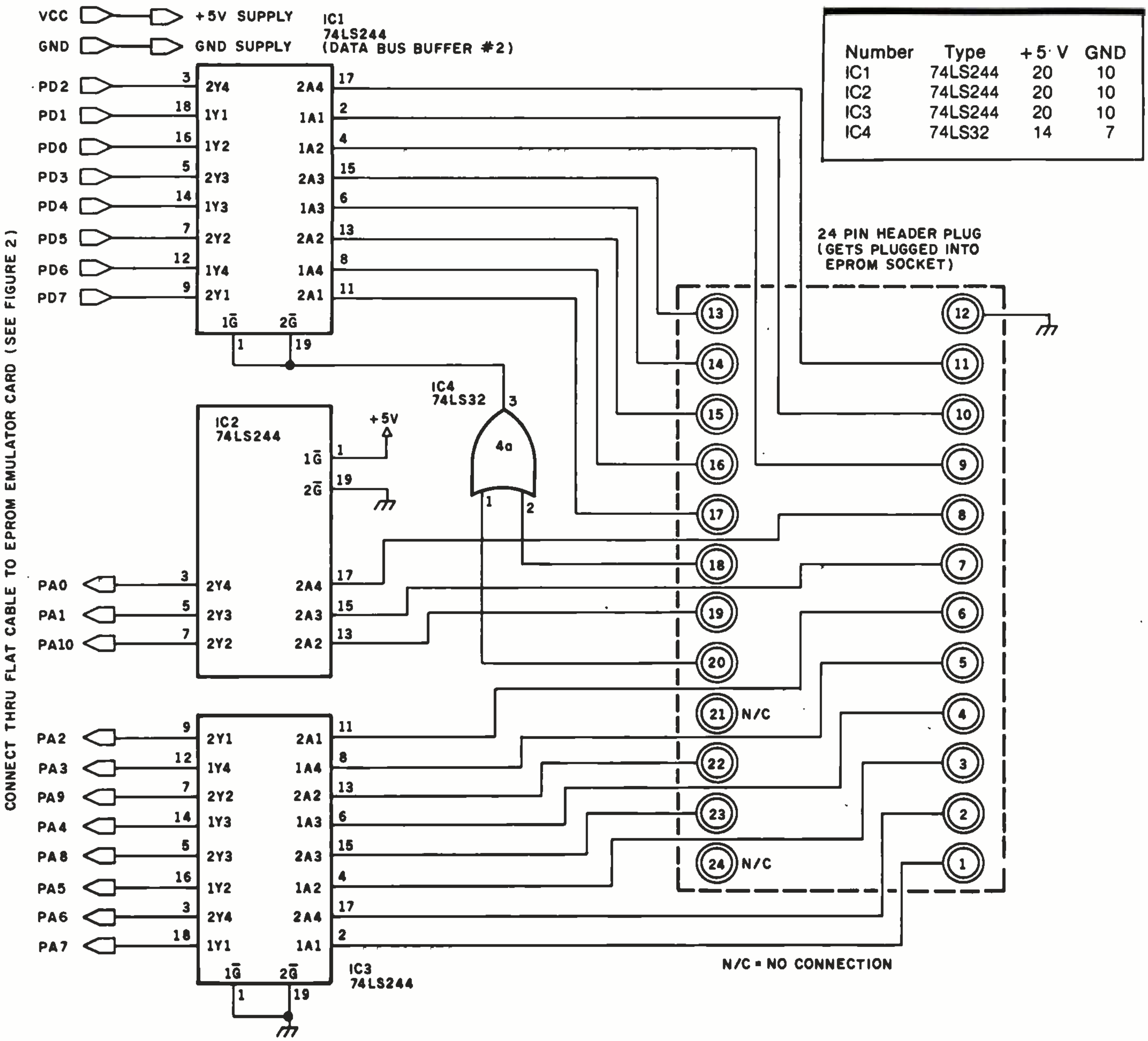

Figure 3: *Schematic diagram of the buffer/adapter board. This segment of the emulator system is used to strengthen the drive capabilities of the EPROM socket to insure that signals are transmitted through the ribbon cable adequately.*

figure 2a) is enabled, as well as the "A" side of the 74LS157 address-line multiplexers (which gives control of the dual-port memory over to the development system), while the EPROM data-bus buffer #1 (IC2, figure 2a) is disabled.

The development system is now in full control of dual-port memory access. If the EPROM socket tried to gain access to the board at the same time, the EPROM data-bus buffer #2 (IC1, figure 3) would be selected. However, since the #1 buffer (IC2, figure 2a) was deselected, no good data would be read. The 74LS32 gate on the buffer board (IC4, figure 3) makes sure that the #2 buffer doesn't get enabled until the EPROM $\overline{CE}$ and $\overline{OE}$ signals (pins 20 and 18) from the target system are both low.

Whenever the $\overline{\text{BOARD SELECT}}$ line is high, the 74LS245 data-bus buffer (IC1, figure 2a) is disabled, while the 74LS244 EPROM data-bus buffer #1 is enabled, along with the "B" side of the 74LS157 address-line multiplexers. This gives the EPROM socket access to the dual-port memory during the times that the development system isn't accessing the board.

Details

This circuit was designed to reside in a 6502-based development system and emulate the Intel 2716 EPROM. The development system is built around the MOS Technology KIM-1 with hardware expansion accessories (48K bytes of memory, an 8-inch floppy-disk drive, and a 15-slot motherboard) from Hudson Digital Electronics (POB 120, Allamuchy, NJ 07820, (201) 362-6574). The emulator was built on a wire-wrap prototyping card (also from Hudson) using normal digital-construction techniques.

The EPROM buffer module in

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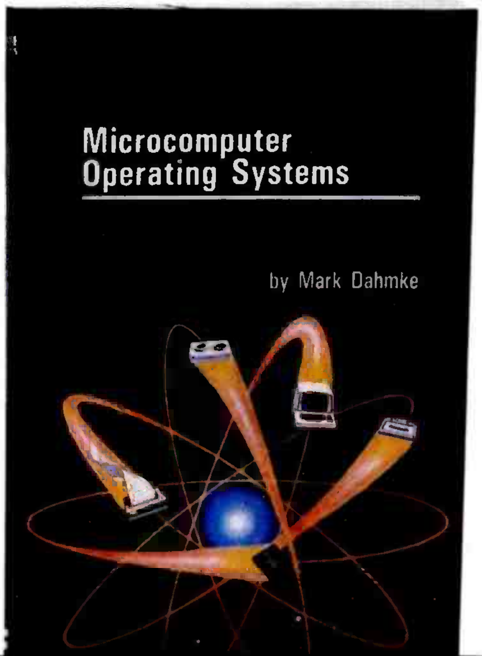

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photo 1 is an earlier version designed to emulate the 2708 or the TI or Intel 2716. Since I ended up using only the Intel 2716-style part, I eliminated the switching feature from the design presented here. This simplified the circuitry quite a bit.

A situation may arise where the 2K-byte dual-port memory board may need to reside at a different physical address in the development system than that of the EPROM socket in the target system. In this case, the system assembler must be able to assemble code that runs at one location but actually resides at another.

Say, for example, that the emulator resides at C000 hexadecimal in the development system, while the EPROM socket is located at F800 hexadecimal in the target system. The system assembler must then be able to assemble object code to operate from the F800 address (so that it can run in the target system), but physically reside at C000 (so that it can be assembled into the emulator). This feature is usually called *assembly with offset*. It is included in the assembler from Hudson, as well as most good assemblers. If your assembler doesn't have this feature, you may be able to assemble to disk (or tape) and reload with an offset. Of course, if the emulator is located at the same physical address as the EPROM socket, you don't have to worry about any of these offset problems.

Users of the 6800 system should have little difficulty adapting the emulator to work with their machines. Users of Z80/8080 equipment will only have to redesign the interface to the development-system side of the emulator.

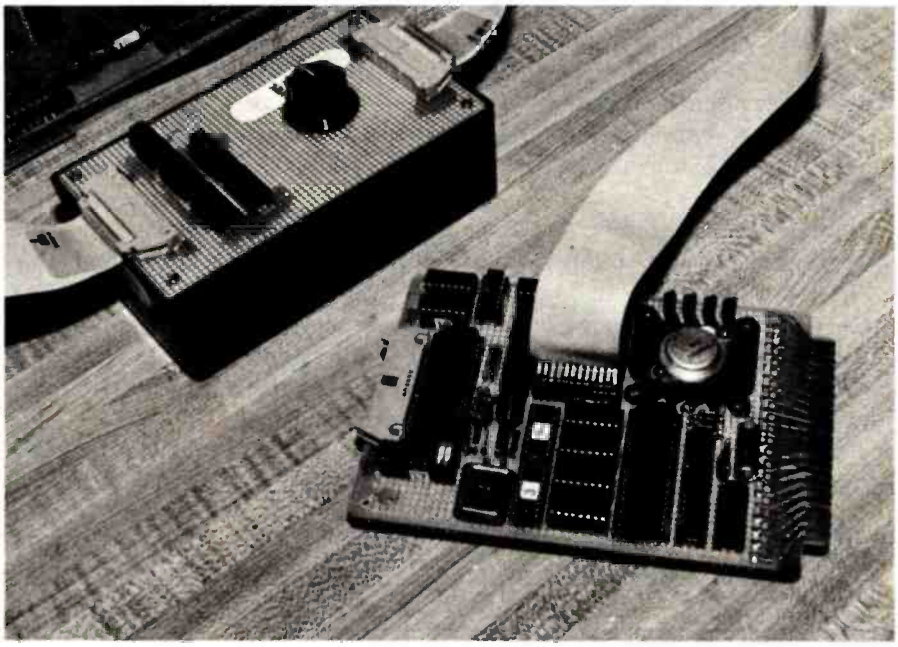
The emulator can easily be expanded to handle the newer 4K-byte EPROMS, with the addition of more memory and another multiplexer.

Another Use for the Emulator

How would you like a programmable character generator for your video board? Just plug the emulator into the character-generator socket (you may have to modify the connection to make it compatible) and load your character set into the dual-port memory. Anytime the video circuit is commanded to display a character, it reads the dual-port memory and displays the character you have programmed.

I also use the board for loading programs into my Rockwell AIM-65, Synertek SYM-1, and Apple II computers. Since the AIM-65 and SYM-1 only have cassette mass storage, I can usually save time and trouble by just saving everything on the floppy disks in the development system.

The EPROM emulator has proven itself to be a worthwhile addition to my arsenal of system-development tools and has paid for itself several times over. ■



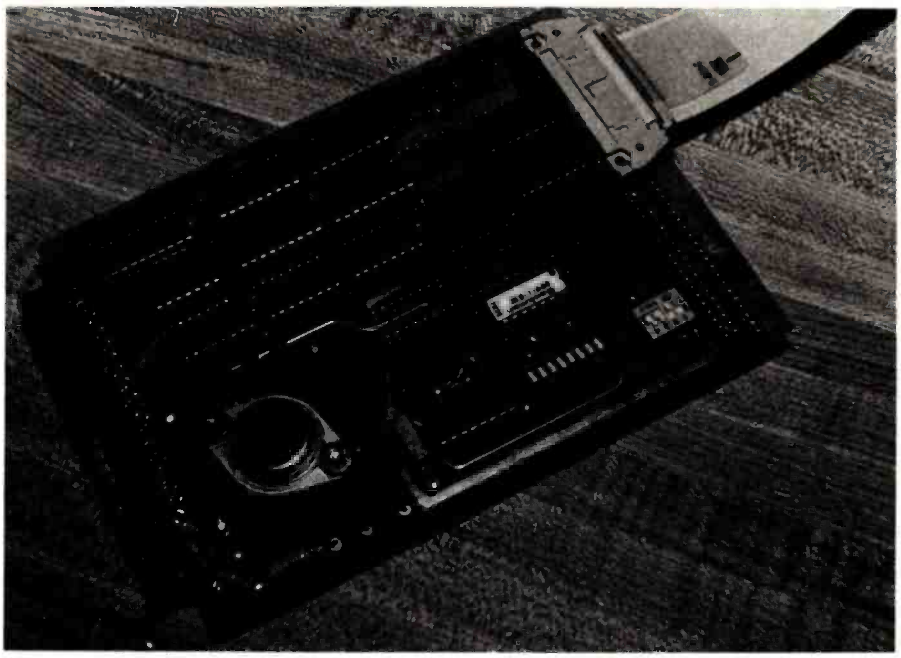


Photo 1: *Close-ups of the parts of the EPROM emulator. The top photo is the early version of the buffer module, with its 24-pin header installed in the EPROM socket of the 6502-based single-board computer under development (the target system). The bottom photo shows the dual-port memory, built on a wire-wrap card.*

Two Tax Aids

Aardvark Individual Tax Plan and Howardsoft Tax Preparer

Mary Jo Kvam
13 Foliage View
West Lebanon, NH 03784

Before I compare two income-tax programs, the Individual Tax Plan by Aardvark Software and the Tax Preparer by Howard Software, let's take a look at the process of creating a tax return.

Income-tax preparation has three phases that you must complete in order to come up with a finished product by April 15.

Phase 1 is record keeping. You must keep records of all the necessary tax facts and figures for the year.

Phase 2 is planning. It involves making certain key decisions so that when you fill out the forms and schedules, your tax position is optimized. These decisions might include whether to file joint or separate returns, how much stock to sell to maximize your tax advantage on long-term capital gain or loss, whether to use the 10-year averaging method for lump-sum distributions, and other considerations.

Phase 3 is the paperwork of actually filling out the tax return to be submitted to the IRS. This phase is compulsory, of course, but your work here will be supported and strengthened by the completion of the other two noncompulsory phases.

The two tax programs reviewed here have different goals and are aimed at different audiences. The Individual Tax Plan will simplify and speed up your work in Phase 2. The Tax Preparer will assist you through Phase 1 and ease you through Phase 3. Both programs run on Apple II disk systems; see the At a Glance text boxes for the specific requirements.

The Aardvark Individual Tax Plan

The Aardvark Individual Tax Plan (AITP) helps you to determine systematically your best tax alternative. You enter a variety of income and expense items to create different tax situations. AITP does the calculations and allows you to isolate the tax results attributable to the

About the Author
Mary Jo Kvam has worked for eight years in data processing and is currently engaged in consulting and freelance writing.

At a Glance

Name
Individual Tax Plan

Type
Income-tax-planning software

Manufacturer
Aardvark Software Inc.
783 North Water Street
Milwaukee, WI 53202
(414) 289-9988

Price
$250

Format
Two 5¼-inch floppy disks—one program and one data disk

Language Used
Apple Pascal Language System

Computer Needed
Apple II or Apple II Plus with 48K bytes of memory; CP/M System; one or more disk drives (DOS 3.3); printer (known to work with Anadex 9500 and 9501, Epson MX-80, NEC 5530, Okidata 22, most others)

Documentation
3-ring binder, 44 pages

Audience
Professional tax planners

At a Glance

Name
Tax Preparer

Type
Income-tax record-keeping software for creation of IRS-acceptable forms and schedules

Manufacturer
Howard Software Services
6713 Vista Del Mar
La Jolla, CA 92037
(714) 454-5079

Price
$99

Format
Two 5¼-inch floppy disks—one program and one storage disk

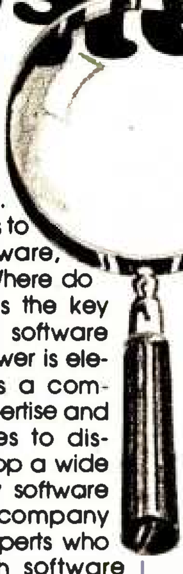
Language Used
Applesoft BASIC

Computer Needed
Apple II Plus with 48K bytes of memory; one or more disk drives (DOS 3.2 or 3.3); printer optional—most parallel-port printers are suitable.

Documentation
3-ring binder, 22 pages

Audience
Individuals and tax professionals

Solve the Great Software Mystery!



You spent a lot of time searching and researching to find just the right computer. But when it comes to compatible software, you're stymied. Where do you turn? What is the key that unlocks the software mystery? The answer is elementary. It takes a company with the expertise and research facilities to discover and develop a wide variety of quality software programs — a company with a staff of experts who understand both software and hardware — a company that is not only reliable but offers unique 24-hour services and — a company dedicated to being your software company.

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The LBS is designed for law offices with up to 25 attorneys and 35 timekeepers, including paralegals and secretaries. The system distributes all Time and Expenses to client accounts or designated Overhead Accounts, and produces monthly Client Review sheets. After any adjustments it also provides: ready-to-mail itemized bills, monthly Office Management Summary, Aged Receivables Report. An Accounts List is also built into the system.

Complex transactions recording is reduced to a minimum because the LBS system is based on daily timesheets prepared by each timekeeper with a complete system for coding client matters and expenses. The attorney auditing the pre-billing review form can choose various predetermined rates, or bill on retainer, contingency fee or an adjusted basis.

The Office Management Summary provides a financial analysis of each attorney's billings, aging of his accounts receivable and an analysis of the work effort of each timekeeper and total for the firm. The Accounts List summarizes current activity and status of each client.

The LBS is designed so that even first-time computer operators can install the system without expert help.

System/documentation-$895
Demonstration System-$ 75
Documentation alone-$ 40

MICRO-TAX

Micro-Tax provides in-house computerized tax capability for the tax practitioner or serious investor. The system is designed to accept information, summarize data, compute tax and print the returns required by the Internal Revenue Service. The system's immediate response capability gives both tax specialist and clients immediate results of the computation.

The system reduces time required to complete a return while also minimizing the tax obligation of the taxpayer within the limit of the law. Three levels of tax preparation systems are available:

Level 1 — Uses 23 schedules and forms, handles multiple clients, and prints IRS approved forms.

Level 2 — All of Level 1 plus six more schedules and forms, depreciation system, state tax interface, integrated data base for year to year data storage, and batch compute and print functions.

Level 3 — All of Level 1 plus partnership schedules and forms.

State tax computation for the following states is available at additional cost: Arizona, California, Illinois, Ohio, Oregon, Maryland, New York, Utah, Virginia and Washington, D.C.

Other states and municipalities are being added.

Prices:
Level 1 — $250
Level 2 — $1,000
Level 3 — $750
Level 2 plus Level 3 — $1,500
State Tax — Call for prices
Demonstration system — $75

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variables entered. By comparing the outcomes, you can determine the most advantageous tax situation.

Step by step, AITP assists you in setting up your tax case. You are prompted for the number of alternatives you want; the maximum is 5 per file. AITP will then prompt you for up to 72 input values (besides spouse entries) to be used in determining the tax due (see table 1). You need not enter all this data, nor even be prompted for all of it. As shortcuts, AITP offers special function keys designed to provide freedom of movement through the data-entry section.

Once you've completed the data-entry section, you give your file a name and save it. It is now an old file, which can easily be reviewed, changed, or deleted. To see all of the tax results for a case, the calculations are performed and the results are displayed on the screen and printed as hard copy. You can set up an additional file that provides more alternatives for the same case by using a different file name. You can create this file from scratch or make changes to an existing file and give the modified file a new name.

System Configuration

AITP requires an Apple II or II Plus with 48K bytes of memory and one or more disk drives using either DOS 3.3 or the Apple Pascal Language system. The disk-controller card must be installed in slot 6 and the printer-interface card in slot 1. Without the printer-interface card

1 Filing Status
2 Exemptions

Income

3 Wages, Salaries
4 Interest After Exclusion
5 Dividends After Exclusion
6 Short-Term Capital Gain/Loss
7 Short-Term Capital Loss Carryover
8 Short-Term Capital Gain—Sale of Principal Residence
9 Long-Term Capital Gain/Loss
10 Long-Term Capital Loss Carryover
11 Long-Term Capital Gain—Sale of Principal Residence
12 Partnership Income
13 Other Income/Loss—A
14 Other Income/Loss—B
15 Other Income/Loss—C
16 Other Income/Loss—D
17 Adjustments to Income

Deductions

18 Medical Insurance Premiums
19 Medicine and Drugs
20 Other Medical and Dental Expenses
21 State Income Taxes Withheld
22 Estimated State Income-Tax Payments
23 Other Taxes
24 Interest Expense
25 Charitable Contributions—20%
26 Charitable Contributions—50%
27 Charitable Contributions Carryover—50%
28 Charitable Contributions—30% (Fair Market Value)
29 Charitable Contributions—30% (Enter Gain If 50% Election Is Applicable)
30 Charitable Contribution Carryover—30%
31 Casualty Loss
32 Miscellaneous Deductions—A
33 Miscellaneous Deductions—B

Additonal Taxes

34 Form 5405
35 Forms 4970, 4972, 5544, and Section 72(m)(5) Penalty Tax

Credits

36 Political/Elderly/Child Care/Residential Energy Credits
37 Investment Credit
38 Foreign Tax Credit
39 WIN Credit
40 Jobs Credit

Other Taxes

41 Self-Employment Tax
42 Recapture of Investment Credit
43 Other Taxes

Payments

44 Federal Income Taxes Withheld
45 Estimated Federal Income-Tax Payments
46 Other Payments

Schedule G

47 1980 Form 1040, Line 34
48 1979 Form 1040, Line 34
49 1978 Form 1040, Line 34
50 1977 Form 1040, Line 34
51 1980 Exemptions
52 1979 Exemptions
53 1978 Exemptions
54 1977 Exemptions
55 1980 Foreign Income
56 1979 Foreign Income
57 1978 Foreign Income
58 1977 Foreign Income
59 Amounts Received Subject to Section 72(m)(5) Penalty
60 Excess Community Income

Form 4625—Minimum Tax

61 Tax Preference Items
62 Tax on Premature Redemption of Individual Retirement Bonds
63 1981 Net Operating Loss Carryover to 1982
64 Minimum Tax Deferred from Earlier Years

Form 4726—Maximum Tax

65 Personal Service Net Income

Form 6251—Alternative Minimum Tax

66 Foreign Tax Credit Adjusted for Alternative Minimum Tax Calculation
67 Other Credits Allowed Against Alternative Minimum Tax

Form 4972—10 Year Avg. Method

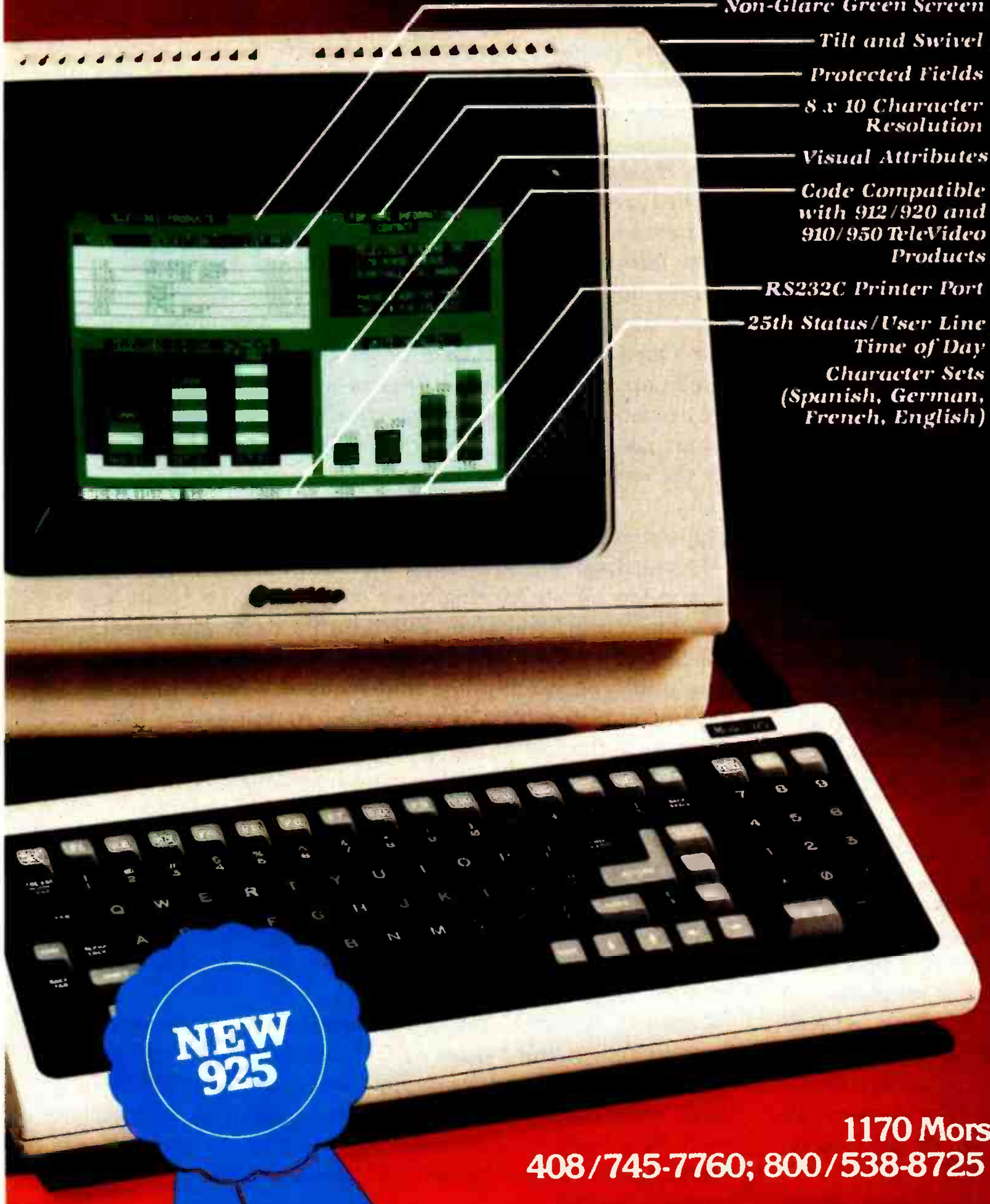
68 Capital Gain Portion of Lump-Sum Distributions
69 Ordinary Income Portion of Lump-Sum Distributions
70 Current Actuarial Value of Annuity
71 Exclusion
72 Federal Estate Tax Attributable to Lump-Sum Distribution

Table 1: *A list of the 72 input values used in Aardvark's Individual Tax Plan to determine the income tax due.*

Circle 353 on inquiry card. →

The Performance Leader....

Model 925



Now you can have it all with TeleVideo's new 925. Code compatible with our 910 and 950 terminals, the 925, with its 6502 microprocessor-based control board can emulate our 912/920 models while operating at speeds up to 19.2K baud. This allows you to grow within the TeleVideo family of terminals, from the conversational to the smart.

The 925, a modular designed unit that uses the same power supply, monitor, and keyboard as the rest of TeleVideo's family, has built-in *proven* reliability and quality from beginning to end. TeleVideo's P31 non-glare, tiltable, green screen and detached selectric style keyboard make the 925 a comfortable, low stress terminal to use.

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in slot 1, AITP will not run. I have no printer at home, so I used a modem card in slot 1 and that worked fine. Aardvark claims that the Individual Tax Plan will interface successfully with most standard printers. A minor hardware modification may be necessary for printers that use the Centronics Parallel Card.

If you have a one-drive system, you will need to make extra copies of the program disk. All of your tax plan cases will be saved on these disks, and Aardvark estimates that between 20 and 30 tax-plan files can be saved on each disk. With a two-drive system you will need to make extra copies of the data disk, as well as a backup of the program disk. Aardvark estimates that between 50 and 75 tax-plan files can be saved on each data disk.

Documentation

The documentaton for AITP is well packaged in a 44-page, 3-ring binder. The sheets are printed on one side only, making them good for notes. The documentation is easy to follow, complete, and concise. I had only to skim through the binder once to become familiar with the layout and feel comfortable with it as a tool.

The documentation has six sections. First, an introduction gives an overview of the program, hardware requirements, etc. The second section teaches you how to use AITP by walking you through two different sample cases. I found this section really helped me become comfortable with the software. It's a kind of "blind faith" approach, because you are setting up cases without knowing a lot about the software, but it works. The third section explains the screen menus, what every choice on every menu will do, and how the menus fit together. Section four describes the auto-entry keys and special function keys, which provide unique shortcuts for entering tax data. The fifth section defines the 72 tax inputs, and the appendixes give input work sheets and illustrations of the inputs and printouts of the two sample cases from section two. Everthing you need to run AITP is included in the documentation. If it weren't for a few minor errors, I would have rated it excellent.

Using the Program

For the most part, AITP is a pleasure to use. The hierarchical menu structure is easy to use and understand. Even during my first session of entering new cases and revising old ones, I knew where I was in relation to the overall program. AITP's error handling is well designed. The program will not crash when given improper input values; it simply refuses to accept them. Screen management is well done too. The screens are crisp and clear, and when there are separate sections on the same screen, they are well partitioned.

AITP could be improved a bit in a few areas. Some menu choices don't really make sense for certain processing paths. When selected, such choices may temporarily cause a slightly jumbled display. This flaw might have been remedied by tailoring the menus to the processing paths. And why prompt for spouse information in cases involving single taxpayers? This situation causes no real harm, but if you're not married you must hit the F (Forward) key a bit more often.

According to Aardvark, this version of AITP will have been superseded by the time this review is published. The new version will reflect the new tax law and include adjustments for tax revisions through 1986. One of the enhancements that the new version will include is a projection capability, so you will be able to determine future tax consequences. You will be able to see the results of your tax planning for the base year plus the next four years.

Also, at an additional cost, you can obtain software designed for state tax planning. Only selected states are available (contact Aardvark for details). Note that the Aardvark Individual Tax Plan is now available to run on CP/M-based microcomputers.

The Howardsoft Tax Preparer

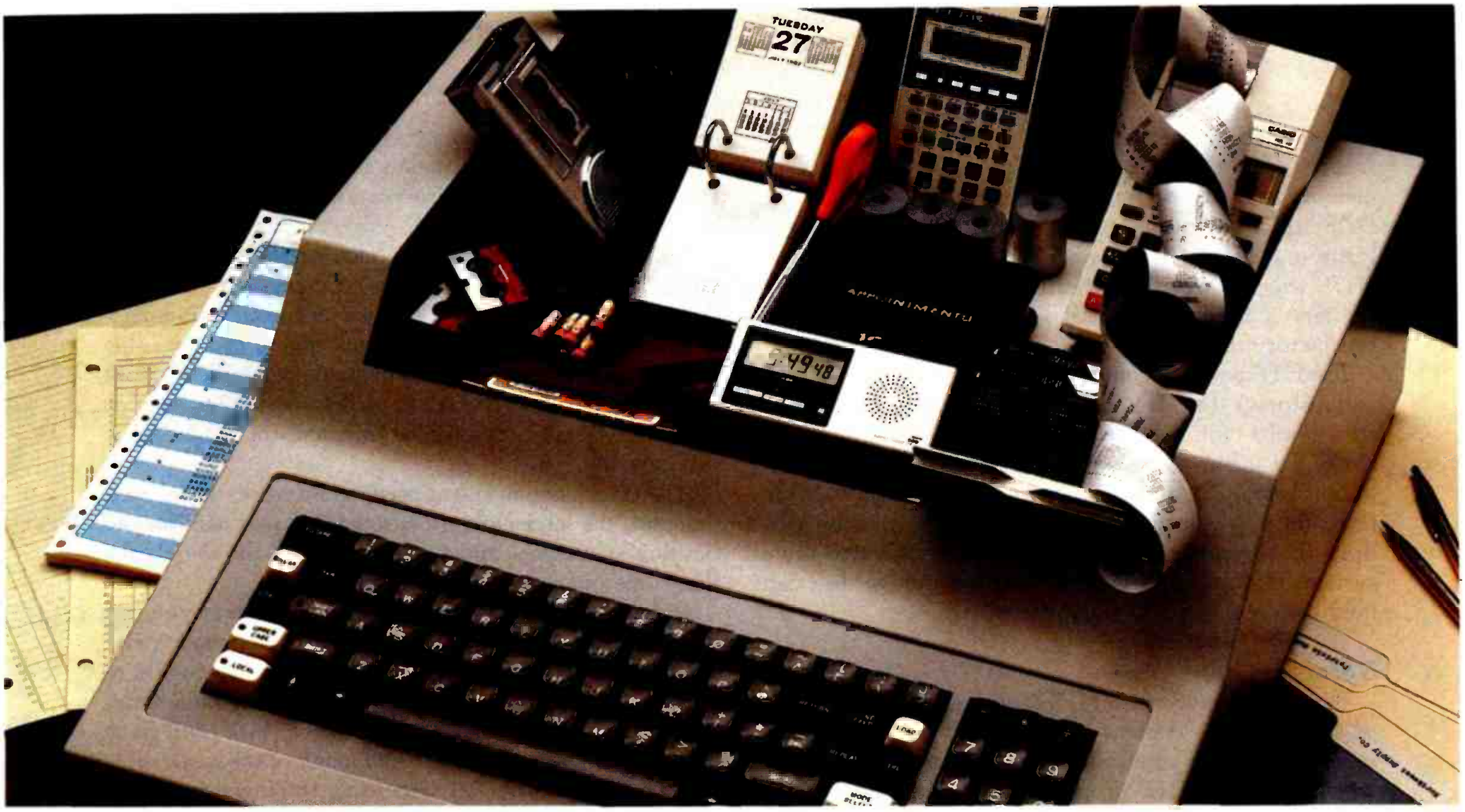
The Howardsoft Tax Preparer (HTP) actually prepares the forms and schedules that comprise the tax return. You enter information for your tax return just as you have always done, but you only need to enter information once. Repetitious inputs and complex procedures are eliminated. HTP takes care of all calculations, and the results are reflected on all lines of all forms where they are needed. An itemization feature allows HTP to be used for tax record keeping throughout the year in preparation for the next filing deadline.

The Process

Howardsoft suggests using the 1040 income-tax form as a guide for structuring your data entry. To create a new tax return, you give your return a name and select the 1040 as the form (file) you want to fill out. You enter data until you reach a line that requires a result from a yet uncompleted form or schedule. At this point, you must go to the end of the 1040 form. You can do this by scrolling or by exiting at the end of a section. After you save the interim results of the 1040, you select the form or schedule that you must complete before continuing with the 1040. Once that form or schedule is completed, you save those results and return to the 1040 form you started by requesting it by file name. This process continues until the 1040 and all other applicable forms and schedules are finished.

Granted, this may not be the fastest way to complete your tax return, but I agree with Howardsoft that it is the most foolproof. Revisions to any form or schedule can be made easily; however, every time you make an adjustment to a form or schedule, you *must* scroll through every other form or schedule that uses that data to ensure proper updating.

HTP creates printed versions of all of the forms and schedules that it handles, and, except for the 1040 form, these can be filed directly with the IRS. Preprinted 1040 forms must be used to meet IRS requirements, and HTP will print directly on the preprinted forms.



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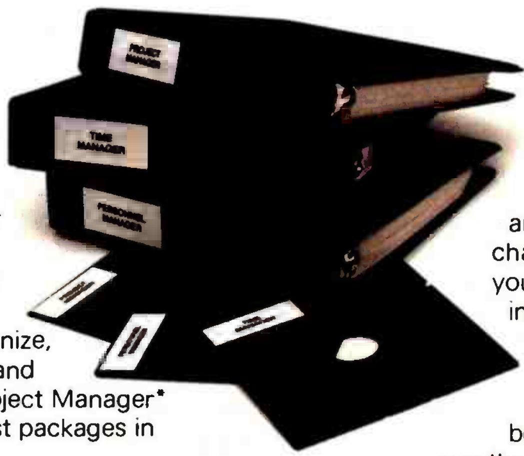

Better management tools. The Manager Series from Microsoft turns an inexpensive personal computer into an executive's toolbox. Not a computer programmer's toolbox. An executive toolbox. Computerized management tools for non-computer people.

Time, people, projects. The Series is a system of software tools that work together to help you plan, organize, schedule and record your business and personal affairs. Time Manager,* Project Manager* and Personnel Manager* are the first packages in the Series.

Write it once. All programs in the Manager Series allow you to transfer information between programs. That means you can enter information in one program and transfer it for management by another.

Time Manager. The key. Time Manager helps you manage your personal time, appointments and priorities. It can also help you manage expenses, costs and job schedules. Or, keep a running tally of costs and hours by day, week, month or year. And Time Manager can act as an "executive" to manage other programs in the Series.

Project Manager. Describe the components of a project to Project Manager. It will create timing, task and resource charts to help you focus on critical tasks. Change one piece of information and Project Manager will recalculate the entire project. Project Manager even flags overcommitted personnel resources.

Personnel Manager. Manage information about people, companies, customers or prospects. From names and addresses to skills, position, and characteristics. Personnel Manager lets you enter any kind of people-related information. Then, organize and retrieve it almost any way you want.

Management software. Even if you've never used a computer before, you should be able to productively use the Manager Series in a very short time. And, when you've learned to use one in the Series, you've virtually learned them all.

Seeing is believing. Ask your local computer store for a demonstration of the Manager Series. It's a series of management tools that could be your best reason to own a personal computer.

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Circle 222 on inquiry card.

System Requirements

HTP requires an Apple II Plus with 48K bytes of memory and one or two disk drives using DOS 3.2 or DOS 3.3. You'll need a printer to prepare the hard copy forms and schedules. Howard Software informs me that HTP will interface successfully with most standard printers. I used an Integral Data Systems 460G with satisfactory results.

The HTP package contains two disks—a program disk and a storage disk. If you have a one-drive system, your storage disk will need to contain label files in order to avoid the inconvenience of frequent switching between the program disk and the storage disk. A label-copying program is provided as part of HTP. The switching of disks then becomes minimal. In the case of a two-drive system, Howardsoft estimates that the storage disk can hold between 7 and 15 extensive returns.

Documentation

The documentation for HTP is in an attractive, durable package, but its content is only in the fair-to-average range. The documentation provides the information you will need to run HTP properly, but it does not make a very useful reference tool. It is unclear and did not help me much in seeing the whole picture. The manual is split into seven separate chapters, but the material is presented in such a way that I rarely knew where to turn for an answer.

The manual is also a bit sparse—for example, a few more forms and schedules in the appendix would have been a great help. And the documentation should do more than just tell you how to look at the sample case on the program disk. It should contain a walk-through for setting up a sample return from beginning to end. As it stands, the documentation needs rewriting to become a worthwhile resource.

Using the Program

HTP is not the easiest program to use. To some extent, this shortcoming can be traced back to the design of the software, but another reason for the program's complexity is that HTP undertakes quite a bit. The software allows you to enter tax data in its rawest and most familiar form, eliminates duplication of input, performs all calculations, and prints out forms and schedules acceptable to the IRS.

I discovered a flaw in HTP that could cause the tax return to be incorrect. The problem concerns capital gains distributions. The amount is entered on Schedule B, but HTP does not automatically carry this figure over to Form 1040 or to Schedule D. You must enter it again manually on either Form 1040 or Schedule D to properly compute your tax return. I did not hit upon any other critical problems, but the depreciation section was confusing and in need of improvement.

HTP could use quite a bit of tailoring. For example, when data for a new tax return are being entered, you face the same routine used for changing data on an existing return. Every entry must be input as if it were changing old data. This means extra steps for each new entry, a time-consuming process. An adjusted routine for new cases is needed.

Some other refinements are also necessary. HTP lets you exit from a form or schedule by entering an "N" at the end of a section. Since you are apt to be going back and forth between various forms and schedules, this exiting capability should also be made available at those points where it is necessary to switch to another form or schedule. Also, the scrolling method for updating is cumbersome.

HTP screen management needs some work; more often than not, the screen seems cluttered. I would sacrifice the flashing statements and inverse displays for the clarity that some open space would provide.

A good feature of the printing routine is that you can enter as many returns as you want and then walk away after you get it going. You'll appreciate this when you're running off a few forms and schedules at the same time.

By the time this review is published, HTP will have been substantially upgraded, and many of the weak spots will have been corrected, according to Howardsoft. For example, the problem with capital gains distribution should be remedied, and Howardsoft plans to replace the scrolling update method with an automatic update method and improve the documentation. Some general software refining should be evident and a tax-planning facility should be added. In addition, Howardsoft will be offering separate interrelated software for preparing the state income-tax return for certain states.

Comparisons

Neither Aardvark nor Howardsoft provides a warranty on the results of its software. This means the IRS will hold *you* responsible for inaccuracies, not the software houses.

AITP stores uncalculated results. The calculated results are not filed on the disk, but are printed directly from memory, which ensures that the results are consistent with the input. In HTP, calculation results are filed on the disk and all printing is done directly from the disk. Thus, it is possible to change an input and then print an incorrect form because the calculations are based on the old input. The HTP documentation warns against this possibility.

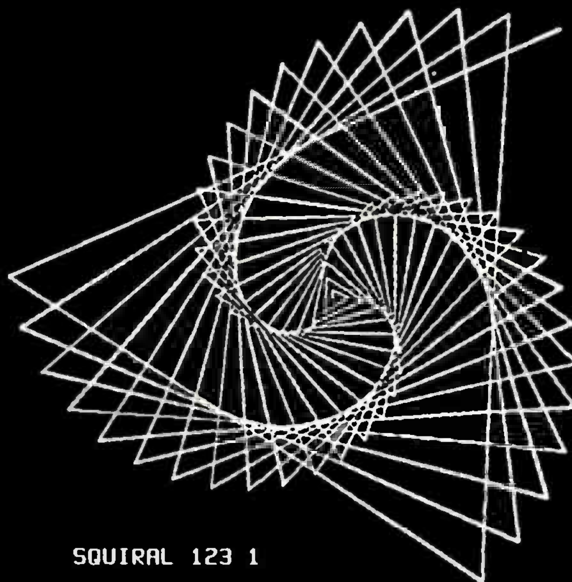
The only way to exit from AITP is to shut off your Apple II. You cannot use Apple system commands or do anything else while you're running AITP. HTP, written in Applesoft BASIC, can be terminated to return control of your Apple II to you. You can use Apple system commands and modify the program if you want.

AITP requires organizational work before you can actually input data, and the bulk of the tax calculations must also be done prior to inputting data. The nonprofessional tax planner may have difficulty in deciding which figures should be included as part of which inputs. On the other hand, nonprofessional tax preparers will *not* find

Circle 356 on inquiry card. →

The Logo Language is Here for the Apple II

```
TO SQUIRAL :ANGLE :DISTANCE
 IF :DISTANCE > 200 THEN STOP
 FORWARD :DISTANCE
 RIGHT :ANGLE
 SQUIRAL :ANGLE :DISTANCE + 3
END
```



SQUIRAL 123 1

Terrapin, the Turtle Company, brings you the Terrapin Logo Language for the Apple II with Turtle graphics, now ready for immediate delivery.

The Terrapin Logo language is a sophisticated and powerful language that is easy for anyone to use. Although originally intended for children, the Logo language is one that the most advanced programmers will enjoy using too. It includes many features common to artificial intelligence research languages permitting programs of great power to be written quickly and easily. Writing comparable programs in other languages is usually much more difficult and time consuming.

The Turtle graphics is fun and easy. With simple commands such as FORWARD, RIGHT, and PENUP you can draw in six hi-res colors. In just a few short sessions you can learn to create figures more complex than the one above whether you know how to program or not.

But the Terrapin Logo language is more than just a graphics language. It supports:

- list structure, allowing easy manipulation of words (strings) and lists
- user defined procedures which can be used exactly as if they were part of the language.
- fully integrated screen editor for procedures and text
- floating point and integer arithmetic
- a total of 120 primitives (commands) including 30 graphics commands
- recursion
- assembly-language interface capability

The Terrapin Logo language was developed by the Artificial Intelligence lab at the Massachusetts Institute of Technology. Terrapin is now authorized by MIT to distribute the results of its 12 years of research to you. To provide quality support for the language, Terrapin has assembled a team that includes two of the three authors who developed the Logo language for the Apple II at MIT, as well as Dr. Feurzeig, the originator of the Logo language.

Every copy of the Terrapin Logo language comes with complete documentation. To run the language, a 48K Apple II with a 16K RAM card or a language card, and one disk drive is required.

Terrapin also offers the robot Turtle, and the following books: *Turtle Geometry, Special Technology for Special Children, Mindstorms, Katie & the Computer,* and *Apple Logo* from Byte Books.

Suggested retail price: $149.95
To order or for more information, call or write:

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Cambridge, MA 02139
(617) 492-8816

Form	Description
Form 1040	U.S. Individual Income Tax Return
Schedule A	Itemized Deductions
Schedule B	Interest and Dividend Income
Schedule C	Profit (or Loss) from Business or Profession
Schedule D	Capital Gains and Losses
Schedule E	Supplemental Income Schedule
Schedule F	Farm Income and Expenses
Schedule G	Income Averaging
Schedule R&Rp	Credit for Elderly
Schedule SE	Computation of Social Security Self-Employment Tax
Schedule TC	Tax Computation Schedule
Form 2106	Employee Business Expenses
Form 3468	Computation of Investment Credit
Form 4562	Depreciation
Form 4726	Maximum Tax on Personal-Service Income
Form 4797	Supplemental Schedule of Gains and Losses
Form 5695	Energy Credits
Form 2210	Underpayment of Estimated Tax by Individuals

These additional forms are offered in a special supplement for those who need them.

Form 2119	Sale or Exchange of Principal Residence
Form 4625	Completion of Minimum Tax—Individuals
Form 6251	Alternative Minimum Tax Computation

Table 2: *A list of all the forms and schedules handled by Howardsoft's Tax Preparer.*

HTP above their level of tax expertise. Inputs need no prior handling if you use the itemization routine, and you make entries as if you were manually completing the return. There is nothing extra to be concerned about and a lot of the bother is taken away. (See table 2 for the forms and schedules which HTP emulates and prints out.)

Both Aardvark and Howardsoft offer updated software to reflect necessary revisions due to changing tax laws. Aardvark makes new versions available to its users within weeks of the passing of tax legislation. Howardsoft publishes its software revisions in January of the next year, because the IRS does not publish the final versions of its new forms and schedules until the end of the calendar year. Both software houses offer these revisions to their customers at a fraction of the cost of the original software. Aardvark and Howardsoft are also periodically expanding and enhancing their software at a reasonable cost.

Conclusions

- Neither Aardvark's Individual Tax Plan nor Howardsoft's Tax Preparer is for the novice. AITP is clearly aimed for use by the tax professional. HTP can be worthwhile for the nonprofessional as well as the professional, but it does require some tax knowledge.
- AITP is a polished product. It is well structured, clear in its documentation, and easy to use. HTP is an ambitious product, but some refinements would make it easier to use.
- AITP and HTP perform as advertised, and the printouts produced are in accordance with the documentation.
- AITP is tax-planning software. HTP does tax record keeping and prepares and prints the tax return. The two programs are not in direct competition. Together they include all phases of tax preparation.■

Acknowledgments
My thanks to Robert Strohsahl of Chips Microcenter, Hanover, New Hampshire, and to C. Bennett Brown, Jr., CPA, of Smith, Batchelder & Rugg, Hanover, New Hampshire, for their kind assistance.

Tax Tips for Computer Owners

Melvyn Feuerman
46-15 Westminster Rd.
Great Neck, NY 11020

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25 West 43rd St.
New York, NY 10036

The Economic Recovery Tax Act of 1981, signed into law by President Reagan on August 13, 1981, provides the largest tax reduction in our nation's history. We will focus on the tax breaks the new law provides to individuals using computer systems in their trade or business.

One of the major objectives of the Tax Act of 1981 was to encourage companies to invest in capital equipment (such as new computer systems) by simplifying and speeding up the depreciation of equipment and by providing a research and development (R&D) tax credit. Some new business deductions became effective retroactively to January 1, 1981. The R&D tax credit went into effect July 1, 1981.

Business Deductions

The new tax law simplifies the method for computing depreciation on equipment, such as computers used in your business. Effective January 1, 1981 (this tax year!) you may use the new Accelerated Cost Recovery System (ACRS) to compute the amount of depreciation you can take each year. For computer

STOP SOFTWARE FAILURES

Using a micro in a product sounds easy... One piece of software can make the difference between success and failure.

What do you do when the software doesn't work? Over the years, we have seen many good products fail, either before or after they reached the market, because the microprocessor software did not do its job.

WHAT WENT WRONG?

Many of the failures occurred because the people programming the micro did not know how to organize a large control program. Those responsible for the product implementation were wizards at hardware design and had easily coded small micro control programs before. But the programming techniques that worked for less than 2K bytes of code simply fell apart as the program grew beyond 4K bytes.

Unfortunately, the loops and tests and flags that work so well for a small program get out of control very rapidly as the program grows. Pretty soon, some of the things the program must do are not being done fast enough. The code gets too complicated, difficult to modify and unreliable. The result: another software failure!

Fortunately, these problems can be avoided by using a program manager. You can divide your complex control program into a number of separate, more manageable programs, called *tasks,* each designed to do one job. For example, a Keyboard Task might handle user input; a Printer Task might generate reports. Each task can be written and tested separately and then combined to form a reliable, finished system.

The program manager, called a *multitasking executive,* supervises the orderly execution of these tasks, assuring that the most important jobs always get done first. Tasks appear to be executing simultaneously. It's almost like having a separate CPU for each task!

That is why professional software designers are now turning to AMX as the starting point for their product and system designs. They know that AMX will shield them from the difficulties of managing the micro, freeing them to concentrate on their application.

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AMX is our **multitasking executive** for the 8080, 8085, Z80 and 6809 processors. We're rather proud of it. We made AMX compact, very fast, and ROMable to meet our own application needs. Even though the AMX nucleus is less than 1400 bytes in size, it features multiple task priorities, intertask message passing with priority queuing, external event synchronization, and interval timing with 32-bit precision. Each feature is clearly explained in the AMX Reference Manual.

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We don't know anyone who can write an executive without errors, so we thoroughly tested AMX in real applications before ever offering it as a product. That is why not one system malfunction has ever been attributed to AMX. That kind of reliability just isn't an accident.

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AMX does not require a particular hardware configuration. Of course, it does need a microprocessor, but even there we offer you a choice. *You* control your environment. *You* pick the I/O method. *You* decide the most optimum interrupt service technique for your system. AMX will support your choice.

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Circle 168 on inquiry card.

equipment purchased in 1981 the applicable recovery percentages are:

Year 1	15%
Year 2	22%
Year 3	21%
Year 4	21%
Year 5	21%

For example, if you purchased a computer in November 1981 for $5000 you can depreciate $750 ($5000 × 0.15) in 1981. You can also get an investment tax credit of 10 percent ($500) on the purchase of the computer. (It is interesting to note that the so-called "half-year" convention works to the advantage of the taxpayer who buys a computer near the end of 1981. He gets the entire tax deduction and tax credit, although the computer will be used for only a short time in 1981.)

You do not have to use the new ACRS to compute depreciation. You still have the option of computing depreciation using the straight-line method.

The Tax Act did repeal one tax break—the first-year extra depreciation allowance of 20 percent of the cost of the equipment. Equipment that you purchased prior to January 1, 1981 should be depreciated using the same rules that were in effect before the new law.

Hardware and software developers should take note that R&D equipment that they purchased after January 1, 1981 receives special treatment. They get a special tax break that allows them to depreciate R&D equipment over a three-year period. The applicable recovery percentages are:

Year 1	25%
Year 2	38%
Year 3	37%

Beginning in 1982, owners of computers (or any capital equipment) will have the option of deducting up to $5000 for hardware and software purchases made in 1982. This tax break will have the very positive effect of encouraging those budding software and hardware entrepreneurs who work full time and have plenty of W-2 income to purchase a computer system to start their own businesses. This break should be very important to developers of software for the new IBM Personal Computer.

Research and Development Tax Credit

Another perhaps more significant new tax break for software and hardware developers is the Research and Development Tax Credit, which retroactively went into effect July 1, 1981. You won't find too much about this credit in your new 1040 instruction manual from the IRS, but a new Form 6765—Credit for Increasing Research Activities—will help you on lonely nights around April 15, 1982.

The R&D Tax Credit applies if you are launching a new computer product or significantly improving an existing computer product and you are having additional R&D expenses as compared to the last three years. You can get a *tax credit* of 25 percent of the increase in R&D expense. You will also have the option of taking all of the R&D expense in one year.

For example, let's assume that you have a software business and that between July 1, 1981 and December 31, 1981 you spent $15,000 developing a new computer product, such as a new mailing-list program or an improved electronic spreadsheet. Also assume that you spent $10,000 on R&D between July 1, 1980 and December 31, 1980. Then, if your business is a sole proprietorship you can take the $15,000 as a business expense on Schedule C and you can take a tax credit of $1250 (25 percent of the $5000 R&D increase) as an R&D Tax Credit on form 1040.

The R&D Tax Credit is of less value to companies that have had little R&D expense in prior years. For example, the R&D Tax Credit for a new business is only 12.5 percent of R&D expenses.

New Penalties

One final comment on the depreciation and R&D tax credits that we have outlined above. They can be used only if you are using your computer in a trade or business. This can be a part-time business, but it cannot be a hobby!

The Tax Act of 1981 also contains additional penalties for taxpayers who file false information, are negligent in their underpayment of taxes, or "pad" or overstate certain deductions. For example, if you underpay your tax because you took too large a deduction for depreciation, you will have to pay a special penalty. Furthermore, interest payments on money you owe the IRS will accumulate at the prime rate of 20 percent established on October 15, 1981. Clearly it is in your best interest to select a competent and honest tax adviser to help you prepare your tax return!

Conclusion

The Tax Act of 1981 should have a very positive effect on the growth of the computer industry. The Tax Act provides incentives for business to purchase computers, and, perhaps most important, it encourages the development of the "cottage industry" of software developers by providing them with R&D tax credits. ■

About the Authors

Melvyn Feuerman is currently the computer systems coordinator for Damson Oil Corporation, one of the nation's largest independent oil and gas companies. Prior to working for Damson, Feuerman was data-processing director of the E.K. Leaton Company, an insurance and pension consulting company. He was also a computer project manager in charge of developing time-sharing tax and financial planning programs for Peat Marwick and Mitchell & Co. He has a BA from CCNY and an MBA from Baruch College.

Melvyn Moller is a Certified Public Accountant who has his own practice in New York City.

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Book Reviews

Beyond Games: Systems Software for Your 6502 Personal Computer

Ken Skier
BYTE/McGraw-Hill
New York, 1981
433 pages, softcover $14.95

Reviewed by
Bob Katz
248 East 90th St. Apt. 3B
New York, NY 10028

At last! An assembly-language programming book that develops useful, real-world tools, has *no* mathematical routines, and is written in plain English. In fact, *Beyond Games* not only teaches you how to write programs, it's entertaining.

If you own an Apple II, Ohio Scientific Challenger I-P, PET 2001, or Atari 800, you'll be able to make *direct* use of the routines developed in this book. But owners of other 6502-based machines (such as KIM, SYM, AIM, etc.) need not despair—Ken Skier's routines interface directly with a microprocessor's *software*, not with any system-specific hardware.

For example, Skier develops a *text-editing program* step by step. One of the first things this program must do is find the ASCII value of a key that has been pressed. Skier teaches us that calling a subroutine is a sound programming technique to perform the maneuver. He gives this subroutine the name GETKEY. All microcomputers that have keyboards already contain the housekeeping routines used to get the value of a key. Some computers call it GETKEY, others may call it by a different name, e.g., GETCHR for "get character." But essentially this subroutine always reduces to a single ROM (read-only memory) address which may be called from Skier's main program.

Skier has researched this calling address, as well as the addresses of all other necessary subroutines within the Apple II and the other computers. *Beyond Games* contains specific Apple, Atari, PET, and OSI versions of a machine-language text-editor program, visible-monitor program, print utilities, and screen-management utilities. These programs are identical in their assembly-language source-code form, regardless of the computer. Thus, owners of other 6502-based computers who wish to use Skier's programs can look up the addresses of their GETKEY or other routines, then substitute these addresses. The documentation provided with a computer should give the addresses of important ROM subroutines.

You may wish to develop an assembly-language or machine-language program on your own, or alter some of the routines for a specific computer not directly supported by the book. You should have no trouble doing this. Skier teaches how to structure a program using the "top down" technique and how to deal with problems in little pieces—in other words, how to proceed logically through the writing of an assembly-language program.

A word about the specific routines. Skier's text editor is very basic and is *not* designed to be a word processor. It *is* designed to write and edit text for inserting (and deleting) strings of any size into any memory location. Even if you don't need any of the routines he provides, the exercise of reading *Beyond Games* will teach you just how a text-editing program is constructed. That alone is worth the price of the book.

If you do decide to use his routines, Skier provides several means to load them into your computer. The easiest (and most expensive) method is to order a data cassette directly from Skier. The next easiest is to key in the machine-language programs from BASIC by using data statements and Skier's *object-code loader*. The latter program contains checksums to protect you from entering mistakes into memory. With care you can also load routines directly into memory as hexadecimal bytes.

In conclusion, those programmers who wish to learn how to write such mathematical routines as 16-bit arithmetic and logarithms should look elsewhere; those who wish to learn how to turn on the relay that controls their lawn sprinkler should also look elsewhere. But anyone who wants to learn to create logical machine-language programs, debuggable programs, or well-documented programs, should read *Beyond Games*. ■

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Dithertizer II

Joe Tomas
Computer City
1525 South Willow St.
Manchester, NH 03103

The Dithertizer II, a new video-digitizer interface for the Apple II computer, creates high-resolution digitized images that can be printed on any printer that has graphics capability. Most Apple users have probably seen graphics demonstrations with pictures of Winston Churchill, Albert Einstein, or soccer balls. These "pictures" were all created by a video digitizer.

Designed by David Hudson of Computer Stations Inc., the Dithertizer II uses a video camera with external synchronization to load any image that can be captured by the camera into the memory (high-resolution-graphics pages) of an Apple II. The Dithertizer II is a "frame-grabber," direct-memory-access-type (DMA) digitizer, requiring only one frame or 1/60 second to capture a binary image. The software lets you create pictures in either of two ways: (1) as a "dithered" gray scale built from multiple binary (black-and-white) images, or (2) as image-intensity contours, using image subtraction from two frames. The number of frames required to create a dithered image is dependent on the dither matrix size, which is selectable via the software. You must use game paddles to adjust the contrast and density of the image being created and view the results on the monitor.

Installation

I ran into a slight problem when I installed my Dithertizer II. The Dithertizer II interface card, which is inserted into slot 7 of the Apple, has two cables attached to it. The first cable has a 6-pin DIN-type connector that attaches to a Sanyo video-camera cable. The second cable is a two-conductor wire with a "piggy-back" IC (integrated circuit) socket at its end. The instructions told me to remove the 74LS34 IC at location C-14 on the Apple's motherboard and replace it with the adapter socket. The instructions placed great emphasis on the orientation of pin 1 when inserting the adapter socket. Next, I reinserted the 74LS34 IC into the adapter, which completed the installation.

After checking the installation, I was ready to go. I mounted the camera on a tripod, aimed it at myself, and booted the software. According to the instructions, the display monitor should have displayed a dithered image. Unfortunately, Murphy's law prevailed—all I saw on the video display screen was diagonal scan lines. Turning the system off, I double-checked the installation. It seemed odd that when the adapter socket was inserted at location C-14, the two-wire cable should extend out the front of the socket rather than the back, especially since the interface card was located behind the socket. Even though pin 1 was properly oriented, I removed the 74LS34, reversed

At a Glance

Name
Dithertizer II

Use
A high-speed frame-grabber, DMA-type video digitizer designed to create computerized images or pictures.

Manufacturer
Computer Stations Inc.
11610 Page Service Dr.
St Louis, MO 63141

Price
Dithertizer II interface, $300.00; Sanyo VC1610X Video Camera, $410.00; Package System Price, $650.00.

Hardware required
Apple II or Apple II Plus, 48K bytes of user memory, one floppy-disk drive with controller, game paddles, video monitor or TV with RF (radio-frequency) modulator, one of the following printers with appropriate interface: Integral Data Systems models 225, 440G, 445G, 460G, 560G, NEC Spinwriter models 5510 or 5520, Anadex models DP9500 or DP9501.

Software required
Dithertizer software included.

Software options
Computer Stations Enhanced Graphics Software for the appropriate printer. Price: $44.95.

Documentation
17-page hardcover notebook-style manual.

Audience
Home hobbyists, photo studios, attention getter for trade shows, motion detection.

the socket, and replaced the IC. Holding my breath, I again turned the system on and behold: it worked. Obviously, the adapter had been miswired. Fortunately, no damage occurred.

The Dithertizer II software contains machine-language routines for frame-grabbing, dithering, and contouring. It includes a demonstration program, written in BASIC, that shows the use of all three routines. The software is supplied in DOS 3.2.1 format, and I had no problem in MUFFINing it to DOS 3.3 format.

Figure 1: *A "dithered" image of the author, as rendered by the Dithertizer II.*

Implementation

Using the Dithertizer II is very simple. Game paddles are used to adjust the displayed image. Paddle 0 sets the black level, while paddle 1 adjusts the contrast or gray tones. Other options, selectable via single-keystroke commands, allow dithering, contouring, freezing the image, saving image to disk, printing the image, and more. Pressing H (for HELP) will display a menu listing all commands and options.

The documentation is short, but it is complete and easily understood. After reading it, I started experimenting, and it took me only a few minutes to become accustomed to image processing. The only part I had difficulty with was determining the amount of gray scale required to create a well-balanced or shaded image. With a little trial and error, I was soon printing good-quality images.

Focusing the camera is important in order to create a sharp image. The Sanyo camera is not a conventional video camera as used on VCRs (video-cassette recorders), but a commercial camera like those used in closed-circuit systems. Unlike VCR-type cameras, the Sanyo does not have through-the-lens viewing to facilitate focusing. The focusing-adjustment ring on the lens is calibrated reasonably well; however, it is difficult to obtain accurate focusing at close range. To overcome this problem, I attached a cable to the RF (radio-frequency) output connector of the camera and then connected it temporarily to the input of my video monitor. This allowed me to focus the camera acccurately. Then I disconnected the cable and plugged the monitor back into the Apple. Incidentally, you can make close-up shots (as close as two to three inches) by carefully unscrewing the camera lens to change its focal length. Also, use a white background if you plan to do portrait or high-contrast work (see figure 1). A white background allows better resolution and detail.

Despite the fact that the Sanyo camera is designed for black-and-white images, I found that I was able to achieve better gray scale and shading by using a color video monitor. The color monitor displayed some gray shades as "blue over gray." This enabled me to determine differences in gray scale, which ultimately resulted in higher-resolution images. A black-and-white monitor made this slightly more difficult to accomplish.

As supplied, the software does not have print routines installed. Assuming you have a printer with dot-graphics capability, you must either write your own print drivers or purchase Computer Stations' Enhanced Graphics Software. This software is available for Integral Data Systems Paper Tiger printers as well as for the NEC Spinwriter models 5510 and 5520 and Anadex models DP9500 and DP9501. The addendum I received with the

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A glance at CalcStar features

Runs on CP/M version 2.0 or above, with 80-column screen, addressable cursor, and at least 48K memory. 56K or more is recommended for fullest utilization.

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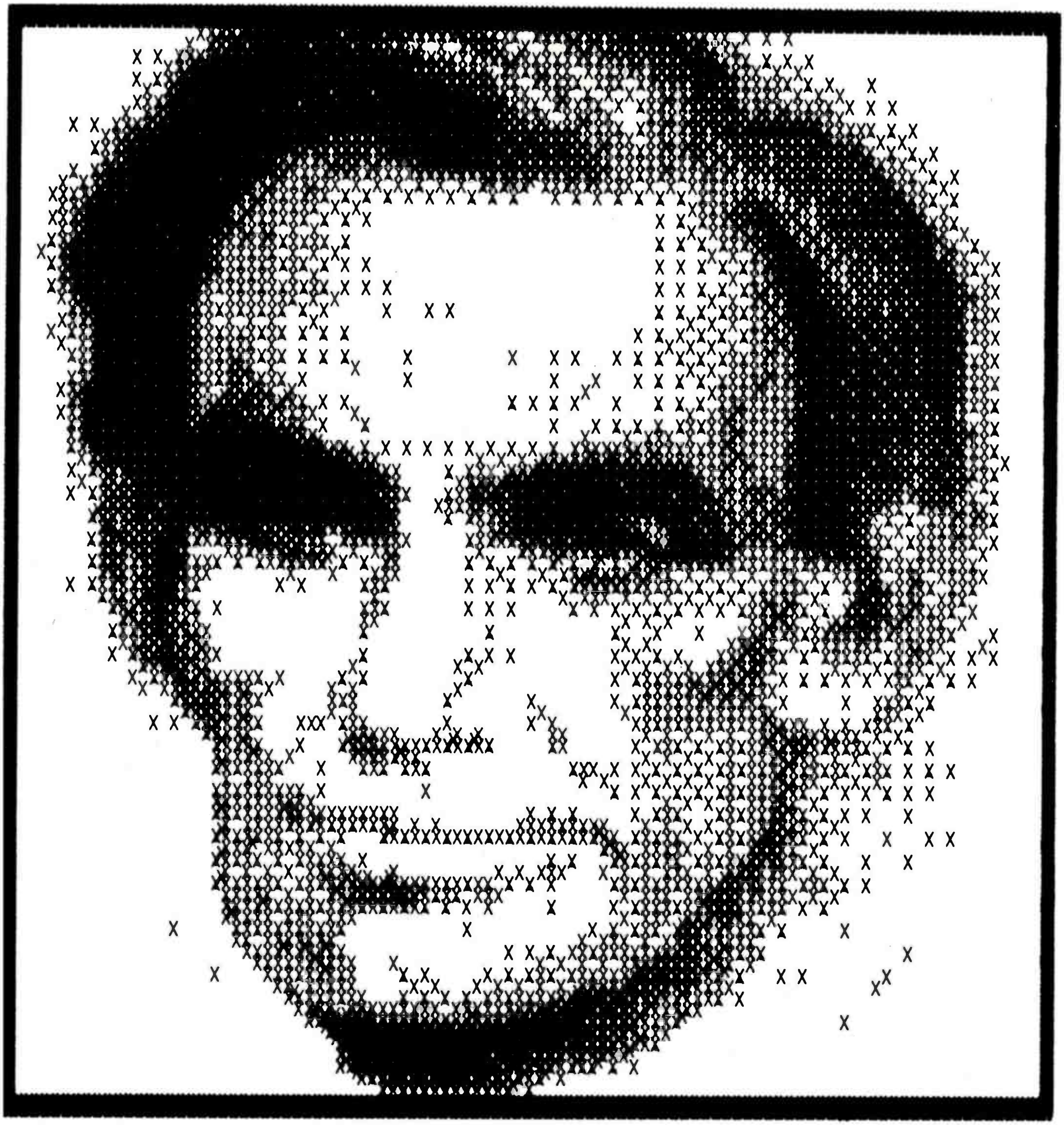


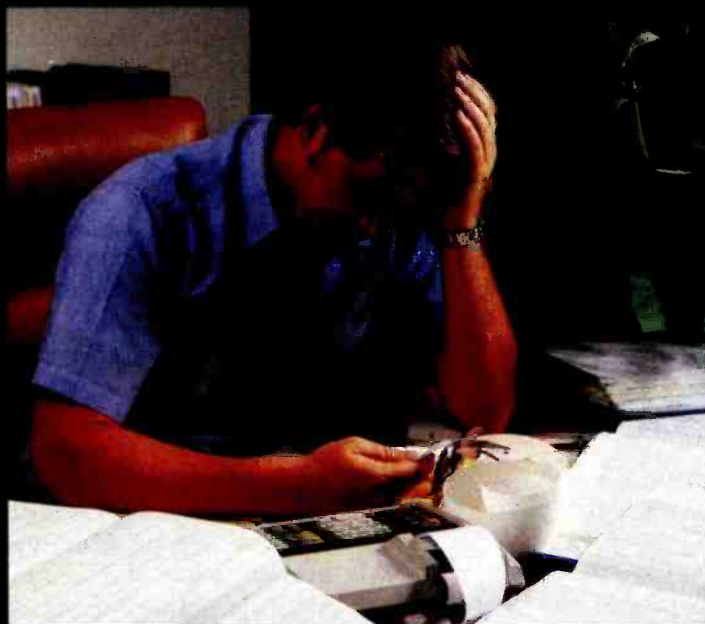
Printer Driver Packages

Several software packages allow Apple II high-resolution graphics to be printed out as hard copy. The pictures accompanying this article were printed with Computer Stations' software drivers for the IDS Paper Tiger. Computer Stations also sells the Enhanced Graphics Software package for the Epson MX-80 dot-matrix printer. Pictures can be created with a graphics tablet or with the Dithertizer II and are saved as binary disk files. This package requires an MX-80 equipped with the Graftrax 80 high-resolution option, costs $44.95, and is available from Computer Stations, 11610 Page Service Dr., St Louis, MO 63141.

Progressive Software has released its Graphics Printing System for the Diablo and NEC full-character printers. The program prints the graphic image from the high-resolution screen to the printer via the Apple High Speed Serial Interface card (or equivalent). The picture above of Abraham Lincoln is an example of the Graphics Printing System's output. The package can be used with a Diablo 1620 or 1640 or with a NEC Spinwriter 5510 or 5520, costs $109.95, and is available from Progressive Software, Suite 323-Blue Bell West, Blue Bell, PA 19422.

Circle 203 on inquiry card.

CASH FLOW PROBLEMS?



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documentation instructed me to make several changes in the demonstration program to call up the required print routine. Additional information concerning the various machine-language routines used is included to assist you in writing your own special-application programs.

Figure 2: *The cover of BYTE, November 1980. Both figure 1 and figure 2 were created on an Integral Data Systems 460G dot-matrix printer.*

Conclusions

The Dithertizer II is a well-constructed video digitizer that does all that its manufacturer claims. The interface card consists of seven ICs, plus a handful of other components, and is very clean in construction. At first glance, the Dithertizer II seems a little overpriced, considering the number of components on the circuit board. However, when you take the developmental costs into consideration, the price seems quite reasonable.

Preliminary releases of the Dithertizer II had only a seven-page instruction manual; it was easily understood and quite complete. George Baltzell of Computer Stations has informed me that new, expanded documentation is now being shipped with the product.

Practical applications? Aside from hobbyist uses, other applications might include motion detection for security systems, an attention-getter for trade shows, advertising, artwork layout (see figure 2), and photo-studio uses. My primary reason for getting the Dithertizer II was for promotional and publicity-type advertising. (I offer a free portrait to any of my customers.) All in all, I have been quite pleased with the product, and we plan to put it to use not only here, but in the grand openings in several of our new stores. ■

A Guided Tour of Apple Pascal Units and Libraries

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Los Angeles, CA 90048

One of the most powerful features of Apple Pascal is its extensibility via a *unit*. Similar in structure to Pascal programs, units have peculiarities that can render them mysterious to UCSD Pascal newcomers.

To clear up some of these mysteries, we will begin by considering what a unit does and how it differs from both a program and an external procedure or function, and then we'll study two units that have markedly different purposes. Next, we will examine the process of compiling and linking these units and binding them to your SYSTEM.LIBRARY.

In addition, I have provided a listing of a Pascal program that, when saved on the system disk as SYSTEM. STARTUP, places a color test pattern and the system date on the screen when the Apple/UCSD system is booted up (see listing 2). This program uses the CALENDAR unit (discussed later), as well as the Pascal units, TURTLEGRAPHICS and APPLESTUFF, that are already resident in the SYSTEM.LIBRARY.

Anyone who first learned programming in BASIC probably finds the lack of direct access to absolute memory one of the few frustrations of Pascal. For those who are unfamiliar with UCSD Pascal (University of California, San Diego), and Pascal in general, the language cannot express the concept of absolute addressing. (BASIC accomplishes this with the CALL <address> statement.) Even assembled machine-code external procedures called by the Pascal host program are automatically relocated at the time of their linkage to the host. (The host program is the Pascal program that calls an externally compiled or assembled subroutine.)

Some Definitions

Let me clarify two terms that will be used frequently throughout the remainder of this article: *source files* and *object files*. When we refer to a source file, we mean the English-like representation of a program, external subroutine, or unit. The source file is the text you type in through an editor like the one in the Apple Pascal operating system.

If this text file conforms with certain syntax rules, the compiler or assembler will turn this text file into the code form that the computer actually executes at run time. This code file is called the object file; it contains *object code* that is generally not human readable. The object code is called *p-code* (pseudocode) if derived from a UCSD Pascal source file, or 6502 machine language if derived from an assembly-language source file through use of the system's assembler. The important point is that the source file is what *you* write, and the object file is what the computer executes at run time. Both are versions of the same program, external subroutine, or unit.

Most of the time, UCSD Pascal's automatic memory management is convenient and frees the programmer from worrying about such things as overstepping allotted memory boundaries and inadvertently erasing parts of the system program. But what if you have a useful EPROM (erasable programmable read-only memory) with no source file, and many of the machine-language routines on that EPROM could be of tremendous use in your Pascal programs if only they could be accessed? There is no way to specify the absolute address of that EPROM, or of a routine within it, from a standard

About the Author
Dr. Tonkens is a cardiologist with a background in small-computer systems. In 1980 he was engaged in full-time research on computer-assisted image-enhancement techniques for real-time two-dimensional echocardiographic images. He continues to act as a consultant for private industry on medical-image processing and database management.

Pascal host program.

Similarly, the Apple II contains many software "switches" of great use to the BASIC programmer that are available via PEEKs and POKEs, but are inaccessible from Apple Pascal.

The UCSD Pascal operating system allows for extensibility of the language by the user in order to fill special needs (like direct addressing of memory) through the use of units. A unit is a compiled subroutine (or more usually a collection of compiled subroutines) that essentially adds new commands to off-the-shelf UCSD Pascal. For instance, a computer musician might have use for a unit that added commands for producing notes of specified pitch. Indeed, UCSD Pascal was customized for the Apple II, through the use of units, for implementing such special functions as producing high-resolution graphics (TURTLEGRAPHICS) and reading the game paddles and generating sound (APPLESTUFF).

There are also commercial units for sale, and soon you will be able to choose from a selection of "canned" units for specialized programming purposes.

Two sample unit listings are shown in listing 1. The first, called WINDOW, provides access to the Apple II's memory by adding PEEK, POKE, and CALL instructions to your Apple's Pascal vocabulary. The second, called CALENDAR, reads the area of the system disk where the system date is stored and makes it accessible to the programmer.

The Power of a Unit

Let us look a little more closely at a unit. Unlike a standard Pascal procedure or function, a unit can exist separately from the body of the main program text and still be incorporated within a Pascal program's object code at run time. But if this were the whole story, a unit would have no advantage over an external procedure.

The power of a unit lies in its ability to house multiple (hopefully related) procedures or functions, both in Pascal and in assembly language, under one roof. All of these proce-

Text continued on page 234

Listing 1: *Two sample units for Apple Pascal. In listing 1a, WINDOW provides access to the Apple's memory by absolute address through the BASIC-like instructions PEEK, POKE, and CALL. In listing 1b, CALENDAR reads the date from the system disk and makes it accessible to the user.*

listing 1a

```
(****************************************
 *                                      *
 *                                      *
 *        INTRINSIC UNIT WINDOW         *
 *                                      *
 *                                      *
 ****************************************)

      (* ROSS M. TONKENS, M.D. *)

           (*VER.01.09.81*)

               (*$S+*)
  (*SWAPPING ON FOR UNIT COMPILATION*)


 UNIT WINDOW;  INTRINSIC CODE 23 DATA 24;


 INTERFACE

(****************************************
 *PROVIDES A "WINDOW" FROM UCSD/PASCAL *
 *INTO ADDRESSABLE MEMORY.  THIS ALLOWS*
 *MANIPULATION OF DATA AT THE BYTE     *
 *LEVEL AS WELL AS CALLS TO MACHINE    *
 *CODE ROUTINES AT ABSOLUTE LOCATIONS  *
 *(AS IN A ROM) DIRECTLY FROM PASCAL.  *
 *                                     *
 *IN ESSENCE THIS UNIT ADDS THE        *
 *FAMILIAR BASIC COMMANDS:             *
 *                                     *
 *       PEEK, POKE, AND CALL          *
 *                                     *
 *TO UCSD PASCAL.                      *
 ****************************************)


 PROCEDURE POKE(ADDR,DATA:INTEGER);

 (*********************************
  *EMULATES BASIC'S "POKE" COMMAND*
  *                               *
  *INVOCATION => POKE(ADDR,DATA)  *
  *********************************)

 FUNCTION PEEK(ADDR:INTEGER):INTEGER;

 (*********************************
  *EMULATES BASIC'S "PEEK" COMMAND*
  *                               *
  *INVOCATION => DATA:= PEEK(ADDR)*
  *********************************)


 (*********************************
  *BOTH ADDR AND DATA MUST BE     *
  *INTEGER VARIABLES NOT CONSTANTS*
  *                               *
  *ADDR MUST BE IN THE RANGE :    *
  *                               *
  *                  -32767..32767*
  *                               *
  *NOTE THAT THIS UNIT ACCEPTS OUT*
  *OF RANGE DATA (0 > DATA > 255) *
  *BY STORING ==>ABS(DATA MOD 256)*
  *********************************)

 PROCEDURE CALL(ADDR:INTEGER);

 (*********************************
  *EMULATES BASIC'S "CALL" COMMAND*
  *                               *
  *THIS IS A "FRONT END" FOR      *
  *INSTALLING ASSEMBLY LANGUAGE   *
  *         .PROC CALL.ASSY       *
  *                               *
  *IN THIS INTRINSIC UNIT.        *
  *********************************)


 IMPLEMENTATION

 TYPE BYTE  = PACKED ARRAY [0..1] OF 0..255;
      DIRTY = RECORD
               CASE BOOLEAN OF
                TRUE : (INT: INTEGER);
                FALSE: (PTR: ^BYTE);
               END;

  (*THIS DEFINES A VARIANT RECORD WHICH
    WILL MAP TO AN ABSOLUTE HARDWARE
    ADDRESS IN THE APPLE                *)


 VAR TRICK : DIRTY;

 PROCEDURE CHECK(VAR DATA:INTEGER);
  FORWARD;



PROCEDURE POKE;
BEGIN
 CHECK(DATA);
 TRICK.INT:= ADDR;
 TRICK.PTR^[0]:= DATA
END;



FUNCTION PEEK;
BEGIN
 TRICK.INT:= ADDR;
 PEEK:= TRICK.PTR^[0]
END;

PROCEDURE CHECK;

(*THIS ASSURES ONLY VALID DATA
  WILL GET POKED.            *)
```

Listing 1 continued on page 228

Listing 1 continued:

```
BEGIN
 DATA:= ABS(DATA MOD 256);
END;



PROCEDURE CALL;
 EXTERNAL;



BEGIN
 (*DUMMY INITIALIZATION*)
END.
;
     .TITLE "*PROCEDURE TO EMULATE BASIC'S 'CALL'*"
;
;
;    ROSS M. TONKENS, M.D.
;
;     VER.01.09.81.13
;
;
     .MACRO POP    ;POPS 16 BIT ADDRESS
;
     PLA
     STA         %1
     PLA
     STA         %1+1
     .ENDM
;
;
;
     .MACRO PUSH   ;PUSHES (RETURN) ADDRESS BACK ONTO STACK
;
     LDA         %1+1
     PHA
     LDA         %1
     PHA
     .ENDM
;
;
;
;
     .PROC CALL,1
;
;
;
; PROGRAM TO CREATE A CALL FUNCTION FOR
; PASCAL IN THE APPLE II
;
; USE THIS ASSEMBLY LANGUAGE PROGRAM TO
; CALL PROGRAMS THAT ARE NOT NORMALLY
; ACCESSIBLE FROM PASCAL.
;
; TO USE:  ASSEMBLE THIS PROGRAM
;          AND SAVE THE CODE FILE ON
;          <YOURDISKNAME> AS
;
;              CALL.ASSY.CODE
;
;          THEN
;          EITHER
;            LINK TO INTRINSIC UNIT "WINDOW"
;          OR
;            LINK DIRECTLY TO YOUR HOST PROGRAM
;            AS FOLLOWS:
;
;          1.DEFINE A PROCEDURE IN YOUR
;            PROGRAM:
;
;            PROCEDURE CALL(ADDR);
;            EXTERNAL;
;            (ADDR MUST BE AN INTEGER VARIABLE.)
```

Listing 1 continued on page 230

Listing 1 continued:

```
;
;           2.COMPILE YOUR PROGRAM, AND THEN RUN
;             THE LINKER.
;
;           3.WHEN ASKED FOR THE LIB.NAME, TYPE:
;
;              <YOURDISKNAME>:CALL.ASSY.CODE
;
;
; WARNING: ANY PROGRAM WHICH CHANGES MEMORY
;          LOCATIONS MAY INTERFERE WITH
;          THE PASCAL OPERATING SYSTEM.
;
;
RETURN  .EQU    0
YRCALL  .EQU    2
;
;
;
;
        POP     RETURN ; SAVE PASCAL RETURN ADDRESS;
        POP     YRCALL ; SAVE OUR CALLING ADDR;
        PUSH    RETURN ; PUT BACK ON STACK;
        JMP     @YRCALL; VECTOR TO PASSED ADDRESS PARAMETER

        .END
```

listing 1b

```
(*$S+,R-*)
(*RANGE CHECKING OFF BECAUSE ONLY BYTE #11, WHICH IS UNITREAD  FROM*)
(*BLOCK #2 CAN BE COUNTED ON TO COMPLY WITH RANGE CONSTRAINTS      *)

(****************************************
*                                       *
*       INTRINSIC UNIT CALENDAR         *
*                                       *
****************************************)

         (* ROSS M. TONKENS, M.D. *)

            (*VER.01.19.81.03*)



UNIT CALENDAR; INTRINSIC CODE 25 DATA 26;

INTERFACE

(****************************************
 *PASSES CURRENT SYSTEM DATE INTO THE   *
 *VARIABLES:                            *
 *              THISDATE:       1..31   *
 *              THISMONTH:      1..12   *
 *              THISYEAR:       1..99   *
 *                                      *
 *AND RETURNS DATE AS A STRING WITH     *
 *LEADING AND TRAILING BLANKS AS THE    *
 *GLOBAL VARIABLE, "TODAY," WHICH HAS   *
 *THE FORM:                             *
 *                                      *
 * <SP><MONTH><SP><DAY><, 19><YEAR><SP>*
 *                                      *
 *                OR                    *
 *                                      *
 *         <SP>JAN 20, 1981<SP>         *
 *                                      *
 *THIS IS ACCOMPLISHED AUTOMATICALLY    *
 *AT RUNTIME FOR ANY PROGRAM USING THIS*
 *UNIT, SO THAT FOR ALL PRACTICAL PUR- *
 *POSES THE PROGRAM "WAKES UP" WITH ALL*
 *THE ABOVE VARIABLES PREINITIALIZED.  *
 ****************************************)
```

Listing 1 continued on page 232

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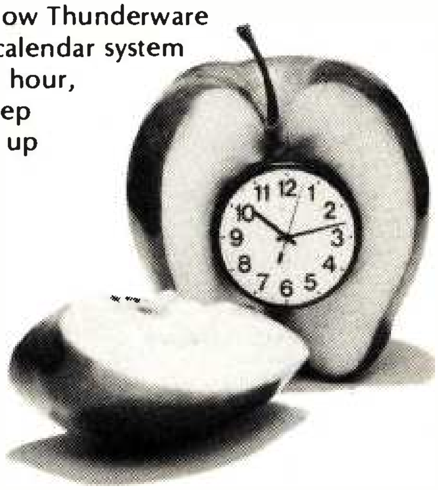

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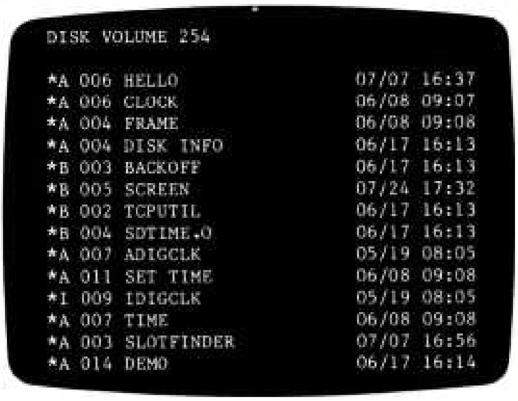

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Listing 1 continued:

```
VAR

THISDATE        : 1..31;
THISMONTH       : 1..12;
THISYEAR        : 1..99;
TODAY           : STRING[14];

PROCEDURE DUMMY;

(*A PROCEDURE IS EXPECTED BY COMPILER AT END OF ANY INTERFACE SECTION*)
IMPLEMENTATION


TYPE

DATE            = PACKED RECORD
                              MONTH    : 1..12;
                              DAY      : 1..31;
                              YEAR     : 0..99;
                         END;



VAR

BLOCK           : ARRAY[0..10] OF DATE;
MONTHNAME       : STRING[3];
DY,YR           : STRING;



   PROCEDURE DUMMY;

     BEGIN
       (*DUMMY*)
     END;



 BEGIN (*INITIALIZATION*)
   UNITREAD(4,BLOCK,SIZEOF(BLOCK),2);

   (*PACKED ARRAY, "BLOCK," IS MAPPED ONTO FIRST 11 BYTES*)
   (*OF BLOCK 2 ON BOOT DISK IN FILE UNIT #4.  ARRAY HAS *)
   (*SIZE OF 11 BYTES BECAUSE THE DATE IS IN 11TH BYTE OF*)
   (*DISK BLOCK #2, AND WE NEED A WAY OF INDEXING TO THE *)
   (*ELEVENTH BYTE.                                      *)

   WITH BLOCK[10] DO
     BEGIN
       THISMONTH:= MONTH;
       THISDATE := DAY;
       THISYEAR := YEAR
     END;
   CASE THISMONTH OF
                        1: MONTHNAME:= 'JAN';
                        2: MONTHNAME:= 'FEB';
                        3: MONTHNAME:= 'MAR';
                        4: MONTHNAME:= 'APR';
                        5: MONTHNAME:= 'MAY';
                        6: MONTHNAME:= 'JUN';
                        7: MONTHNAME:= 'JUL';
                        8: MONTHNAME:= 'AUG';
                        9: MONTHNAME:= 'SEP';
                       10: MONTHNAME:= 'OCT';
                       11: MONTHNAME:= 'NOV';
                       12: MONTHNAME:= 'DEC';
   END;(*CASE*)
   STR(THISDATE,DY);

  STR(THISYEAR,YR);
  TODAY:= CONCAT(' ',MONTHNAME,' ',DY,', 19',YR,' ')
END. (*INITIALIZATION*)
```

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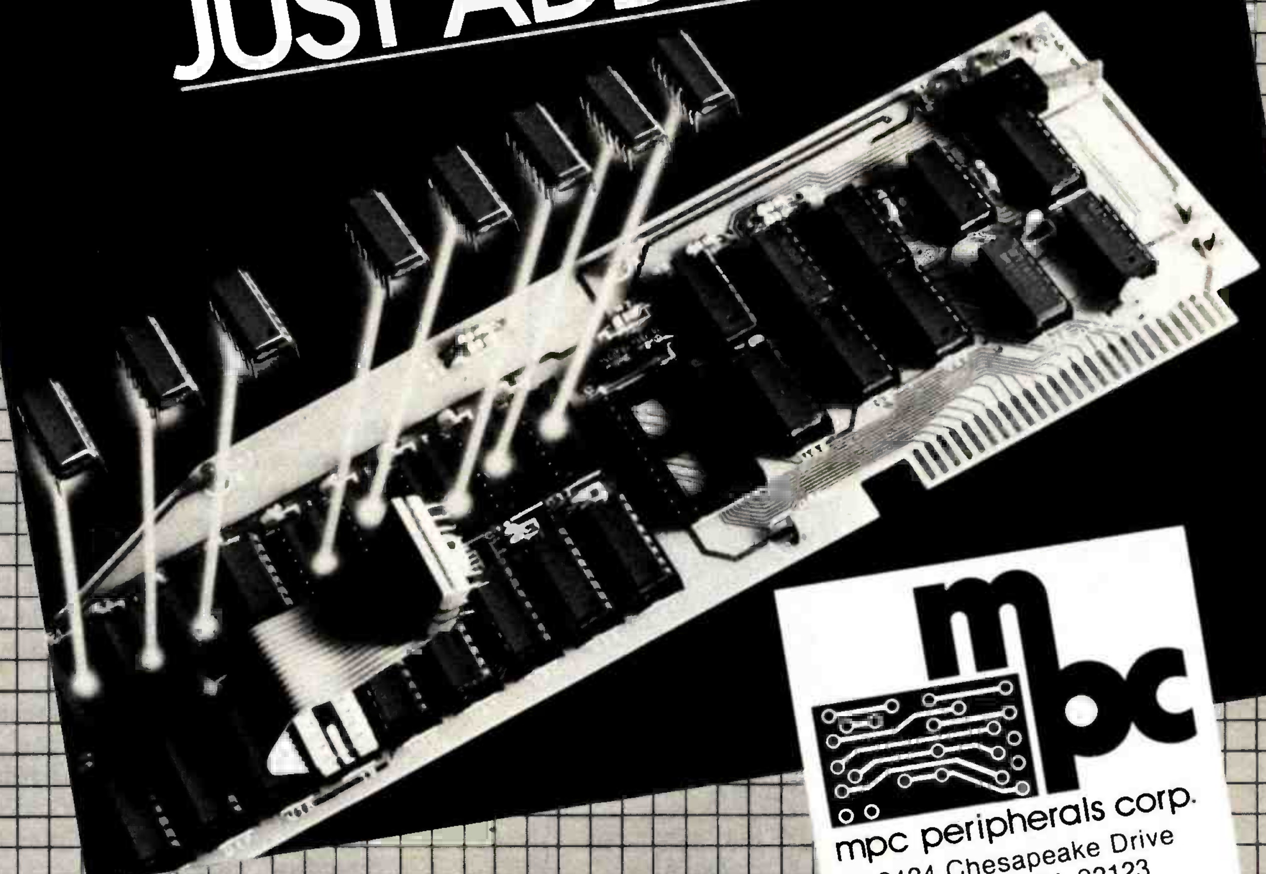

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Text continued from page 226:
dures and functions are available from within a Pascal host program just as if they and their related constants, types, and variables had been declared globally within the host program itself. As a matter of fact, units may even be nested (ie: one unit may employ another unit in its construction).

In order to graft the procedures and functions declared within a unit onto a Pascal host program, you need only include the reserved word USES, followed by the name of the unit, after the program heading (assuming the unit has been installed in SYSTEM.LIBRARY on the system disk; otherwise, see page 69 of the *Apple Pascal Language Reference Manual*).

Units come in two varieties: *regular* and *intrinsic*. While a regular unit becomes incorporated into the code file of the host program at compile time, it must be explicitly linked at the time of compilation. (Linkage can be thought of as the process of grafting an external subroutine onto a Pascal host program.) In this sense a regular unit is quite similar to an external procedure or function, except that it allows you to link many procedures and functions simultaneously. Once linked, a copy of the regular unit's object code actually resides within the host program's object-code file. Thus a regular unit, once linked, need no longer be present in the system at the time the host program is run because a copy has already become part of the host program.

On the other hand, an intrinsic unit must reside in a special file called SYSTEM.LIBRARY on the system disk when a host program calling it is executed. This is because an intrinsic unit is linked to the host program *and loaded into memory with it* at the time the host program is run. (In the latest update of Apple/UCSD Pascal Version 1.1, the programmer can even specify that a portion of a program reside in main memory only while it is actually executing.) The Pascal host program contains no image within it of any intrinsic units it employs, and it expects to find those intrinsic units in SYSTEM.LIBRARY.

The advantage of this is that linkage is accomplished automatically at run time. When you debug a Pascal program, you are continually revising the source code and recompiling. This process can be tedious enough, especially if the program is long, but recurrent relinking can render it unbearable. Even though the RUN command invokes an attempt at automatic relinking of all external procedures and functions, linking still takes a lot of time. Intrinsic units, on the other hand, are essentially "prelinked" and waste not a second at compile time—a real blessing if you do a lot of programming.

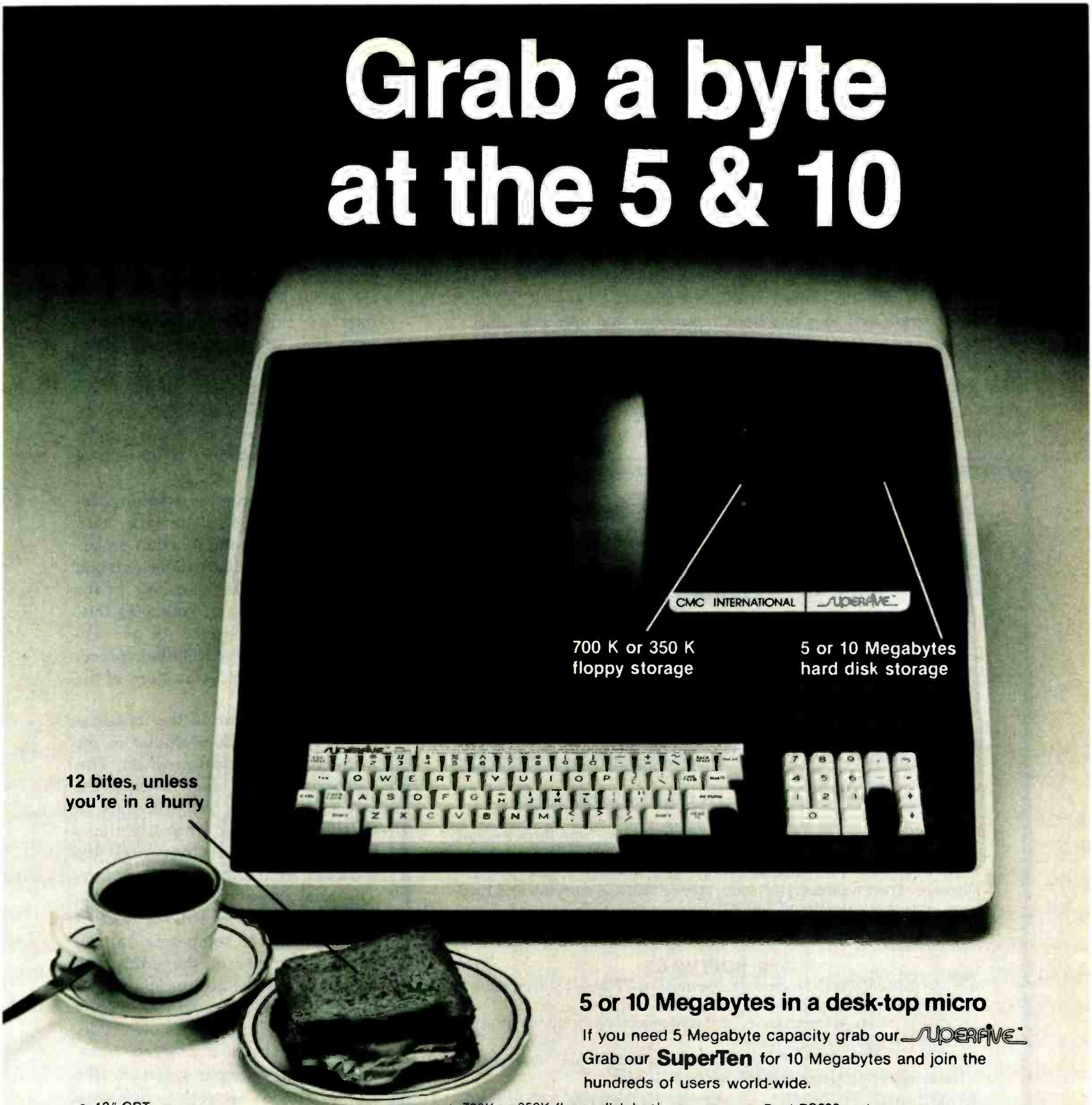
In comparison to the hardware domain, an intrinsic unit is like a computer peripheral with a standard plug configuration through which it communicates with the computer. You simply plug it into the computer to make it work. A regular unit is more like a peripheral to which connections from the computer must be individually soldered at the time of interfacing.

A Specific Example

Like a Pascal program, a unit is a set of algorithms draped over an orderly superstructure. This superstructure is illustrated in the WINDOW unit of listing 1. We will study the general structure of units through this example.

First, note that the compiler SWAPPING option must be enabled, (*$S+*), in order to compile any unit. Next, the heading, UNIT WINDOW, identifies this text to the compiler as a unit, as opposed to a program or external procedure.

INTRINSIC designates this as an intrinsic unit; that is, one that is "prelinked." Returning to the hardware analogy, CODE 23 and DATA 24 are a way of specifying which "pins" on a "standard intrinsic unit connector plug" are active. If you wish to write your own unit, or are just curious about how these CODE and DATA segment numbers are assigned, you can refer to the "Program Segmentation" section of the *Addendum to the*



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Apple Pascal Language Reference Manual.

The interface section of a unit is the only internal detail that is visible from the outside. It is comparable to the socket on the side of a computer peripheral. The interface defines the manner in which the unit can communicate with the UCSD Pascal host program. All the variables in the interface section will be shared with any host program as if they had been declared as global variables within the host. The same holds true for any label, constant, or type declaration within the interface section. If any variables are declared within the interface of an intrinsic unit, a data segment must be declared in addition to an obligatory code segment (see page 76, in the *Apple Pascal Language Reference Manual*).

The procedure and function declarations of the interface are really the core of the unit. The names of these procedures and functions will become, in essence, new words in the vocabulary of any UCSD Pascal host program that uses that unit.

Through the use of units, there is virtually no practical limit on the number of new commands you can teach your system to recognize. The interface's procedure and function declarations are abbreviated to the procedure or function name plus parameters, as if they were FORWARD declarations in a standard Pascal program.

One peculiarity of units is that Apple/UCSD Pascal assumes you are writing the unit for the explicit purpose of declaring procedures and functions in the interface. Therefore, the manuals never mention that the interface must contain at least one procedure or function declaration. (If, like me, you always manage to stumble on the exception to the rule—as in UNIT CALENDAR in listing 1—then you must insert a dummy procedure declaration at the end of the interface.)

The implementation section contains any label, constant, type, variable, procedure, and function declarations that are private to the unit and not intended to be accessible to the Pascal host program. Following this, we find the expansion of the abbreviated (FORWARD-like) procedure and function declarations of the interface section.

Finally, we come to the initialization section, which is similar to the main part of a Pascal program. This section is optional, and, as long as the last END; of the last procedure or function is followed by an additional END. statement (note the period), the compiler will remain quite happy. The usual purpose of the initialization section is to perform some sort of housekeeping or setup task in preparation for use of the unit's new commands by the host program. The initialization is executed first, before any of the host program's own code, as soon as the host program is invoked. An example given in the *Apple Pascal Language Reference Manual* is the table of trigonometric values that the initialization section of the TRANSCEND unit generates in main memory for later reference by the trigonometric functions this unit adds to standard UCSD Pascal.

If included, the text for the initialization section is sandwiched between a BEGIN and the unit's final END. (whose period signals the end of text to the compiler). I have in-

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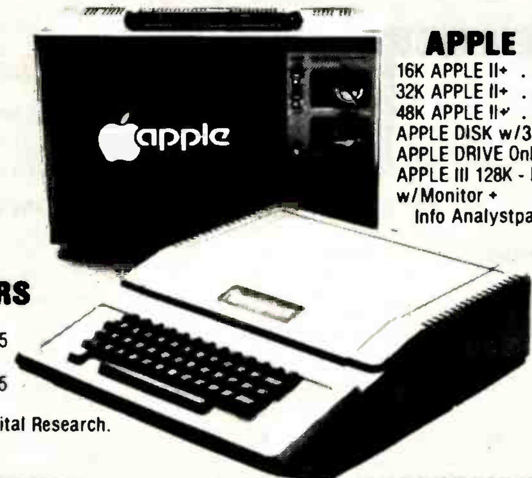

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cluded a dummy initialization section for illustrative purposes in the listing of WINDOW.

Using Units

It is instructive to compare the initialization section of the CALENDAR listing with the dummy version in the WINDOW listing. In CALENDAR, the initialization section is used to read an area of the system disk and load data from this area into public variables declared in the interface section. No procedures or functions are declared in the interface section of this unit (except for a dummy procedure, as described previously). Thus, when any program that employs CALENDAR begins execution, the first action undertaken is a reading of system date information from the system disk and storage of the information in variables that can be accessed immediately by the host program. To the host program, these preinitialized variables look the same as constants since they already contain values before the main program even begins execution.

As an aside, a unit can be built within a skeleton program designed to exercise and test it. Just substitute the expanded unit terminated by an END; (note the semicolon) where the USES <unitname> declaration would normally appear. When the surrounding program runs as expected, the unit may be "shelled" out like a peanut, recompiled (after exchanging the final semicolon for a period), and used as is or bound into a collection of units (called a *library file*) on disk.

This brings us to the task of compiling the listed units and binding them into the SYSTEM.LIBRARY. If you have only one disk drive you would be best served by reading and understanding the following, but also sending for a disk with all of the files on it (see the information in the text box on page 244). This will save an inordinate amount of juggling to fit many obligatory files on one 5-inch disk. If you have two or more drives, and have never had the experience of compiling and linking a unit and installing it in a library, I heartily recommend that you type in all the text from the listings and see the instructions that follow. (You should be seated at a Language-Card-equipped Apple II as you read the remainder of this article.)

To begin, enter the UCSD editor and type in the text file for the INTRINSIC UNIT WINDOW. Compile it, and save both text and code files on disk APPLE2, as U.WINDOW. TEXT and U.WINDOW.CODE. Next, type in the assembly-language listing, CALL, assemble it (by typing A from the command level), and save text and code files on disk APPLE2 as CALL.ASSY.TEXT and CALL.ASSY.CODE.

Now you must link the external procedure, CALL.ASSY.CODE, to the host unit, U.WINDOW.CODE. Type L from the command level to invoke the linker. You should ultimately see the question:

HOST FILE?

Type APPLE2:U.WINDOW.CODE and then hit the Return key (the .CODE suffix may be omitted when using the updated Pascal version 1.1). Next, you will be asked:

LIB FILE?

to which you should answer, CALL.ASSY.CODE and hit the Return key. The question will be repeated. This time you simply hit the Return key. The next question:

MAP FILE?

asks where you wish to send messages concerning the progress of the linking process. You might find it instructive to reply CONSOLE: so you can read the linker messages on the screen. Finally, you will be asked for the name of the object-code file to which you wish the finished, linked version sent with the prompt:

OUTPUT FILE?

Answer with APPLE2:U.WINDOW. CODE, followed by Return. At this

Text continued on page 244

Before you buy any printer, give it this test.

	Other	IMP-4	
GREAT GRAPHICS	?	2	Only IMP-4 gives you bi-directional printing of dot addressable graphics at no extra cost. And with our Quad Density feature, you can even print 19008 dots per square inch! That's more than twice the resolution of Epson's finest!
SIMPLE PLUG-IN	?	2	Apple, TRS-80, PET, Atari, HP... you name it. We've got the industry's widest range of interfaces ready to plug into your computer.
3-WAY PAPER HANDLING	?	2	Axiom's IMP-4 lets you use single sheets, roll paper, or continuous tractor-fed forms. On other printers these features are probably expensive options, if available at all.
LIFETIME 9-WIRE PRINT HEAD	?	2	Axiom's rugged head prints good looking tightly formed characters with lower-case descenders, 6 different character sizes and boldfaces too, all printed bi-directionally at up to 100 cps!
MODERN STYLING	?	2	Styling isn't the main reason you choose a printer, but isn't it nice to know you're getting a printer that will also look great in your office or home?
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Listing 2: *Apple Pascal program to display a high-resolution color test pattern and the system-disk date.*

```
(****************************************
 *                                      *
 *              STARTUP                 *
 *                                      *
 ****************************************)

              (*$S+*)

    (* ROSS M. TONKENS, M.D. *)

       (*VER.01.24.81.01*)

(****************************************
 *PRODUCES A SIX COLOR HIGH RESOLUTION*
 *COLOR BAR TEST PATTERN WITH THE      *
 *SYSTEM DATE DISPLAYED IN THE CENTER *
 *ALONG WITH ANY GREETING OR MESSAGE  *
 *THE USER MAY DESIRE.                *
 *                                    *
 *WHEN THIS PROGRAM IS SAVED ON THE   *
 *BOOT DISKETTE AS                    *
 *                                    *
 *          "SYSTEM.STARTUP"          *
 *                                    *
 *THE APPLE WILL "WAKE UP" DISPLAYING *
 *A COLOR TEST PATTERN AND WHAT IT    *
 *BELIEVES TO BE THE CORRECT DATE,    *
 *THUS SAVING THE USER FROM HAVING TO *
 *INVOKE THE FILER TO CHECK THE DATE  *
 *AFTER BOOTING.  THIS IS ACCOMPLISHED*
 *BY BLOCKREADING THE AREA OF THE BOOT*
 *DISK WHERE THE SYSTEM DATE IS STORED*
 *AND DISPLAYING THIS INFORMATION ON  *
 *THE HIRES SCREEN.  THE METHOD IS    *
 *THEREFORE VALID BOTH FOR MANUAL     *
 *UPDATE SYSTEMS AS WELL AS FOR THOSE *
 *SYSTEMS CONTAINING A CLOCK WHICH    *
 *AUTOMATICALLY UPDATES THE SYSTEM    *
 *DATE ON THE BOOT DISKETTE.          *
 **************************************)


USES TURTLEGRAPHICS,APPLESTUFF,CALENDAR;

(*=========================================
 YOU SHOULD FIRST BIND THE UNIT, "CALENDAR,"
 TO THE SYSTEM.LIBRARY (SEE ACCOMPANYING
 ARTICLE) BEFORE COMPILING THIS PROGRAM.
 THIS IS BECAUSE "SYSTEM.LIBRARY" IS WHERE
 THE COMPILER EXPECTS TO FIND ALL "INTRINSIC"
 UNITS.
 ===========================================*)


CONST

MINX          =     0; (*HIRES SCREEN BOUNDS*)
MINY          =     0; (*  "      "      "  *)
MAXX          =   279; (*  "      "      "  *)
MAXY          =   191; (*  "      "      "  *)
CHARWD        =     7; (*HIRES CHAR WIDTH  *)
CHARHT        =     8; (*HIRES CHAR HEIGHT *)


VAR

LEFT,
RIGHT,
TOP,
BOTTOM,
COLOR,
INC      : INTEGER;



 PROCEDURE BAR;


 (*DRAWS THE VERTICAL COLOR BARS ON THE SCREEN*)
 (*ONLY 5 COLORS USED SINCE BORDER AND TEXT   *)
 (*WINDOWS ARE IMPLICITLY BLACK, THE 6TH COLOR*)


 VAR

 COLR: SCREENCOLOR;


   BEGIN
     CASE COLOR OF
                   1: COLR:= WHITE;
                   2: COLR:= BLUE;
                   3: COLR:= ORANGE;
                   4: COLR:= GREEN;
                   5: COLR:= VIOLET
     END;
     VIEWPORT(LEFT,RIGHT,TOP,BOTTOM);
     FILLSCREEN(COLR);
     IF COLOR < 5 THEN
       BEGIN
         LEFT:= LEFT + INC;
         RIGHT:= RIGHT + INC
       END
   END;
```

Listing 2 continued on page 242

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Listing 2 continued:

```
     PROCEDURE MESSAGE;


     (*"LOADS" PROCEDURE SAYIT WITH USER MESSAGE STRING*)


     VAR

     MSSG            : STRING;
     VTAB            : 1..24;
     CH              : CHAR;
   (*TODAY           : STRING;     PREDECLARED IN "UNIT CALENDAR"*)

   PROCEDURE SAYIT;

   (*CALCULATES COORDINATES FOR CENTERING USER*)
   (*MESSAGE ON THE HIRES SCREEN AND PRINTS IT*)

   VAR

   X,Y: INTEGER;


     BEGIN
       X:= ROUND((280 - LENGTH(MSSG) * CHARWD)/2);
       Y:= MAXY - VTAB * 8;
       VIEWPORT(X -  CHARWD,X + LENGTH(MSSG) * CHARWD + 2 * CHARWD,
                Y - CHARHT,Y + 2 * CHARHT);
       FILLSCREEN(BLACK);
       MOVETO(X,Y);
       WSTRING(MSSG);
     END;



   (*============================================
     SUBSTITUTE YOUR MESSAGES AND VTABS FOR THE
     ONES BELOW.  OF COURSE YOU WILL WANT TO KEEP
     THE DATE WHICH IS STORED IN THE PREDECLARED
     STRING VARIABLE "TODAY" FROM "UNIT CALENDAR."
     ============================================*)


   BEGIN
     MSSG:= ' GOOD DAY, DR. TONKENS! ';
     VTAB:=  8; SAYIT;
     MSSG:= ' WELCOME TO APPLE/UCSD PASCAL 1.1 ';
     VTAB:= 10; SAYIT;
     MSSG:= CONCAT(' THE DATE IS',TODAY);
     VTAB:= 12; SAYIT;
     MSSG:= ' DIGIT ALICE AT YOUR DISPOSAL ';
     VTAB:= 16; SAYIT;
     MSSG:= ' HIT <RETURN> WHEN READY ';
     VTAB:= 22; SAYIT;
     VIEWPORT(MINX,MAXX,MINY,MAXY)
   END;




BEGIN (*STARTUP*)
  INITTURTLE;
  LEFT:= 0;RIGHT:= ROUND(MAXX/5) - 1;
  TOP:= MINY; BOTTOM:= MAXY;
  INC:= RIGHT + 1;
  FOR COLOR:= 1 TO 5 DO
    BAR;
  MESSAGE;
  REPEAT UNTIL KEYPRESS;
  TEXTMODE
END. (*STARTUP*)
```

ALL YOU DO IS PLUG IT IN!

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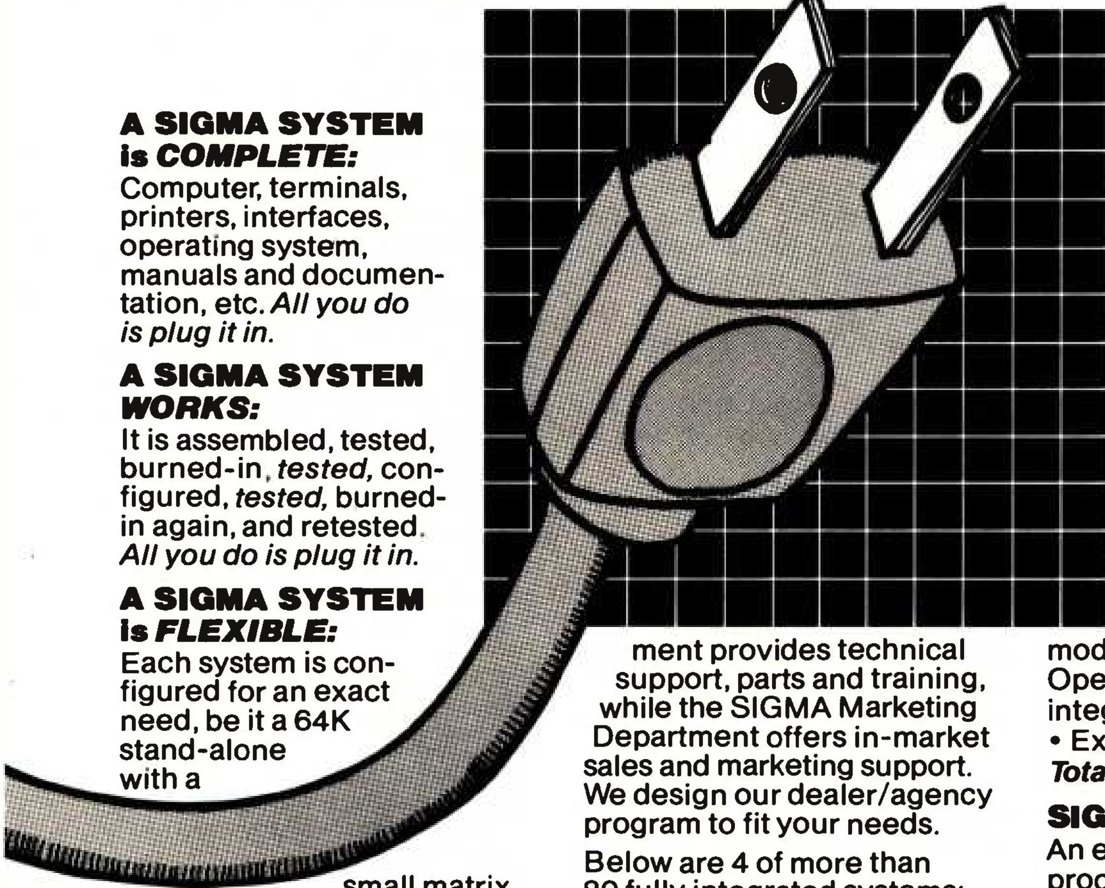

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Text continued from page 238:
point, WINDOW (currently saved as APPLE2:U.WINDOW.CODE) is ready to be bound to SYSTEM.LIBRARY.

However, before installing WINDOW in SYSTEM.LIBRARY you should enter and compile CALENDAR from its listing and save the text and code files as APPLE2:U.CALENDAR.TEXT and APPLE2:U.CALENDAR.CODE.

At this point a few words are in order about a library file. All object-code files in UCSD Pascal can be visualized as residing within a "cabinet" having sixteen shelves. Each shelf can hold only one item, called a segment. A segment represents one stand-alone piece of object code. A unit, even one which invokes external assembly-language subroutines, still represents only one segment, since the subroutine, once linked to the unit, becomes an integral part of that unit's object code. The only time a unit occupies more than one "shelf" in the cabinet is when that unit is an intrinsic unit with both code and data segments. (This subject was briefly examined in the discussion of WINDOW.) Pascal programs use only one shelf. This is because any program, no matter how lengthy, is still one stand-alone piece of object code. There are exceptions to this rule if the program is so lengthy that it has to be broken up into pieces, but this subject is beyond the scope of our current discussion (see the "Program Segmentation" section of the *Addendum to the Apple Pascal Language Reference Manual*).

A library is merely one of these "cabinets" whose shelves contain useful collections of precompiled subroutines instead of a program. If we wish to fill two of the empty "shelves" in SYSTEM.LIBRARY with the WINDOW and CALENDAR units, we begin by executing APPLE3:LIBRARY from the command level. To the prompt:

OUTPUT CODE FILE ->

reply APPLE1:SYSTEM.LIBRARY followed by Return. When

LINK CODE FILE ->

appears, again reply, APPLE1:SYSTEM.LIBRARY and hit Return. Now, when

SLOT TO LINK INTO?

appears, reply = to initiate automatic copying of all the old units into the new library.

Be sure to watch the screen during this process, as you can actually see a dynamic depiction of units being stored in the new library's code slots. You will again be prompted:

SLOT TO LINK INTO?

to which you should reply: N (for new file). Again, you will also be asked:

LINK CODE FILE ->

which you answer with APPLE2:U.WINDOW.CODE Return. Type the following: 1 7 2 8 N. You will see the by now familiar prompt:

LINK CODE FILE ->

Reply, APPLE2:U.CALENDAR.CODE Return. Now to the question:

SLOT TO LINK INTO?

reply as follows: 1 9 2 10 Q.

You will be prompted with the question:

NOTICE?

so that, if you wish, you may type in a copyright or the current date on which you appended this library. This message will then be embedded in the library file on disk for later retrieval through the LIBMAP utility on disk APPLE3. The next Return (with or without a NOTICE) will terminate execution of LIBRARY, returning you to the command level, and replace the old copy of SYSTEM.LIBRARY on disk APPLE1 with your new, appended verison.

If you want a copy of the interface sections of the units in the new SYSTEM.LIBRARY, simply execute APPLE3:LIBMAP. Answer Y to all (Y/N)? prompts after specifying APPLE1:SYSTEM.LIBRARY when asked to:

ENTER LIBRARY NAME:

Answer, PRINTER: or CONSOLE:, Return, to the request:

MAP OUTPUT FILE NAME:

and hit Return when asked again, in order to return to the command level.

Conclusion

The extensibility of UCSD Pascal through units is one of its most powerful features, one that is similar in concept to using one of a genii's three magic wishes to ask for more magic wishes.

I hope this article will encourage readers to explore the power of the unit and investigate some of its mysteries. ■

Acknowledgments

The author wishes to acknowledge the work of Daniel D. Sokol (see "Notes on Absolute Location Interfaces to Apple Pascal," September 1980 BYTE, page 324), from which many of the programming examples in this article were taken.

For those with only one disk drive (or an aversion to typing) a disk is available with copies of the following files:

- *U.WINDOW.TEXT and U.WINDOW.CODE*
- *CALL.ASSY.TEXT and CALL.ASSY.CODE*
- *U.CALENDAR.TEXT and U.CALENDAR.CODE*
- *STARTUP.TEXT and STARTUP.CODE*
- *SYSTEM.LIBRARY with WINDOW and CALENDAR installed*

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This is the best micro computer implementation of GIN RUMMY existing. The computer plays exceptionally well, and the HIRES graphics are superb. What else can be said?

POKER PARTY (Available for all computers) Price: $17.95 Cassette/$21.95 Diskette
POKER PARTY is a draw poker simulation based on the book, POKER, by Oswald Jacoby. This is the most comprehensive version available for microcomputers. The party consists of yourself and six other (computer) players. Each of these players (you will get to know them) has a different personality in the form of a varying propensity to bluff or fold under pressure. Practice with POKER PARTY before going to that expensive game tonight! Apple cassette and diskette versions require a 32 K (or larger) Apple II.

CRIBBAGE 2.0 (TRS-80 only) Price: $14.95 Cassette/$18.95 Diskette
This is simply the best cribbage game available. It is an excellent program for the cribbage player in search of a worthy opponent as well as for the novice wishing to improve his game. The graphics are superb and assembly language routines provide rapid execution. See the software review in 80 Software Critique.

THOUGHT PROVOKERS

MANAGEMENT SIMULATOR (Atari, North Star and CP/M only) Price: $19.95 Cassette/$23.95 Diskette
This program is both an excellent teaching tool as well as a stimulating intellectual game. Based upon similar games played at graduate business schools, each player or team controls a company which manufacturers three products. Each player attempts to outperform his competitors by setting selling prices, production volumes, marketing and design expenditures etc. The most successful firm is the one with the highest stock price when the simulation ends.

FLIGHT SIMULATOR (Available for all computers) Price: $17.95 Cassette/$21.95 Diskette
A realistic and extensive mathematical simulation of take-off, flight and landing. The program utilizes aerodynamic equations and the characteristics of a real airfoil. You can practice instrument approaches and navigation using radials and compass headings. The more advanced flyer can also perform loops, half-rolls and similar aerobatic maneuvers. Although this program does not employ graphics, it is exciting and very addictive. See the software review in COMPUTRONICS. Runs in 16K Atari.

VALDEZ (Available for all computers) Price: $15.95 Cassette/$19.95 Diskette
VALDEZ is a computer simulation of supertanker navigation in the Prince William Sound/Valdez Narrows region of Alaska. Included in this simulation is a realistic and extensive 256 × 256 element map, portions of which may be viewed using the ship's alphanumeric radar display. The motion of the ship itself is accurately modelled mathematically. The simulation also contains a model for the tidal patterns in the region, as well as other traffic (outgoing tankers and drifting icebergs). Chart your course from the Gulf of Alaska to Valdez Harbor! See the software reviews in 80 Software Critique and Personal Computing.

BACKGAMMON 2.0 (Atari, North Star and CP/M only) Price: $14.95 Cassette/$18.95 Diskette
This program tests your backgammon skills and will also improve your game. A human can compete against a computer or against another human. The computer can even play against itself. Either the human or the computer can double or generate dice rolls. Board positions can be created or saved for replay. BACKGAMMON 2.0 plays in accordance with the official rules of backgammon and is sure to provide many fascinating sessions of backgammon play.

CHECKERS 3.0 (PET only) Price: $16.95 Cassette/$20.95 Diskette
This is one of the most challenging checkers programs available. It has 10 levels of play and allows the user to change skill levels at any time. Although providing a very tough game at level 4-8, CHECKERS 3.0 is practically unbeatable at levels 9 and 10.

CHESS MASTER (North Star and TRS-80 only) Price: $19.95 Cassette/$23.95 Diskette
This complete and very powerful program provides five levels of play. It includes castling, en passant captures and the promotion of pawns. Additionally, the board may be preset before the start of play, permitting the examination of "book" plays. To maximize execution speed, the program is written in assembly language (by SOFTWARE SPECIALISTS of California). Full graphics are employed in the TRS-80 version, and two widths of alphanumeric display are provided to accommodate North Star users. See review in onComputing.

LEM LANDER (32K Apple Disk only) Price: $16.95 Diskette
Pilot your LEM LANDER to a safe landing on any of nine different surfaces ranging from smooth to treacherous. The game paddles are used to control craft attitude and thrust. This is a real-time high res challenge!

FOREST FIRE! (Atari only) Price: $16.95 Cassette/$20.95 Diskette
Using excellent graphics and sound effects, this simulation puts you in the middle of a forest fire. Your job is to direct operations to put out the fire while compensating for changes in wind, weather and terrain. Not protecting valuable structures can result in startling penalties. Life-like variables are provided to make FOREST FIRE! very suspenseful and challenging. No two games have the same setting and there are 3 levels of difficulty.

SPACE EVACUATION! (Apple, Atari and TRS-80 only) Price: $15.95 Cassette/$19.95 Diskette
Can you colonize the galaxy and evacuate the Earth before the sun explodes? Your computer becomes the ship's computer as you explore the universe to relocate millions of people. This simulation is particularly interesting as it combines many of the exciting elements of classic space games with the mystery challenge of ADVENTURE.

MONARCH (Atari only) Price: $11.95 Cassette/$15.95 Diskette
MONARCH is a fascinating economic simulation requiring you to survive an 8-year term as your nation's leader. You determine the amount of acreage devoted to industrial and agricultural use, how much food to distribute to the populace and how much should be spent on pollution control. You will find that all decisions involve a compromise and that it is not easy to make everyone happy. Runs in 16K Atari.

CHOMPELO (Atari only) Price: $11.95 Cassette/$15.95 Diskette
CHOMPELO is really two challenging games in one. One is similar to NIM; you must bite off part of a cookie, but avoid taking the poisoned portion. The other game is the popular board game REVERSI. It fully uses the Atari's graphics capability, and is hard to beat. This package will run on a 16K system.

SPACE LANES (Available for all computers) Price: $10.95 Cassette/$14.95 Diskette
SPACE LANES is a simple but exciting space transportation game which involves up to four players (including the computer). The object is to form and expand space transportation companies in a competitive environment. The goal is to amass more net worth than your opponent. The economics include stock purchases and company mergers. Watch your wealth grow!

AVAILABILITY

DYNACOMP software is supplied with complete documentation containing clear explanations and examples. Unless otherwise specified, all programs will run within 16K program memory space (ATARI requires 24K). Except where noted, programs are available on ATARI, PET, TRS-80 (Level II) and Apple (Applesoft) cassette and diskette as well as North Star single density (double density compatible) diskette. Additionally, most programs can be obtained on standard (IBM 3740 single density/double density compatible format) 8" CP/M floppy disks for systems running under MBASIC (for example, Altos, Xerox 820 and many others) 5¼" CP/M diskettes are available for the North Star and Osborne computer systems.

**ATARI, PET/CBM, NORTH STAR, CP/M, IBM, OSBORNE and XEROX are registered tradenames and/or trade marks.*

***Except where noted, all TRS-80 Model I software is available on cassette (only) for the TRS-80 Model III. Exceptions: VALDEZ, CRIBBAGE, GRAFIX, CHESSMASTER. TRS-80 diskettes are not supplied with either DOS or BASIC.*

DYNACOMP OFFERS THE FOLLOWING

- Widest variety
- Guaranteed quality
- Fastest delivery
- Friendly customer service
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- 24 hour order phone

AND MORE...

STARTREK 3.2 (Available for all computers) Price: $11.95 Cassette/$15.95 Diskette
This is the classic Startrek simulation, but with several new features. For example, the Klingons now shoot at the Enterprise without warning while also attacking starbases in other quadrants. The Klingons also attack with both light and heavy cruisers and move when shot at! The situation is hectic when the Enterprise is besieged by three heavy cruisers and a starbase S.O.S. is received! The Klingons get even! See the software reviews in A.N.A.L.O.G., 80 Software Critique and Game Merchandising.

BLACK HOLE (Apple only) Price: $14.95 Cassette/$18.95 Diskette
This is an exciting graphical simulation of the problems involved in closely observing a black hole with a space probe. The object is to enter and maintain, for a prescribed time, an orbit close to a small black hole. This is to be achieved without coming so near the anomaly that the tidal stress destroys the probe. Control of the craft is realistically simulated using side jets for rotation and main thrusters for acceleration. This program employs Hi-Res graphics and is educational as well as challenging.

SPACE TILT (Apple and Atari only) Price: $10.95 Cassette/$14.95 Diskette
Use the game paddles to tilt the plane of the TV screen to "roll" a ball into a hole in the screen. Sound simple? Not when the hole gets smaller and smaller! A built-in timer allows you to measure your skill against others in this habit-forming action game.

ESCAPE FROM VOLANTIUM (Atari only) Price: $15.95 Cassette/$19.95 Diskette
Bring the action and excitement of an arcade into your home with ESCAPE FROM VOLANTIUM! To escape you must maneuver your space ship around obstacles and laser blast the dragon (without being eaten). If he is killed with a direct shot (not just a leg lopped off), a door opens to the outside. However, the door does not stay open indefinitely. If you fail to escape in time, the door closes and a new dragon appears. Sometimes you can smash through the door by repeatedly chipping away at it. Other times it is impervious. At the higher levels of play more obstacles and dragons appear, adding to the excitement. Uses high resolution graphics and sound. Runs in 16K.

ALPHA FIGHTER (Atari only) Price: $14.95 Cassette/$18.95 Diskette
Two excellent graphics and action programs in one! ALPHA FIGHTER requires you to destroy the alien starships passing through your sector of the galaxy. ALPHA BASE is in the path of an alien UFO invasion; let five UFO's get by and the game ends. Both games require the joystick and get progressively more difficult the higher you score! ALPHA FIGHTER will run on 16K systems.

THE RINGS OF THE EMPIRE (Atari only) Price: $16.95 Cassette/$20.95 Diskette
The empire has developed a new battle station protected by rotating rings of energy. Each time you blast through the rings and destroy the station, the empire develops a new station with more protective rings. This exciting game runs on 16K systems, employs extensive graphics and sound and can be played by one or two players.

INTRUDER ALERT (Atari only) Price: $16.95 Cassette/$20.95 Diskette
This is a fast paced graphics game which places you in the middle of the "Dreadstar" having just stolen its plans. The droids have been alerted and are directed to destroy you at all costs. You must find and enter your ship to escape with the plans. Five levels of difficulty are provided. INTRUDER ALERT requires a joystick and will run on 16K systems.

MIDWAY (Atari only) Price: $14.95 Cassette/$18.95 Diskette
MIDWAY is an exciting extension of the game of Battleship. It mixes the challenges of strategy and chance. Your opponent can be another human or the computer. Color graphics and sound are both included. Runs in 16K.

TRIPLE BLOCKADE (Atari only) Price: $14.95 Cassette/$18.95 Diskette
TRIPLE BLOCKADE is a two-to-three player graphics and sound action game. It is based on the classic video arcade game which millions have enjoyed. Using the Atari joysticks, the object is to direct your blockading line around the screen without running into your opponent(s). Although the concept is simple, the combined graphics and sound effect lead to "high anxiety".

GAMES PACK I (Available for all computers) Price: $10.95 Cassette/$14.95 Diskette
GAMES PACK I contains the classic computer games of BLACKJACK, LUNAR LANDER, CRAPS, HORSERACE, SWITCH and more. These games have been combined into one large program for ease in loading. They are individually accessed by a convenient menu. This collection is worth the price just for the DYNACOMP version of BLACKJACK.

GAMES PACK II (Available for all computers) Price: $10.95 Cassette/$14.95 Diskette
GAMES PACK II includes the games CRAZY EIGHTS, JOTTO, ACEY-DUCEY, LIFE, WUMPUS and others. As with GAMES PACK I, all the games are loaded as one program and are called from a menu. You will particularly enjoy DYNACOMP's version of CRAZY EIGHTS.

Why pay $7.95 or more per program when you can buy a DYNACOMP collection for just $10.95?

MOON PROBE (Atari and North Star only) Price: $11.95 Cassette/$15.95 Diskette
This is an extremely challenging "lunar lander" program. The user must drop from orbit to land at a predetermined target on the moon's surface. You control the thrust and orientation of your craft plus direct the rate of descent and approach angle. Runs in 16K Atari.

SPACE TRAP (Atari only, 16K) Price: $14.95 Cassette/$18.95 Diskette
This galactic "shoot'em up" arcade game places you near a black hole. You control your spacecraft using the joystick and attempt to blast as many of the alien ships as possible before the black hole closes about you.

CHIRP INVADERS (PET/CBM only) Price: $14.95 Cassette/$18.95 Diskette
CHIRP INVADERS is an addictive game using action graphics. A Federation space station must be reached before the Chirps conquer the Earth. Stationary obstacles, moving meteors, and the attacking Chirps must all be avoided for a successful journey. Good luck.

ADVENTURE

CRANSTON MANOR ADVENTURE (North Star and CP/M only) Price: $29.95 Diskette
At last! A comprehensive Adventure game for North Star and CP/M systems. CRANSTON MANOR ADVENTURE takes you into mysterious CRANSTON MANOR where you attempt to gather fabulous treasures. Lurking in the manor are wild animals and robots who will not give up the treasures without a fight. The number of rooms is greater and the associated descriptions are much more elaborate than the current popular series of Adventure programs, making this game the top in its class. Play can be stopped at any time and the status stored on diskette. Not available in 5¼" CP/M format.

GUMBALL RALLY ADVENTURE (North Star only, 48K) Price: $21.95 Diskette
Take part in this outlaw race from the east coast to the west coast. The goal is to find your way to the finish line while maintaining the highest possible speed. You may choose one of five cars available at the garage. The choice will affect your speed and range. Remember to take spare parts and don't get caught speeding!

UNCLE HARRY'S WILL (North Star only, 40K) Price: $34.95 Diskette
Uncle Harry has died and has left you everything. However, he has neglected to mention where everything is! Instead, his will consists of a poem which contains clues. You will have to travel all over the United States both by car and on foot to solve the puzzle, and there are over 300 locations to probe. Be careful and watch out for red herrings!

SPEECH SYNTHESIS

DYNACOMP is now distributing the new and revolutionary TYPE-'N-TALK™ (TNT) speech synthesizer from Votrax. Simply connect TNT to your computer's serial interface, enter text from the keyboard and hear the words spoken. TNT is the easiest-to-program speech synthesizer on the market. It uses the least amount of memory and provides the most flexible vocabulary available anywhere!

List price $375. DYNACOMP'S price $329.95. Please add $5.00 for shipping and handling.

TALK TO ME (T'N'T Atari only, 24K) Price: $14.95 Cassette/$18.95 Diskette
This program presents a superb tutorial on speech synthesis using the Atari 800 and TYPE 'N TALK™. TALK TO ME will illustrate normal word generation as well as phoneme generation. The documentation includes many helpful programming tips.

MISCELLANEOUS

CRYSTALS (Atari only) Price: $ 9.95 Cassette/$13.95 Diskette
A unique algorithm randomly produces fascinating graphics displays accompanied with tones which vary as the patterns are built. No two patterns are the same, and the combined effect of the sound and graphics are mesmerizing. CRYSTALS has been used in local stores to demonstrate the sound and color features of the Atari. Runs in 16K Atari.

NORTH STAR SOFTWARE EXCHANGE (NSSE) LIBRARY
DYNACOMP now distributes the 23 volume NSSE library. These diskettes each contain many programs and offer an outstanding value for the purchase price. They should be part of every North Star user's collection. Call or write DYNACOMP for details regarding the contents of the NSSE collection.

Price: $9.95 each/$7.95 each (4 or more)
The complete collection may be purchased for $149.95

Circle 114 on inquiry card.

BUSINESS and UTILITIES

MAILMASTER (Atari diskette only) — Price: $39.95 Diskette

MAILMASTER is a very versatile software package for managing and manipulating mail lists and mini data bases. Each disk can hold over 700 customer entries containing name, address, three 3-letter key words and a phone number. The display is marked so that entries may be made and edited with ease. The status (e.g., disk space left, options, etc.) is shown at all times. Labels may be printed 1,2 or 3 up, and all sorting (zip code and alphabetic) is performed by a fast machine language program.

SORTIT (North Star only) — Price: $29.95 Diskette

SORTIT is a general purpose sorting program written in 8080 assembly language. This program will sort sequential data files generated by NORTH STAR BASIC. Primary and optional secondary keys may be numeric or one to nine character strings. SORTIT is easily used with files generated by DYNACOMP's MAIL LIST program and is very versatile in its capabilities for all other BASIC data file sorting.

PERSONAL FINANCE SYSTEM (Atari and North Star only) — Price: $39.95 Diskette

PFS is a single diskette, menu-oriented system composed of ten different programs. Besides recording your expenses and tax deductible items, PFS will sort and summarize expenses by payee, and display information on expenditures by any of 26 user defined codes by month or by payee. PFS will even produce monthly bar graphs of your expenses by category! This powerful package requires only one disk drive, minimal memory (24K Atari, 32K North Star) and will store up to 600 records per disk (and over 1000 records per disk by making a few simple changes to the programs). You can record checks plus cash expenses so that you can finally see where your money goes and eliminate guesswork and tedious hand calculations. Contains high speed machine language sort.

FAMILY BUDGET (Apple and Atari only) — Price: $34.95 Diskette

FAMILY BUDGET is a very convenient financial record-keeping program. You will be able to keep track of cash and credit expenditures as well as income on a daily basis. You can record tax deductible items and charitable donations. FAMILY BUDGET also provides a continuous record of all credit transactions. You can make daily cash and charge entries to any of 21 different expense accounts as well as to 5 payroll and tax accounts. Data are easily retrieved giving the user complete control over an otherwise complicated (and unorganized!) subject.

INTELINK (Atari only) — Price: $49.95 Diskette

This software package contains a menu-driven collection of programs for facilitating efficient two-way communications through a full duplex modem (required for use). In one mode of operation you may connect to a data service (e.g., The SOURCE or MicroNet) and quickly load data such as stock quotations onto your diskette for later viewing. This greatly reduces "connect time" and thus the service charge. You may also record the complete contents of a communications session. Additionally, programs written in BASIC, FORTRAN, etc. may be built off-line using the support text editor and later "uploaded" to another computer, making the Atari a *very* smart terminal. Even Atari BASIC programs may be uploaded. Further, a command file may be built off-line and used later as controlling input for a time share system. That is, you can set up your sequence of time-share commands and programs, and the Atari will transmit them as needed; batch processing. All this adds up to saving both connect time and your time.

TEXT EDITOR II (CP/M) — Price: $29.95 Diskette/$33.45 Disk

This is the second release version of DYNACOMP's popular TEXT EDITOR I and contains many new features. With TEXT EDITOR II you may build text files in chunks and assemble them for later display. Blocks of text may be appended, inserted or deleted. Files may be saved on disk/diskette in right justified/centered format to be later printed by either TEXT EDITOR II or the CP/M ED facility. Futher, ASCII CP/M files (including BASIC and assembly language programs) may be read by the editor and processed. In fact, text files can be built using ED and later formatted using TEXT EDITOR II. All in all, TEXT EDITOR II is an inexpensive, easy to use, but very flexible editing system.

DFILE (Atari and North Star diskettes only) — Price: $19.95

This handy program allows North Star and Atari disk users to maintain a specialized data base of all files and programs in the stack of disks which invariably accumulates. DFILE is easy to set up and use. It will organize your disks to provide efficient locating of the desired file or program.

FINDIT (North Star only) — Price: $19.95

This is a three-in-one program which maintains information accessible by keywords of three types: Personal (eg: last name), Commercial (eg: plumbers) and Reference (eg: magazine articles, record albums, etc). In addition to keyword searches, there are birthday, anniversary and appointment searches for the personal records and appointment searches for the commercial records. Reference records are accessed by a single keyword or by cross-referencing two or three keywords.

SHOPPING LIST (Atari only) — Price: $12.95 Cassette/$16.95 Diskette

SHOPPING LIST stores information on items you purchase at the supermarket. Before going shopping, it will remind you of all the things you might need, and then display (or optionally print) your shopping list and the total cost. Adding, deleting, changing and storing data is very easy. Runs with 16K.

TAX OPTIMIZER (North Star only) — Price: $39.95 Diskette

The TAX OPTIMIZER is an easy-to-use, menu oriented software package which provides a convenient means for analyzing various income tax strategies. The program is designed to provide a quick and easy data entry. Income tax is computed by all tax methods (regular, income averaging, maximum and alternate minimum tax). The user may immediately observe the tax effect of critical financial decisions. TAX OPTIMIZER has been thoroughly field tested in CPA offices and comes complete with the current tax tables in its data files. TAX OPTIMIZER is tax deductible!

UTIL (Apple only, 48K) — Price: $19.95 Diskette

UTIL is a disk-oriented utility system which permits examining and changing of the contents of DOS 3.2 and 3.3 diskettes at the bit (nibble or byte) level. With UTIL you can easily examine the contents of a diskette sector by sector, restructure the sector pointers, reallocate sectors (e.g. bad sectors may be "hidden"), and perform many other sophisticated operations. For the experienced programmer.

TURNKEY AND MENU (Atari only) — Price: $17.95 Diskette

TURNKEY is a utility program which allows you to create autoboot/autorun diskettes easily. Simply load and run TURNKEY, load the program diskette to be modified, and answer the questions! The TURNKEY diskette also comes with DOS 2.0 and includes another program, MENU. MENU lists the contents of your diskette alphabetically, and permits the running of any BASIC program on the diskette by typing a single key. TURNKEY and MENU provide you with the ability to run any program on your diskette by simply turning on the computer and pressing a single key.

STOCKAID (Atari only) — Price: $29.95 Diskette

STOCKAID provides a powerful set of tools for stock market analysis. With STOCKAID you can display point and figure charts, as well as bar charts with oscillators. You can also examine long term moving averages and on-balance volume features. STOCKAID allows you to input daily data with a single diskette storage capability of 239 days × 16 stocks. Included are stock dividend and split adjustment capabilities. A very professional package!

EDUCATION

HODGE PODGE (Apple only, 48K Applesoft or Integer BASIC) — Price: $19.95 Cassette/$23.95 Diskette

Let HODGE PODGE be your child's teacher. Pressing any key on your Apple will result in a different and intriguing "happening" related to the letter or number of the chosen key. The program's graphics, color and sound are a delight for children from ages 1½ to 7. HODGE PODGE is a non-intimidating teaching device which brings a new dimension to the use of computers in education. See review in Infoworld.

TEACHER'S AIDE (Atari only) — Price: $13.95 Cassette/$17.95 Diskette

TEACHER'S AIDE consists of three basic modules contained in one program. The first module provides addition and subtraction exercises of varying levels of difficulty. The second module consists of multiplication problems in which the student may be tested both on the final answer and/or on the subtotal answers in the long hand procedure. Several levels of complexity are provided here as well. The third module consists of division problems; one particularly nice feature of the division module is that the long hand division steps can be displayed along with the remainder in order to clearly demonstrate the procedure by which the remainder is derived. Using TEACHER'S AIDE is not merely a drill, but rather a learning experience.

ORDERING INFORMATION

All orders are processed and shipped within 48 hours. Please enclose payment with order and include the appropriate computer information. If paying by VISA or Master Card, include all numbers on card. Purchase orders accepted.

Shipping and Handling Charges
Within North America: Add $2.00
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All orders (excluding books) are sent First Class

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Deduct 10% when ordering 3 or more programs. Dealer discount schedules are available upon request.

8" CP/M Disks
Add $2.50 to the listed diskette price for each 8" floppy disk (IBM soft sectored CP/M format). Programs run under Microsoft MBASIC or BASIC-80.

5¼" CP/M Disks
All software available on 8" CP/M disks is also available on 5¼" disks, North Star format.

Ask for DYNACOMP programs at your local software dealer. Write for detailed descriptions of these and other programs from DYNACOMP.

DYNACOMP, Inc. (Dept. B)
1427 Monroe Avenue
Rochester, New York 14618
24 hour order phone: (716)442-8731 recording
Office phone (9AM-5PM EST): (716)442-8960

New York State residents please add 7% NYS sales tax.

STATISTICS and ENGINEERING

DIGITAL FILTER (Available for all computers) — Price: $39.95 Cassette/$43.95 Diskette

DIGITAL FILTER is a comprehensive data processing program which permits the user to design his own filter function or choose from a menu of filter forms. The filter forms are subsequently converted into non-recursive convolution coefficients which permit rapid data processing. In the explicit design mode the shape of the frequency transfer function is specified by directly entering points along the desired filter curve. In the menu mode, ideal low pass, high pass and bandpass filters may be approximated to varying degrees according to the number of points used in the calculation. These filters may optionally also be smoothed with a Hanning function. In addition, multi-stage Butterworth filters may be selected. Features of DIGITAL FILTER include plotting of the data before and after filtering, as well as display of the chosen filter functions. Also included are convenient data storage, retrieval and editing procedures.

DATA SMOOTHER (Not available for Atari) — Price: $19.95 Cassette/$23.95 Diskette

This special data smoothing program may be used to rapidly derive useful information from noisy business and engineering data which are equally spaced. The software features choice in degree and range of fit, as well as smoothed first and second derivative calculation. Also included is automatic plotting of the input data and smoothed results.

FOURIER ANALYZER (Available for all computers) — Price: $19.95 Cassette/$23.95 Diskette

Use this program to examine the frequency spectra of limited duration signals. The program features automatic scaling and plotting of the input data and results. Practical applications include the analysis of complicated patterns in such fields as electronics, communications and business.

TFA (Transfer Function Analyzer) — Price: $19.95 Cassette/$23.95 Diskette

This is a special software package which may be used to evaluate the transfer functions of systems such as hi-fi amplifiers and filters by examining their response to pulsed inputs. TFA is a major modification of FOURIER ANALYZER and contains an engineering-oriented decibel versus log-frequency plot as well as data editing features. Whereas FOURIER ANALYZER is designed for educational and scientific use, TFA is an engineering tool. Available for all computers.

HARMONIC ANALYZER (Available for all computers) — Price: $24.95 Cassette/$28.95 Diskette

HARMONIC ANALYZER was designed for the spectrum analysis of repetitive waveforms. Features include data file generation, editing and storage/retrieval as well as data and spectrum plotting. One particularly unique facility is that the input data need not be equally spaced or in order. The original data is sorted and a cubic spline interpolation is used to create the data file required by the FFT algorithm.

FOURIER ANALYZER, TFA and HARMONIC ANALYZER may be purchased together for a combined price of $49.95 (three cassettes) and $59.95 (three diskettes).

REGRESSION I (Available for all computers) — Price: $19.95 Cassette/$23.95 Diskette

REGRESSION I is a unique and exceptionally versatile one-dimensional least squares "polynomial" curve fitting program. Features include very high accuracy; an automatic degree determination option; an extensive internal library of fitting functions; data editing; automatic data, curve and residual plotting; a statistical analysis (eg: standard deviation, correlation coefficient, etc.) and much more. In addition, new fits may be tried without reentering the data. REGRESSION I is certainly the cornerstone program in any data analysis software library.

REGRESSION II (PARAFIT) (Available for all computers) — Price: $19.95 Cassette/$23.95 Diskette

PARAFIT is designed to handle those cases in which the parameters are imbedded (possibly nonlinearly) in the fitting function. The user simply inserts the functional form, including the parameters (A(1), A(2), etc.) as one or more BASIC statement lines. Data, results and residuals may be manipulated and plotted as with REGRESSION I. Use REGRESSION I for polynomial fitting, and PARAFIT for those complicated functions.

MULTILINEAR REGRESSION (MLR) (Available for all computers) — Price: $24.95 Cassette/$28.95 Diskette

MLR is a professional software package for analyzing data sets containing two or more linearly independent variables. Besides performing the basic regression calculation, this program also provides easy to use data entry, storage, retrieval and editing functions. In addition, the user may interrogate the solution by supplying values for the independent variables. The number of variables and data size is limited only by the available memory.

REGRESSION I, II and MULTILINEAR REGRESSION may be purchased together for $51.95 (three cassettes) or $63.95 (three diskettes).

ANOVA (Not available on Atari cassette or for PET/CBM) — Price: $39.95 Cassette/$43.95 Diskette

In the past the ANOVA (analysis of variance) procedure has been limited to the large mainframe computers. Now DYNACOMP has brought the power of this method to small systems. For those conversant with ANOVA, the DYNACOMP software package includes the 1-way, 2-way and N-way procedures. Also provided are the Yates 2^{K-P} factorial designs. For those unfamiliar with ANOVA, do not worry. The accompanying documentation was written in a tutorial fashion (by a professor in the subject) and serves as an excellent introduction to the subject. Accompanying ANOVA is a support program for building the data base. Included are several convenient features including data editing, deleting and appending.

BASIC SCIENTIFIC SUBROUTINES, Volumes 1 and 2 (Not available for Atari)

DYNACOMP is the exclusive distributor for the software keyed to the popular texts *BASIC SCIENTIFIC SUBROUTINES, Volumes 1 and 2* by F. Ruckdeschel (see advertisements in BYTE magazine). These subroutines have been assembled according to chapter. Included with each collection is a menu program which selects and demonstrates each subroutine.

Volume 1
Collection #1: Chapters 2 and 3 - Data and function plotting; complex variables and functions.
Collection #2: Chapter 4 - Extended matrix and vector operations.
Collection #3: Chapters 5 and 6 - Random number generators (Poisson, Gaussian, etc.); series approximations.
Price per collection: $14.95 Cassette/$18.95 Diskette

All three collections are available for $39.95 (three cassettes) and $49.95 (three diskettes).

Volume 2
Collection #1: Chapter 1 - Linear, polynomial, multidimensional, parametric least squares.
Collection #2: Chapter 2 - Series approximation techniques (economization, inversion, reversion, shifting, etc.).
Collection #3: Chapter 3 - Functional approximations by iteration and recursion.
Collection #4: Chapter 4 - CORDIC approximations to trigonometric, hyperbolic, exponential and logarithmic functions.
Collection #5: Chapter 5 - Table interpolation, differentiation and integration (Newton, LaGrange, splines).
Collection #6: Chapter 6 - Methods for finding the real roots of functions.
Collection #7: Chapter 7 - Methods for finding the complex roots of functions.
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Price per collection: $14.95 Cassette/$18.95 Diskette

All eight collections are available for $99.95 (eight cassettes) and $129.95 (eight diskettes).

Because the texts are a vital part of the documentation, *BASIC SCIENTIFIC SUBROUTINES, Volumes 1 and 2* are available from DYNACOMP:

BASIC SCIENTIFIC SUBROUTINES, Vol 1 (319 pages): $19.95 + 75¢ postage
BASIC SCIENTIFIC SUBROUTINES, Vol 2 (790 pages): $23.95 + $1.50 postage

See reviews in KILOBAUD and Dr. Dobbs.

ROOTS (Available for all computers) — Price $10.95 Cassette/$14.95 Diskette

In a nutshell, ROOTS simultaneously determines all the zeroes of a polynomial having real coefficients. There is no limit on the degree of the polynomial, and because the procedure is iterative, the accuracy is generally very good. No initial guesses are required as input, and the calculated roots are substituted back into the polynomial and the residuals displayed.

ACTIVE CIRCUIT ANALYSIS (ACAP) (48K Apple only) — Price: $25.95 Cassette/$29.95 Diskette

ACAP is the analog circuit designer's answer to LOGIC SIMULATOR. With ACAP you may analyze the response of an active or passive component circuit (e.g., a transistor amplifier, band pass filter, etc.). The circuit may be probed at equal steps in frequency, and the resulting complex (i.e., real and imaginary) voltages at each component juncture examined. By plotting the magnitude of these voltages, the frequency response of a filter or amplifier may be completely determined with respect to both amplitude and phase. In addition, ACAP prints a statistical analysis of the range of voltage responses which result from tolerance variations in the components. ACAP is easy to learn and use. Simply describe the circuit in terms of the elements and their placement, and execute. Circuit descriptions may be saved onto cassette or diskette to be recalled at a later time for execution or editing. ACAP should be part of every circuit designer's program library.

LOGIC SIMULATOR (Apple only; 48K RAM) — Price: $24.95 Cassette/$28.95 Diskette

With LOGIC SIMULATOR you may easily test your complicated digital logic design with respect to given set of inputs to determine how well the circuit will operate. The elements which may be simulated include multiple input AND, OR, NOR, EXOR, EXNOR and NAND gates, as well as inverters, J-K and D flip-flops, and one-shots. The response of the system is available every clock cycle. Inputs may be clocked in with varying clock cycle lengths/displacements and delays may be introduced to probe for glitches and race conditions. At the user's option, a timing diagram for any given set of nodes may be plotted using HIRES graphics. Save your breadboarding until the circuit is checked by LOGIC SIMULATOR.

NUMBERKRUNCHER (TRS-80 only) — Price: $69.95 Cassette/$73.95 Diskette

This program is the most complete numerical analysis system available for the TRS-80. It can handle up to 255 data sets, each set having a six character name. It includes complete data editing facilities and convenient data input/output capability. The analyses available are multiple linear regression and correlation determination of residuals, data transformations and extensive graphics generation, including axis naming, and more. The supporting documentation is extremely well written and well organized, and includes appendices which describe the numerical procedures used in the program.

STATSORT (TRS-80 only) — Price: $39.95 Cassette/$43.95 Diskette

STATSORT consists of several menu selected programs which allow the user to create (build, edit, merge), format and print files, (machine) sort them on any field, and numerically analyze (maximum, minimum, average, variance, standard deviation) tabulated data. STATSORT is well documented and easy to use. The cassette version can also be employed to create a data type which can be read by the Radio Shack Advanced Statistical Package.

STATTEST (TRS-80 only) — Price: $19.95 Cassette/$23.95 Diskette

This is a statistical inference package which helps you make wise decisions in the face of uncertainty. In an interactive fashion you can build and edit data files and test the differences in means, variances and proportions. STATTEST will also perform data analysis as well as do linear correlation and regression. This menu-directed statistical workhorse is rounded out with a chi-square contingency test and a (uniform and normal) random sample generator. The documentation is written by a college professor who guides you through the various tests.

ABOUT DYNACOMP

DYNACOMP is a leading distributor of small system software with sales spanning the world (currently in excess of 50 countries). During the past three years we have greatly enlarged the DYNACOMP product line, but have maintained and improved our high level of quality and customer support. The achievement in quality is apparent from our many repeat customers and the software reviews in such publications as COMPUTRONICS, 80 Software Critique, A.N.A.L.O.G., Creative Computing and Kilobaud. Our customer support is as close as your phone. It is always friendly. The staff is highly trained and always willing to discuss products or give advice.

Technical Forum

A Fast Approximation for Fast Fourier

Mark H. Polczynski
Eaton/CCSD
901 South 12th St.
Watertown, WI 53094

Two articles in BYTE have presented approximations for rapidly calculating $M=\sqrt{a^2+b^2}$. Richard Lord in "Fast Fourier for the 6800" (February 1979 BYTE, page 108) approximates M by $M'=L+S$, where L is the larger of the quantities a and b, and S is the smaller. Bob Leedom in a "Technical Forum" (June 1979 BYTE, page 188) points out that the approximation can be greatly improved by letting $M'=L+KS$ and choosing K to minimize the error of approximation, $E=M-M'$.

The optimum value of K depends on the user's requirements. Four strategies for optimizing K suggest themselves:

1. minimize the peak-to-peak error
2. minimize the average magnitude of the error
3. set the average positive error equal to the average negative error
4. set the average error equal to zero

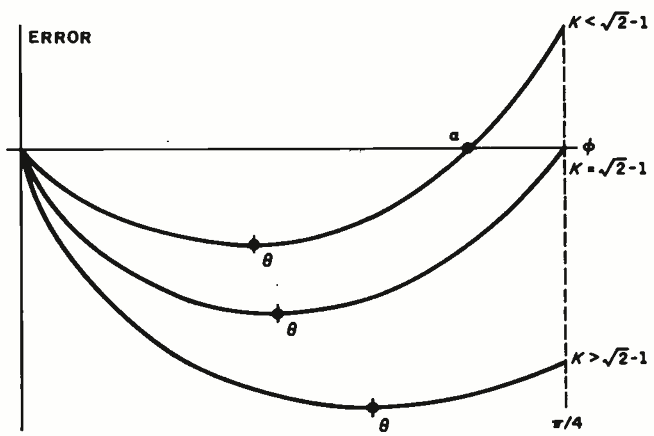

Figure 1: *Generalized error curve for $E = 1 - \cos(\phi) - K \sin(\phi)$.*

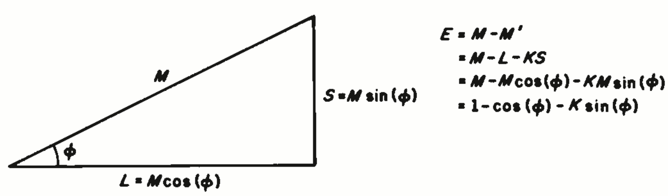

Figure 2: *Constructing $E = M - M'$.*

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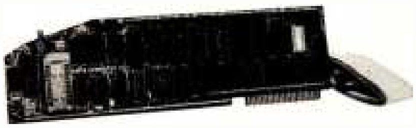

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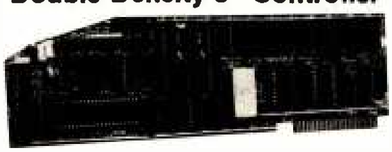

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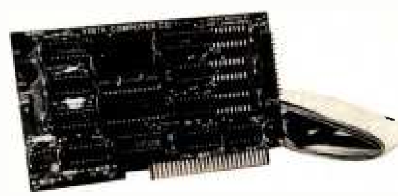

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Circle 370 on inquiry card.

Omniterm: Smart Terminal Program for the TRS-80

Bob Liddil
POB 66
Peterborough, NH 03458

The addition of communications capabilities to a computer inaugurates a new concept in personal computing. With a modem, a telephone, and an intelligent terminal program, a microcomputer becomes an instrument for external data collection or transmission. With these tools, you can communicate with similarly equipped computers throughout the world.

The most critical of these tools is the terminal program. True, an inferior modem or faulty telephone line can cause problems, but the terminal program can open endless possibilities or cause severe limitations, depending on its features (or lack of them).

At a Glance

Name
Omniterm

Type
Intelligent terminal program

Author
David Lindbergh

Manufacturer
Lindbergh Systems
49 Beechmont St.
Worcester, MA 01609

Price
$95

Language
Z80 machine code

Format
5-inch floppy disk

Documentation
40-page softbound book

Computer
TRS-80 Models I and III disk systems with 32 K RAM minimum

Audience
Any computer owner who needs to communicate with another computer

Omniterm, a new product from a small company in Massachusetts, has most of the possible features of a smart terminal program. But even a novice user, normally overwhelmed by complex programs, can easily adjust to Omniterm.

A popular use of terminal programs is the bulletin board network, which consists of approximately 400 automatically answered, electronic-message centers around the country. You can dial any of these numbers and leave a message for someone in that area or take advantage of local features such as receiving public-domain programs or sending electronic mail.

Since all bulletin board systems do not operate on the same type of computer, your terminal program should be able to adjust to different system requirements.

Omniterm seems equal to the demands placed on it. As long as I stayed on TRS-80-based bulletin board systems, I had no difficulty with elementary tasks when using the inexpensive ($24.95) terminal program from Instant Software called Terminal 80. But when I tried Modem Over Manhattan, an interesting service in New York, or ABBS (Apple Bulletin Board System) in Cleveland, or even the TRS-80-based Big Byte system in Cincinnati, Terminal 80 fell apart. Omniterm worked flawlessly with all these services.

Omniterm's command mode, accessible any time during its use, gives fingertip control of everything you need when communicating with another system. One-keystroke entries make it easy.

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MC6800S	Microprocessor, Ceramic	14.66
MC6801L1	Microprocessor with Lilbug	34.21
MC6802CL	Microprocessor, Clock and RAM, Ceramic	27.23
MC6800CP	Microprocessor, Clock and RAM, Plastic	12.71
MC6802L	Microprocessor, Clock and RAM, Ceramic	18.57
MC6802P	Microprocessor, Clock and RAM, Plastic	10.13
MC6803G	Microprocessor, Plastic	16.06
MC6803L	Microprocessor, Ceramic	27.23
MC6803L-1	Microprocessor, 1.25 MHz, Ceramic	36.45
MC6805P2L1	Microprocessor with ROM	22.69
MC6805P2P1	Microprocessor with ROM, Plastic	13.83
MC6805R2L1	8 Bit MCU A/D Evaluation Program	41.55
MC6805R2P1	8 Bit MCU A/D Evaluation Program	30.03
MC6805U2L2	8 Bit MCU Evaluation Program	34.21
MC6805U2P2	8 Bit MCU A/D Evaluation Program	22.69
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MC6809EL	8 Bit Microprocessor, External Clock, Ceramic	30.16
MC6809EP	8 Bit Microprocessor, External Clock, Plastic	18.85
MC6809L	8 Bit Microprocessor, External Clock, Ceramic	30.16
MC6809P	8 Bit Microprocessor, External Clock, Pl.	18.85
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MC6821CP	PIA, Plastic	5.94
MC6821L	Replaced by MC6821S	12.99
MC6821P	PIA, Plastic	4.54
MC6821S	PIA, Ceramic	9.78
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MC6828P	Priority Interrupt Controller	26.98
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MC6840P	PTM, Plastic	8.73
MC6840S	PTM, Ceramic	13.27
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MC6843P		34.21
MC6844L	Replaced by MC6844P	35.47
MC6844P		24.44
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MC6845P	CRT Controller, Plastic	19.90
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MC6847YP	VDG, Interface	16.06
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MC6850CP	ACIA, Plastic	5.45
MC6850L	Replaced by MC6850S	11.31
MC6850P	ACIA, Plastic	4.40
MC6850S	ACIA, Cerdip	6.98
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MC6852P	SSDA, Plastic	5.45
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MC6854L	ADLC, Ceramic	19.55
MC6845P	ADLC, Plastic	11.87
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MC6860L	Replaced by MC6860S	14.52
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MC6882AL	Linear-Octal Buffer/Latch	6.13
MC6882BL	Linear-Octal Buffer/Latch	6.34
MC6885L	Linear-Hex Bus Buffer	2.31
MC6885P	Linear-Hex Bus Buffer	2.00
MC6886L	Linear-Hex Bus Buffer	2.31
MC6886P	Linear-Hex Bus Buffer	2.00
MC6887L	Linear-Hex Bus Buffer	2.31
MC6887P	Linear-Hex Bus Buffer	2.00
MC6888L	Linear-Hex Bus Buffer	2.31
MC6888P	Linear-Hex Bus buffer	2.00
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MC8506P	Polynomial Generator (16 Bit)	26.10
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MC12009P	2 Modulus Prescaler	17.24
MC12011L	2 Modulus Prescaler	20.35
MC12011P	2 Modulus Prescaler	17.24
MC12012L	2 Modulus Prescaler	25.82
MC12012P	2 Modulus Prescaler	21.89
MC12013L	Divide by 10/Divide by 11	20.35
MC12013P	Divide by 10/Divide by 11 2 Modulus Prescaler	17.24
MC12014L	Counter Controller Logic	7.30
MC12014P	Counter Controller Logic	6.16
MC12020L	Offset Control	2.67
MC12020P	Offset Control	2.21
MC12021L	Offset Programmer	4.27
MC12021P	Offset Programmer	3.58
MC12040L	Phase Frequency Detector	14.17
MC12040P	Phase Frequency Detector	11.99
MC12060L	Crystal Oscillator	6.83
MC12060P	Crystal Oscillator (100 KHz-2 MHz)	5.75
MC12061L	Crystal Oscillator (2 MHz-20 Mhz)	6.83
MC12061P	Crystal Oscillator (2 MHz-20 Mhz)	5.75
MC12071P	High Speed Prescaler	15.76
MC12072P	High Speed Prescaler	11.82

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MC146805E2Z	CMOS Microprocessor	42.94
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MC55325L	Memory Driver	10.52

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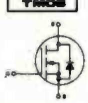

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MTM2N90	TMOS Metal TO-3	18.85	MTM1224	TMOS Metal TO-3	14.31
MTM2P45	TMOS Metal TO-3	14.31	MTM1225	TMOS Metal TO-3	18.41
MTM2P50	TMOS Metal TO-3	18.41	MTP2N85	TMOS Plastic TO-220	18.41
MTM3N55	TMOS Metal TO-3	14.31	MTP2N90	TMOS Plastic TO-220	18.85
MTM3N60	TMOS Metal TO-3	18.41	MTP2P45	TMOS Plastic TO-220	14.31
MTM8N55	TMOS Metal TO-3	38.03	MTP2P50	TMOS Plastic TO-220	18.41
MTM8N60	TMOS Metal TO-3	41.25	MTP3N55	TMOS Plastic TO-220	14.31
MTM7N45	TMOS Metal TO-3	38.03	MTP3N60	TMOS Plastic TO-220	18.41
MTM7N50	TMOS Metal TO-3	41.25	MTP8N12	TMOS Plastic TO-220	10.79
MTM8N12	TMOS Metal TO-3	10.79	MTP8N15	TMOS Plastic TO-220	12.38
MTM8N15	TMOS Metal TO-3	12.38	MTP474	TMOS Plastic TO-220	14.31
MTM8N35	TMOS Metal TO-3	38.03	MTP475	TMOS Plastic TO-220	18.41
MTM8N40	TMOS Metal TO-3	41.25	MTP564	TMOS Plastic TO-220	14.31
MTM15N35	TMOS Metal TO-3	78.18	MTP565	TMOS Plastic TO-220	18.41
MTM15N40	TMOS Metal TO-3	90.74	MTP814	TMOS Plastic TO-220	14.31
MTM474	TMOS Metal TO-3	14.31	MTP815	TMOS Plastic TO-220	18.41
MTM475	TMOS Metal TO-3	18.41	MTP1034	TMOS Plastic TO-220	14.31
MTM564	TMOS Metal TO-3	14.31	MTP1035	TMOS Plastic TO-220	18.41
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MC10104	1.10	1.99	.92	1.73	Quad 2-I AND Gate
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MC10106	1.10	1.99	.92	1.73	Triple 4-3-3 I NOR Gate
MC10107	1.17	2.11	1.00	1.86	Triple Exc. OR/NOR
MC10109	1.10	1.99	.92	1.73	Dual 4-5 I OR/NOR Gate
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MC10118	1.10	1.99	.92	1.73	Dual 2-W 3-1 OR/AND Gate
MC10119	1.17	2.11	1.00	1.85	4-W 4-3-3-3 I DR/AND Gate
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MC10124	3.01	4.22	2.52	3.01	Quad TTL to MECL Trans.
MC10125	3.01	4.22	2.52	3.01	Quad MECL to TTL Trans.
MC10128	8.49	11.05	-	-	Dual Bus Driver
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MC10130	3.01	4.22	2.52	3.01	Dual D Latch
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MC10132	3.51	4.81	3.04	4.22	Dual MUX w/Latch & Reset
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MC10135	3.75	4.99	3.04	4.08	Dual J-K MS Flip Flop
MC10136	15.10	18.04	13.74	18.42	Universal Hex. Counter
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MC10183	48.88	58.24	-	-	4x2 Multiplier
MC10186	6.83	8.38	6.94	7.48	Hex D M-S FF with Reset
MC10188	3.27	4.52	2.82	3.98	Hex Buffer with Enable
MC10189	3.27	4.52	2.82	3.83	Hex Inv. with Enable
MC10190	7.81	8.82	8.31	8.07	Quad MST to MECL 10K Trans.
MC10191	7.01	8.92	8.31	8.07	Hex MECL 10K to MST Trans.
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MC10194	3.89	5.25	3.31	4.55	Dual Bus Transceiver
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MC10197	2.52	3.34	2.07	2.78	Hex AND Gate
MC10198	23.83	28.74	22.51	27.13	One-Shot Multivibrator
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MC10216	1.83	3.05	1.38	2.41	Hi-Speed Triple Line Receiver
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MCM10147L	128 x 1 MECL 10K RAM (10405)	18.79
MCM10148L	64 x 1 MECL 10K RAM	18.78
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Circle 21 on inquiry card.

```
        OMNITERM COMMAND MODE—HIT <BREAK> TO QUIT

P  PRINTER                  IS:     OFF   X  SYSTEM COMMANDS
R  SCREEN REFORMATTING      IS:      54   T  CHANGE/EXAMINE TABLES
C  CR SUPPRESSION           IS:     OFF   U  CHANGE UART SETTINGS
L  LF SUPPRESSION           IS:      ON   A  SEND CONTROL-A & QUIT
D  DUPLEX                   IS:    FULL   @  SEND "AT" SYMBOL & QUIT
E  ECHO                     IS:     OFF   B  SCROLL BACK DISPLAY
G  CR/LF GROUPING           IS:     OFF   Z  ZERO REAL-TIME CLOCK
I  INPUT TO BUFFER          IS:     OFF   F  FILL BUFFER FROM DISK
O  OUTPUT FROM BUFFER       IS:     OFF   S  SAVE BUFFER TO DISK

BAUD RATE  =          150           PARITY ERRORS :            0
DATA BITS  =            8           FRAMING ERRORS:            0
STOP BITS  =            2           OVERRUN ERRORS:            0
PARITY     =         NONE           BUFFER:      0 OF 27,339 USED
```

Figure 1: *The command menu as it appears on the screen in Omniterm. The menu is displayed by pressing the @ key twice. Return to the active telecommunications mode is accomplished by pressing the <break> key. Displaying the menu does not interrupt the flow of data through the program.*

The printer is accessible during communications. While using one service, I activated the printer while the instructions were coming on the screen; this gave me a reference sheet, saving valuable long-distance time. In the command mode, a status indicator lets you know whether the printer function is on or off. A buffer lets the printer fall behind the screen if it is not fast enough to keep up. Omniterm buffers 2048 characters of data before it runs out of room.

Some bulletin board or "information utility" systems are not set up for the TRS-80 64-column screen. Apple or Atari 40-column and Videotext 32-column units can cause problems with the video display. Omniterm allows you to reformat the screen from the command table. This gives you a 64-column screen, regardless of what your computer is receiving. The status of this function is displayed in the command mode.

For additional screen-format control, you can select carriage-return suppression, line-feed suppression, and carriage-return/line-feed grouping.

Omniterm also lets you determine the communications protocol (baud rate, bits per data word, stop bits, parity,

full or half duplex, and automatic character echo). This gives you much flexibility for dealing with the various bulletin board and information services available.

Superior file handling separates Omniterm from less "intelligent" terminal programs. File capabilities include sending, receiving, and saving to and retrieving from disk. Omniterm has a file-transfer buffer of 27,644 bytes. You can input to the buffer from the remote computer and save to disk, or input to the buffer from the disk and output to the remote computer. It's easy to use these functions. To test them, I loaded a simple program from Forum-80 in Nashua, New Hampshire, saved it to disk, and executed it afterward to make sure it ran. I sent a BASIC adventure game to a youngster in Massachusetts; I received a BASIC adventure he had written for me, saved it to disk, and communicated via the keyboard and screen in between file transfers. It worked, even though I'm no professional.

Other useful command features are the special system commands that, among other things, allow you to save any communications protocol permanently to disk, to be called from the command mode whenever you need it. Another unique feature is the ability to backtrack into a special buffer and reconstruct what has appeared on the screen before a disconnect—useful for retrieving and reviewing pertinent data without using the printer or making another telephone call.

A novel item is a graphics "bell" that appears on the screen when a control-G is received. If an audio amplifier is attached to the system via the cassette port, you'll also get an audible beep.

Omniterm comes with a 61-page instruction book, punched to fit in a binder. It is written so the beginner can understand the workings of the program. However, it is not too simplistic; there are technical explanations for the expert.

David Lindbergh has obviously spent much time and care on this project. His knowledge of the subject and professional presentation enhance the product considerably. Its $95 price tag places Omniterm in competition with Lance Micklus's ST80 series of terminal programs, including ST80III, currently regarded by many as the standard for this type of program.

Conclusions

The program is very easy to use and works well. Most of the information you need is available on the menu, which can be displayed at any time without breaking connections to the host computer.

All the screen-formatting controls and communications conventions are software selectable, which means you can use the program with a wide variety of host computer systems.

The clearly written instructions and documentation are complete.

These features, coupled with its competitive price, make Omniterm a contender for the title of best in its class. ■

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Voice Synthesis for the Color Computer

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Would you believe that using three resistors, an inexpensive integrated circuit (IC), two capacitors, a plug, a \$1.59 microphone, and some software you can record and play back your voice on a TRS-80 Color Computer with 16K bytes of RAM? What if I told you that the quality is better than that of Texas Instruments' Speak & Spell?

In this article I'll show you how to take any sound input, digitize it, store it in memory, and play it back on request, all with the few components mentioned above! The catch is that the 16K bytes of RAM will allow you to record only about 1⅓ seconds of sound. However, by sacrificing some reproduction fidelity you may be able to extend the recording time to 13 seconds or more. This article is meant primarily to show you how to capture the sounds, record them, and play them back. I'll leave the improvements up to you. [*This is the third in a series of articles describing hardware and software projects for the Radio Shack TRS-80 Model I, Model III, and Color Computer. For a list of previous titles in the series, see the references at the end of this article . . .* Ed.]

About the Author
William Barden Jr. has written many books on microcomputer programming and design. He is a member of the Association for Computing Machinery (ACM) and the Institute of Electrical and Electronics Engineers (IEEE).

Voice-Frequency Parameters

The range of hearing for humans is from 20 to 20,000 hertz (Hz), or cycles per second. In fact, the upper limit for most people is considerably lower than 20,000 Hz. The average telephone circuit has an upper frequency limit of 3500 Hz, and voice clarity suffers surprisingly little. Amateur radio operators, to increase their transmitters' average power output, restrict audio frequencies even further, to 3000 Hz or so. To reproduce acceptable voice, therefore, I need to design circuits capable of playing back frequencies up to 3500 Hz. First, of course, I have to *capture* the voice data. A fundamental rule of digital recording is that the sampling rate must be at least twice the maximum frequency to be recorded. Voices, then, must be recorded at rates of 7000 Hz or better. In other words, the voice input must be converted to digital form at a rate of 7000 samples per second or better.

Analog-to-Digital Conversion

To convert the voice signal to digital form, I will use an analog-to-digital converter (ADC), which takes the analog voice input and converts it to a digital value (see figure 1). The larger the number of bits in the sample, the finer the resolution in the digital representation of the analog value. If the ADC offers six bits of data, for example, each digital value will be within 2^{-6}, or $\frac{1}{64}$, of the analog input value. A 5-bit ADC will produce values within $\frac{1}{32}$ of the analog input value, and so on. When the digitized form of the input is replayed, the output waveform will approximate the original by a series of square waves. The higher the sampling rate and the resolution of the ADC, the more the output will resemble the original, as shown in figure 2.

For hardware reasons explained later, I'll use a 6-bit ADC. To avoid wasting bits, I could pack four 6-bit values into three 8-bit bytes. However, it's less trouble and faster simply to put a 6-bit ADC value in each byte and ignore the two unused bits, as shown in figure 3. A sampling rate of 7000 Hz, therefore, will fill 7000 bytes of memory for each second of recorded sound.

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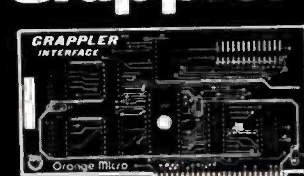

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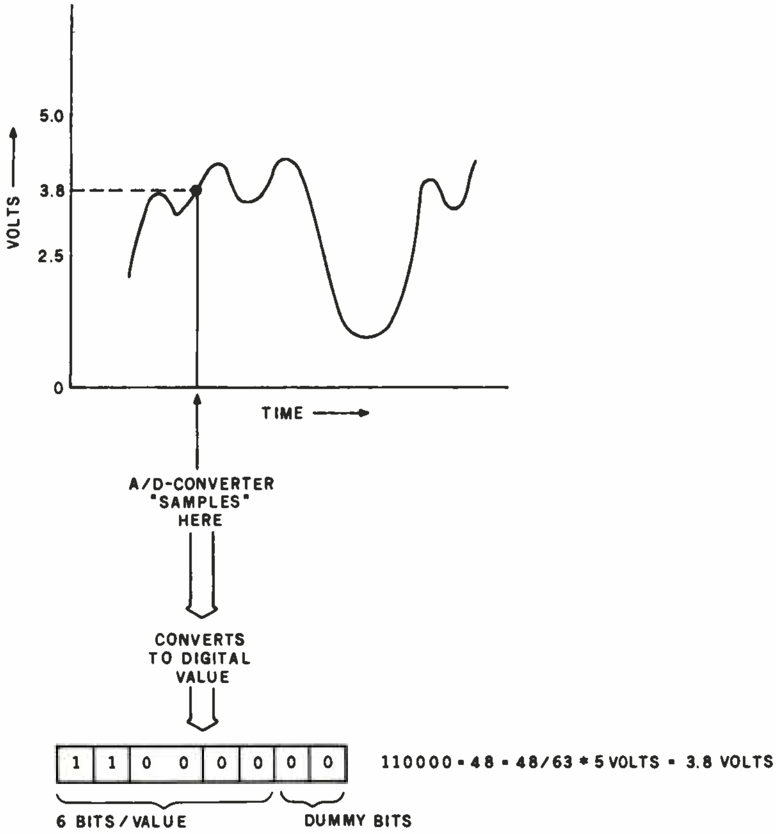

Figure 1: *An ADC converts an electrical analog, such as voltage, to a binary value.*

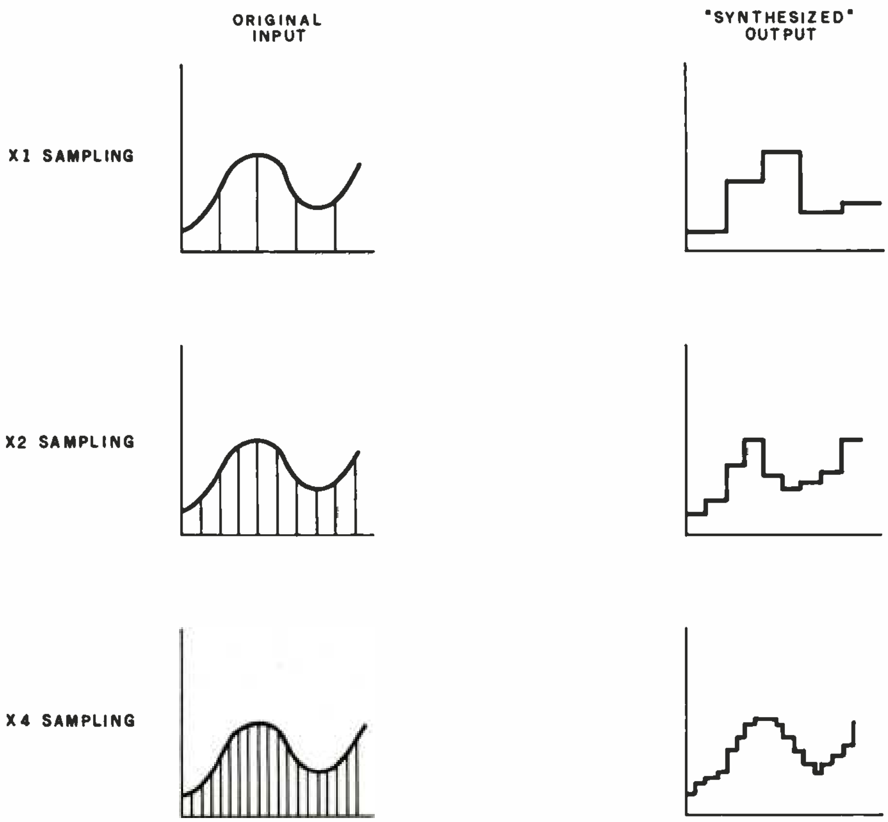

Figure 2: *The sampling rate and number of bits in the ADC determine how closely the input signal can be reproduced.*

In commercial voice-synthesis integrated circuits, many techniques are used to reduce the amount of storage required for audio data. Texas Instruments, National Semiconductor, and other companies produce hardware that can synthesize voices using only a few hundred bytes of data per second of speech. In these circuits, the voice-reproduction processor uses silent periods, symmetry of waveforms, and replication of patterns to compress the data. Fourier waveform analysis and other advanced techniques are used as well. The result of all this processing is a compact, specially encoded form of the voice data for the special hardware involved. However, I'll stick with the "brute force" approach for the time being. Later in the article, I'll discuss ways to cut down on the storage requirements.

To play back digitized sounds, I need the inverse of an ADC, a digital-to-analog converter (DAC). The DAC will take in as data each digitized value and produce as output a voltage level proportional to that value. A sequence of all these voltage levels will simulate an analog waveform. If the data was originally captured by a 6-bit ADC, then a 6-bit DAC is required to reproduce each sample.

In theory this brute-force voice capture and synthesis process is simple: take an analog voltage as input from the audio source, sample it 7000

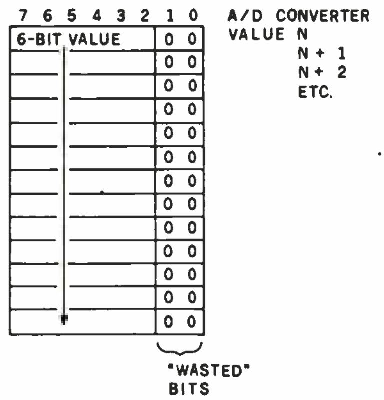

Figure 3: *Although 25 percent of the storage space is wasted in storing 6-bit ADC values in 8-bit bytes, it is efficient in terms of storage speed.*

times per second with an ADC, store the digitized ADC output values in the memory of a digital computer, and then play back the values from memory with a DAC. The process is illustrated in figure 4.

Color Computer Hardware

The Color Computer has a built-in 6-bit DAC and ADC circuit (see reference 2). Under normal use, the DAC synthesizes sine waves for recording cassette data and generating musical tones. The ADC exists partially in hardware and partially in software and is used to perform analog-to-digital (A/D) conversion on the joystick positions.

Color Computer DAC. The DAC (figure 5) is a 6-bit circuit that operates as fast as data can be output to it. I'll have to use assembly-language coding, however, to get the required output rates of 7000 or more bytes per second. BASIC would only allow several hundred operations per second, far too few for my purpose.

Each 6-bit digitized value can be output to hexadecimal address $FF20, the PIA (peripheral interface adapter) for the DAC. [*In accordance with 6809 microprocessor conventions, numbers in hexadecimal form are prefixed with a dollar sign . . .* **Ed.**] The value will be held in the PIA until overwritten by the next value. The output of the DAC is very rapid (less than a microsecond), and so it appears that the DAC is no problem in my timing scheme. The output of the DAC goes to a radio-frequency/audio modulator that converts the signal to a television picture with audio. Audio from the DAC, therefore, will be heard through the audio circuits of the television used with the Color Computer.

Color Computer ADC. The ADC is shown in figure 6. It uses a comparator IC, which compares two inputs. The output of the comparator is either 1 or 0 depending upon whether the plus input is lower or higher than the minus input. The output rate of the comparator is extremely fast. To get the comparator output, I read address $FF00 and look at bit 7 of that value.

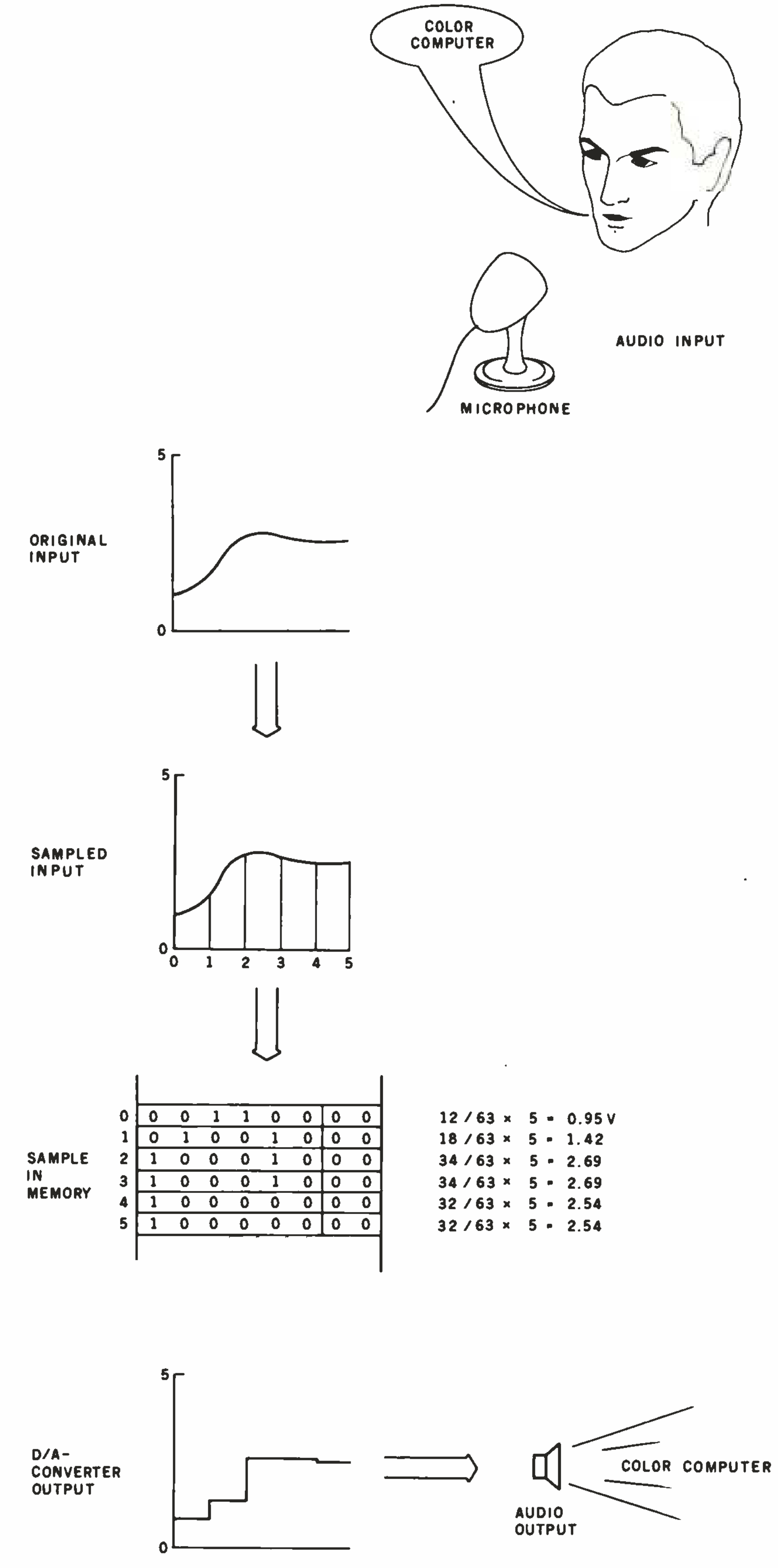

Figure 4: *Brute-force voice synthesis samples input to digitize it, stores the ADC values in memory, and then outputs the values from memory to a DAC.*

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	IBM Compatible (128 B/S, 26 Sectors) w/ W P N & Hub Ring	3064	2.30	–	–	–	–	–	–	–	–	–	FD34 9000	–	–
	IBM Compatible (128 B/S 26 Sectors) REVERSIBLE	1779	3.19	473072	54431	–	–	–	FD-2	740/2-0	–	15150	FF34-8000	F171111X	–
	IBM System 6 Compatible	3066	2.04	473077	54461	800509	1669066	–	–	740-0 086	–	15003	FD60-9000	F118111X	–
	IBM Compatible (256 B/S 15 Sectors)	3109	1.99	473073	–	800504	2305845	–	–	740-3600	–	15005	FD36-9000	F112111X	–
	IBM Compatible (512 B/S 8 Sectors)	3110	1.99	473074	–	800506	1669064	–	–	–	–	15004	FD80-9800	F113111X	–
	Shugart Compatible, 32 Hard Sector	3015	1.99	470601	53607	101/1	–	FH1-32	FD-132	740-32	S/A 101	15025	FD32 9000	–	421322
	Wang Compatible, 32 Hard Sector w/Hub Ring	3067	2.49	–	54401	–	–	–	–	740-32RH	–	–	–	F37A411X	–
	CP1 8000 Compatible	3045	2.89	–	–	–	–	–	–	–	–	15276	–	–	–
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	Soft Sector (128 B/S 26 Sectors) REVERSIBLE	3093	3.89	–	–	–	–	–	–	–	–	–	–	–	–
	Shugart Compatible 32 Hard Sector	3091	2.89	470661	54506	101/1D	–	FH1-32D	–	741-32	S/A 109	15073	FD32-8000	F33A411X	423322
	Wang Compatible 32 Hard Sector w/Hub Ring	3096	3.09	–	–	–	–	–	–	–	–	–	–	–	–
Flexible Disc 2s Double Headed Drives Single Density Media	Soft Sector (128 B/S 26 Sectors)	3113	3.09	–	54420	800814	1766870	–	–	–	S/A-150	15153	FD10-4000	F121111X	–
	Soft Sector (256 B/S 15 Sectors)	3106	3.09	473477	54296	800815	2736780	FD2 256D	–	742-0	–	15154	FD10-4016	F122111X	424012
Flexible Disc 2d Double Headed Drives Double Density Media	Soft Sector (Unformatted)	3102	3.09	473466	–	DY150	–	FD2 XDM	FD-2D	743-0	–	15103	DD34-4001	–	425002
	Soft Sector (128 B/S 26 Sectors)	3115	3.09	–	–	–	–	–	–	–	S/A-150	–	–	–	–
	Soft Sector (256 B/S 26 Sectors)	3103	3.09	473411	54325	800817	1766872	FD2-256D	–	743-0/256	–	15101	DD34-4026	F144111X	425002
	Soft Sector (512 B/S 15 Sectors)	3114	3.09	473472	54479	800818	1669044	–	–	743-0/512	–	15160	DD34-4015	F145111X	425012
	Soft Sector (1024 B/S 8 Sectors)	3104	3.09	473473	54486	800819	1669045	–	–	743-0/1024	–	15162	DD34-4008	F147111X	424022
	32 Hard Sector	3105	3.09	470661	–	101/2D	–	FH2-32D	–	743-32	S/A-151	15176	DD32-4000	F34A411X	425322
	Burroughs B 80 Compatible 32 Hard Sector	3092	3.09	–	–	–	–	–	–	–	–	–	–	F34A611X	–
	Soft Sector (1024 B/S, 8 Sectors) w/ Hub Ring	3116	3.49	–	–	–	–	–	–	–	–	–	–	–	–
	Shugart Compatible, 32 Hard Sector	3151	3.39	–	–	–	–	–	–	–	–	–	DD32-4000	–	–
Flexible Disc FD Memorex 651 or Equiv Drive Compatible	FD VI (Vinyl Jacket)	3071/2003	2.69	470661	–	FDIV	–	–	FD-165	811-0	–	15006	FD65-1000	F61A111X	–
Mini Flexible Disc 1s 5¼" Single-Headed Drives Single Density Media	Soft Sector (Unformatted)	3401	1.94	476001	54756	104/1	–	MD1	MD 1	744-0	S/A-104	15300	MD525-01	M11A211X	441002
	10 Hard Sector	3403	1.94	476010	54757	107/1	–	–	MD 110	744-10	S/A-107	15325	MD525-10	M41A211X	441102
	16 Hard Sector	3405	1.94	476016	54258	105/1	–	MH1	MD 116	744-16	S/A-105	15326	MD525-16	M61A211X	441162
	Soft Sector (Unformatted) w/Hub Ring	3431	2.14	–	–	–	–	–	–	–	–	–	MD525-01	–	–
	10 Hard Sector, w/Hub Ring	3433	2.14	–	–	–	–	–	–	–	–	–	MD525-10	–	–
	16 Hard Sector, w/Hub Ring	3435	2.14	–	–	–	–	–	–	–	–	–	MD525-16	–	–
Mini Flexible Disc 1d 5¼" Single-Headed Drives Double-Density Media	Soft Sector (Unformatted)	3417	2.14	–	54846	104/1D	–	–	–	–	–	–	MD525-01	–	–
	10 Hard Sector	3418	2.14	–	54849	107/1D	–	–	–	–	–	–	MD525-10	–	–
	16 Hard Sector	3419	2.14	–	54852	105/1D	–	–	–	–	–	–	MD525-16	–	–
	Soft Sector (Unformatted) w/Hub Ring	3481	2.34	–	–	–	–	–	–	–	–	–	MD525-01	–	–
	10 Hard Sector w/Hub Ring	3483	2.34	–	–	–	–	–	–	–	–	–	MD525-10	–	–
	16 Hard Sector w/Hub Ring	3485	2.34	–	–	–	–	–	–	–	–	–	MD525-16	–	–
Mini Flexible Disc 2d 5¼" Double Headed Drives Double Density Media	Soft Sector (Unformatted)	3421	2.59	–	54824	104/2D	–	–	–	–	S/A-154	–	MD550-01	–	–
	10 Hard Sector	3423	2.59	–	54827	107/2D	–	–	–	–	S/A-157	–	MD550-10	–	–
	16 Hard Sector	3425	2.59	–	54830	105/2D	–	–	–	–	S/A-155	–	MD550-16	–	–
	Soft Sector (Unformatted) w/Hub Ring	3491	2.79	–	–	–	–	–	–	–	–	–	MD550-01	–	–
	10 Hard Sector w/Hub Ring	3493	2.79	–	–	–	–	–	–	–	–	–	MD550-10	–	–
	16 Hard Sector w/Hub Ring	3495	2.79	–	–	–	–	–	–	–	–	–	MD550-16	–	–

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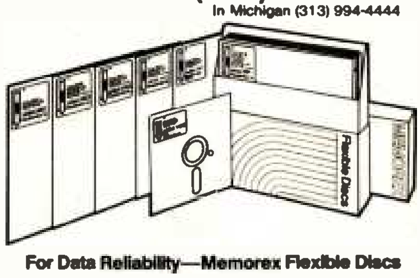

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One of the inputs to the comparator is from the external joystick connector. This should be a voltage level from 0 to +5 volts (V). The joystick input can be a voltage from the joystick potentiometer, or it can be any voltage in that range from any external device including an audio amplifier. The second input to the comparator is from the DAC and is also 0 to +5 V. A/D conversion is accomplished by rapidly changing the DAC output and checking the comparator output until I find the two values that bracket the voltage from the joystick input.

The Color BASIC ROM (read-only memory) provides a machine-language subroutine to accomplish this. It uses a type of binary search to converge on the joystick input value (for details, see reference 2). However, the subroutine processes *four* input values: right joystick X and Y and left joystick X and Y. In addition, the routine compares the current value of each channel with the previous one until they match. All of this overhead allows sampling rates of only 600 to 700 per second, too slow for my needs. I need a high-speed ADC!

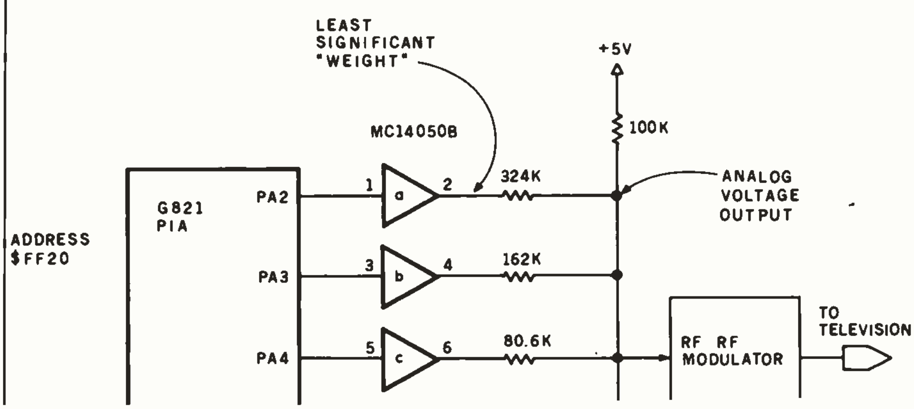
Voice-Synthesis Software

INPUT Routine. The software for such a high-speed ADC is shown in the text box with listing 1. It may not be the fastest ADC routine around, but it *does* allow conversion of about 7733 samples per second. One technique used in the routine is "linear coding" without loops, eliminating the loop overhead. The logic is explained in detail in the text box.

The INPUT routine takes $6 \times 19.1 + 14.6$ microseconds (μs) for each ADC conversion, allowing 7733 samples per second. Note that during each 129.2-μs conversion, the input voltage may change and the final value may be off by 25 percent or more, as shown in figure 7. In the majority of cases, however, the result is fairly close for these high sampling rates of audio frequencies.

The RAM buffer is 10,300 bytes long, providing for about 1⅓ seconds' worth of recording.

OUTPUT Routine. The OUTPUT routine (listing 2) is considerably



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3415 Kashiwa Street • Torrance, California 90505 simpler than the input routine. The routine points to the beginning of the buffer, delays about 1/7000 second, fetches a value from memory (LDA,X+), outputs the value to the DAC (STA $0FF20), tests for the end of the buffer (BUFEND), and then returns for the next value if there are more data remaining.

SELECT Routine. The SELECT routine connects the right joystick X channel to the ADC and routes the DAC output to the television's built-in speaker. SELECT is executed once at the beginning of both INPUT and OUTPUT.

BASIC Driver. The 6809 assembly-language subroutines shown in listings 1 and 2 are *relocatable*, that is, they can be placed and run anywhere in memory and still operate properly. Listing 3 shows the same

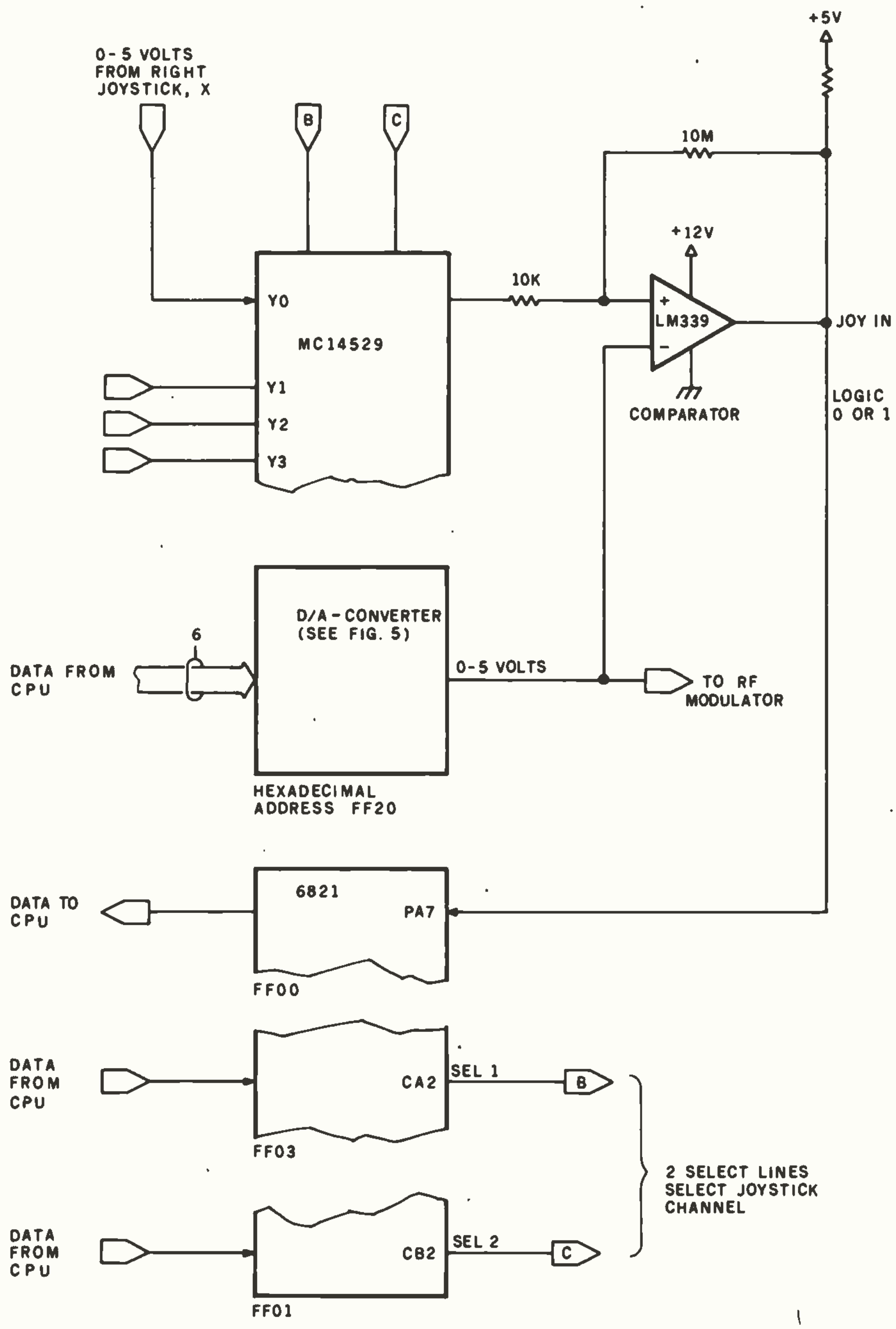

Figure 6: *The Color Computer ADC uses a comparator, the DAC, and software to bracket the joystick input value.*

Listing 1: *The INPUT routine is coded in 6809 assembly language with a minimum of branch instructions to maximize execution speed. The routine performs 7733 A/D conversions per second.*

```
172B                    ORG     $172B
                  *******************************************
                  * SPEECH SYNTHESIS PROGRAM                *
                  * ACCUMULATES 1 1/3 SECONDS WORTH OF INPUT  *
                  * PLAYS BACK ON REQUEST                   *
                  * ENTER AT INPUT TO RECORD                *
                  * ENTER AT OUTPUT TO PLAY BACK            *
                  *******************************************
                  *
           17C4   BUFFER  EQU     $4000-10300
           3FFF   BUFEND  EQU     $3FFF    END OF BUFFER
172B 17    0085   INPUT   LBSR    SELECT   SELECT RIGHT,X
172E 108E  FF00           LDY     #$0FF00 LOAD INPUT PIA ADDRESS
1732 8E    17C4           LDX     #BUFFER LOAD BUFFER PNTR ADDRESS
1735 C6    80     INP005  LDB     #$80       LOAD START VALUE
1737 F7    FF20           STB     $0FF20       OUTPUT FIRST VALUE
173A A6    A4             LDA     ,Y           INPUT COMPARATOR
173C 2B    04             BMI     INP015       GO IF TOO LOW
173E C0    40             SUBB    #$40         SUBTRACT DELTA
1740 20    04             BRA     INP020       GO TO SECOND ITERATION
1742 CB    40     INP015  ADDB    #$40         ADD DELTA
1744 20    00             BRA     INP020       GO TO SECOND ITERATION
1746 F7    FF20   INP020  STB     $0FF20       OUTPUT SECOND VALUE
1749 A6    A4             LDA     ,Y           INPUT COMPARATOR
174B 2B    04             BMI     INP025       GO IF TOO LOW
174D C0    20             SUBB    #$20         SUBTRACT DELTA
174F 20    04             BRA     INP030       GO TO THIRD ITERATION
1751 CB    20     INP025  ADDB    #$20         ADD DELTA
1753 20    00             BRA     INP030       GO TO THIRD ITERATION
1755 F7    FF20   INP030  STB     $0FF20       OUTPUT THIRD VALUE
1758 A6    A4             LDA     ,Y           INPUT COMPARATOR
175A 2B    04             BMI     INP035       GO IF TOO LOW
175C C0    10             SUBB    #$10         SUBTRACT DELTA
175E 20    04             BRA     INP040       GO TO FOURTH ITERATION
1760 CB    10     INP035  ADDB    #$10         ADD DELTA
1762 20    00             BRA     INP040       GO TO FOURTH ITERATION
1764 F7    FF20   INP040  STB     $0FF20       OUTPUT FOURTH VALUE
1767 A6    A4             LDA     ,Y           LOAD COMPARATOR
1769 2B    04             BMI     INP045       GO IF TOO LOW
176B C0    08             SUBB    #8           SUBTRACT DELTA
176D 20    04             BRA     INP050       GO TO FIFTH ITERATION
176F CB    08     INP045  ADDB    #8           ADD DELTA
1771 20    00             BRA     INP050       GO TO FIFTH ITERATION
1773 F7    FF20   INP050  STB     $0FF20       OUTPUT FIFTH VALUE
1776 A6    A4             LDA     ,Y           INPUT COMPARATOR
1778 2B    04             BMI     INP055       GO IF TOO LOW
177A C0    04             SUBB    #4           SUBTRACT DELTA
177C 20    04             BRA     INP060       GO TO SIXTH ITERATION
177E CB    04     INP055  ADDB    #4           ADD DELTA
1780 20    00             BRA     INP060       GO TO SIXTH ITERATION
1782 F7    FF20   INP060  STB     $0FF20       OUTPUT SIXTH VALUE
1785 A6    A4             LDA     ,Y           INPUT COMPARATOR
1787 2B    04             BMI     INP065       GO IF TOO LOW
1789 C0    02             SUBB    #2           SUBTRACT DELTA
178B 20    04             BRA     INP070       GO FOR NEXT VALUE
178D CB    02     INP065  ADDB    #2           ADD DELTA
178F 20    00             BRA     INP070       GO FOR NEXT VALUE
1791 E7    80     INP070  STB     ,X+        STORE VALUE
1793 8C    3FFF           CMPX    #BUFEND    TEST FOR END OF BUFFER
1796 26    9D             BNE     INP005     GO IF NOT END
1798 39                   RTS              END-RETURN
```

The INPUT Routine

For those of you not acquainted with assembly language, the input routine shown in listing 1 is not as imposing as it looks. The datum on the extreme left of the listing is the hexadecimal location in memory where the instruction is found. The next two columns represent the machine code of the instruction in hexadecimal. The fourth column is simply a line number. The remaining four columns are the assembly-language program containing the optional label, the op-code mnemonic, the operand, and comments, respectively. The dollar sign ($) is used to signify a hexadecimal value. The pound sign (#) indicates that the operand is an "immediate" value to be used by the op code, rather than a variable in memory.

Six sections of the code are virtually identical. Each one starts with STB $0FF20 and ends with BRA INP*xxx*.

In each section the value in the B register is output to the DAC by STB $0FF20. The DAC immediately changes this value to a voltage level. The output of the comparator is then loaded into the A register by LDA ,Y. The Y register was previously loaded with the address of the comparator output, $0FF00. If the value in A has bit 7 set, a branch on minus (BMI) is done, and a delta value (one-half of the present range) is added to the value in the B register. If the value in A has bit 7 reset, the SUBB #$*xx* is done to subtract the delta value.

The six sections taken together constitute a binary search to find the input value. At INP070, the B register holds the final value. It is stored in the next memory location pointed to by the X register. The ",X+" form of the instruction automatically increments the X register by 1 to point to the next location after the current store. The X register is then compared to BUFEND, the last location for storing digitized values. If there is space left, the routine branches back to INP005 to sample the next value.

Circle 346 on Inquiry card.

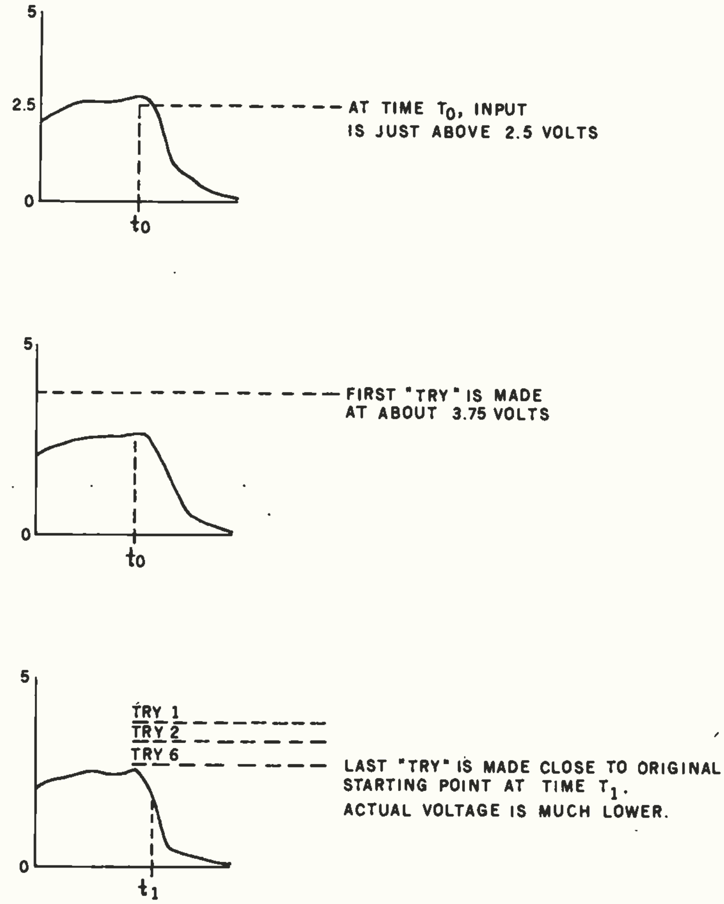

Figure 7: *By the time the software has bracketed a given voltage sample, the true voltage has often changed significantly, as shown in this sequence. However, as long as the sampling rate is at least twice the highest frequency to be measured, the magnitude of the error will be acceptable.*

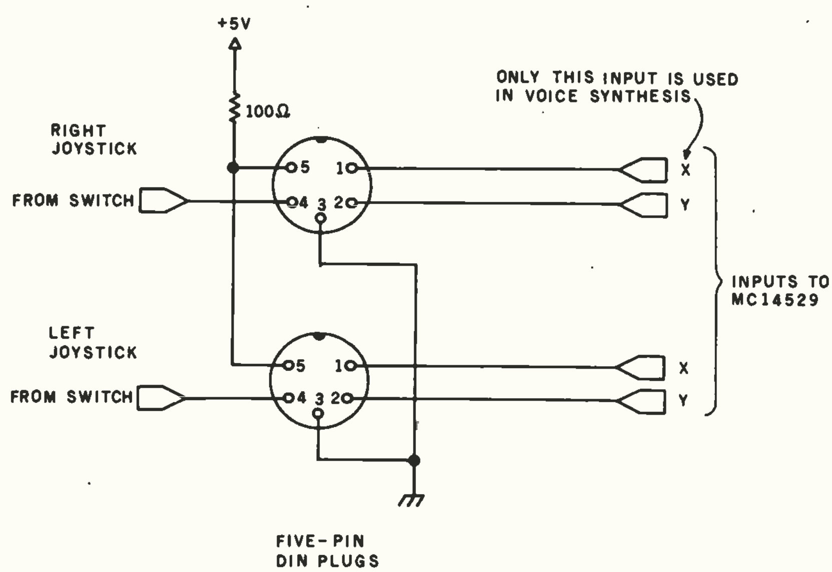

Figure 8: *The Color Computer's joystick inputs allow four channels of data. Only the X input of the right channel is used in this project.*

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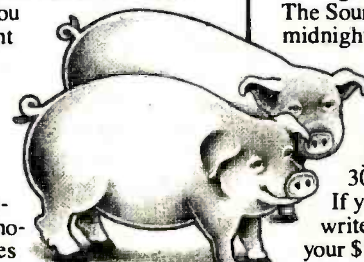

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Listing 2: *The OUTPUT routine is coded in 6809 assembly language. It retrieves values stored in memory and reproduces the original input by outputting the data at the original input rate. Data is output to the television audio modulator.*

```
1799 8D    18        00710 OUTPUT  BSR     SELECT   SELECT DAC OUTPUT
179B 86    3C        00720         LDA     #$3C     LOAD INITIALIZATION VALUE
179D B7    FF23      00730         STA     $0FF23   INITIALIZE PIA FOR OUTPUT
17A0 8E    17C4      00740         LDX     #BUFFER  POINT TO BUFFER
17A3 86    13        00750 OUT010  LDA     #19        DELAY COUNT
17A5 4A              00760 OUT020  DECA                 DELAY LOOP
17A6 26    FD        00770         BNE     OUT020       DELAY
17A8 A6    80        00780         LDA     ,X+        GET VALUE
17AA B7    FF20      00790         STA     $0FF20     OUTPUT TO DAC
17AD 8C    3FFF      00800         CMPX    #BUFEND    TEST FOR END OF DATA
17B0 26    F1        00810         BNE     OUT010     GO IF NOT END
17B2 39              00820         RTS              END-RETURN
17B3 B6    FF01      00830 SELECT  LDA     $0FF01   GET PIA CONFIGURATION
17B6 84    F7        00840         ANDA    #$0F7    RESET LSB OF MUX SELECT
17B8 B7    FF01      00850         STA     $0FF01   STORE
17BB B6    FF03      00860         LDA     $0FF03   GET PIA CONFIGURATION
17BE 84    F7        00870         ANDA    #$0F7    RESET MSB OF MUX SELECT
17C0 B7    FF03      00880         STA     $0FF03   STORE
17C3 39              00890         RTS              RETURN
           0000      00900         END
```

Listing 3: *A BASIC program that loads the INPUT and OUTPUT routines into memory, defines them as external USR calls, and allows the user to store and play back up to 1½ seconds of speech.*

```
100 PCLEAR 1:CLEAR 10,&H1720
110 REM VOICE SYNTHESIS PROGRAM IN BASIC FORM
120 DATA 247,255,32,166,164,43,4,192,0,32,4,203,0,32,0
130 DATA 23,0,133,16,142,255,0,142,23,196,198,128
140 DATA 231,128,140,63,255,38,157,57,141,24,134,60,183,255,35
150 DATA 142,23,196,134,19,74,38,253,166,128,183,255,32
160 DATA 140,63,255,38,241,57,182,255,1,132,247,183,255,1,182,255,3
170 DATA 132,247,183,255,3,57
180 FOR J=0 TO 5
190 RESTORE
200 FOR I=&H1737+J*15 TO &H1745+J*15
210 READ A
220 POKE I,A
230 NEXT I
240 POKE &H173F+J*15,2^(6-J)
250 POKE &H1743+J*15,2^(6-J)
260 NEXT J
270 FOR I=&H172B TO &H1736
280 READ A
290 POKE I,A
300 NEXT I
310 FOR I=&H1791 TO &H17C3
320 READ A
330 POKE I,A
340 NEXT I
350 DEFUSR0=&H172B:DEFUSR1=&H1799
360 INPUT "RECORD (R) OR PLAY (P)?";A$
370 IF A$="R" THEN A=USR0(0) ELSE IF A$="P" THEN A=USR1(0) ELSE GOTO 360
380 GOTO 360
```

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programs converted to DATA values in an Extended Color BASIC program. This BASIC program stores DATA values into memory locations \$172B through \$17C3. To condense the number of DATA values, the loop from 180 through 260 replicates the six sections of the INPUT routine six times. Values of 64, 32, 16, 8, 4, and 2 are POKEd for the delta values in two places. The following loops move the remaining values.

There are two entry points to the code, one at INPUT and one at OUTPUT. In this fixed location for the program, INPUT is at location \$172B and OUTPUT is at location \$1799. USR0 calls the INPUT routine and USR1 calls the OUTPUT routine.

Building the Input Device

The normal joystick inputs are shown in figure 8. Each joystick plug is a 5-pin DIN jack. On each DIN jack, one pin is connected to the X

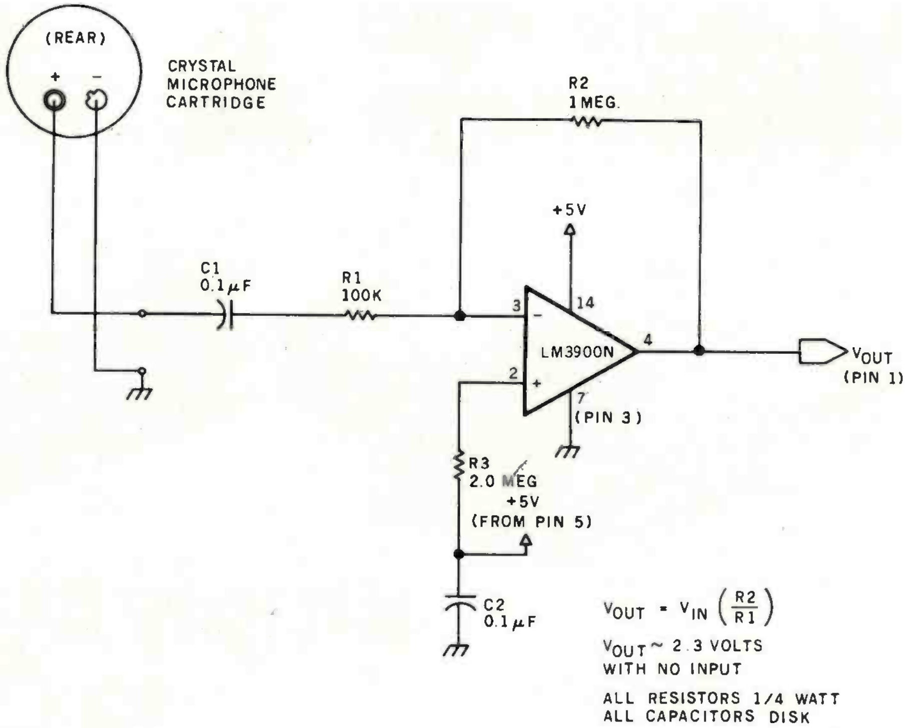

Figure 9: *An op-amp serves as a "× 10" amplifier to up the output from the crystal microphone to the voltage range of 0 to 4.6 V.*

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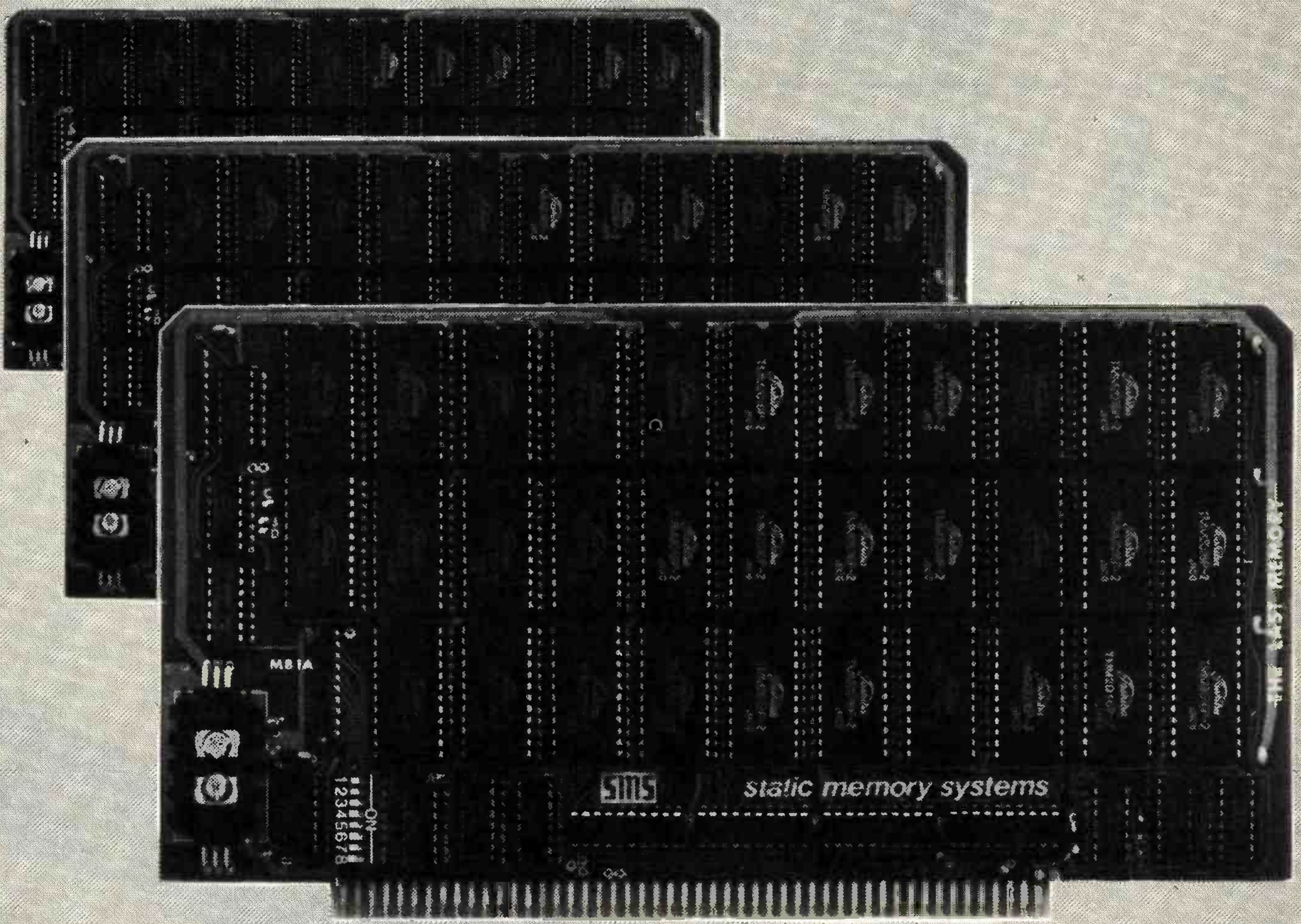

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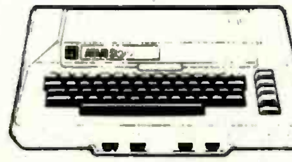

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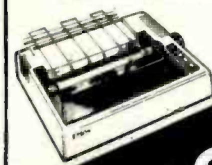

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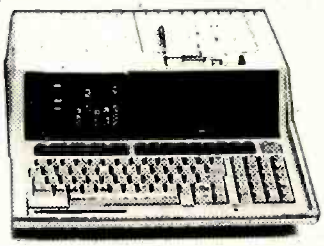

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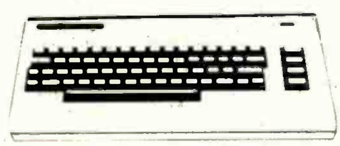

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channel, one to the Y channel (up/down), one to ground, one to +5 V DC, and one to a push-button switch on the joystick. The joysticks are dual potentiometers with resistances varying according to the X/Y position of the joystick. The output of each potentiometer varies from 0 to about +5 V.

In this application I'll be using only the X channel of the right joystick. I'd like to convert an audio signal, which is essentially an AC voltage, to a level of 0 to 5 V DC. This level can then be sampled, digitized, and stored in memory by the ADC hardware and software.

Figure 9 shows a simple voice-input circuit for connection to the Color Computer's right joystick jack. To convert the sound to an analog voltage, I use a crystal microphone. Its output is on the order of tenths of a volt. A simple "op amp" (operational amplifier) ups this voltage to the desired 0 to 5-V range. The amplifier's resting voltage, or bias, is about 2.3 V. As sound is applied, this voltage fluctuates in the 0 to 5-V range.

Since the amplifier I'm using requires less than 0.004 amperes, I can power it with the 5-V DC supply available from pin 5 on the Color Computer's DIN jack. The only side effect this will produce is a 0.4-V drop across the 100-ohm resistor on the 5-V lead.

The easiest way to construct the amplifier is to mount the parts on a prototype board, as shown in figure 10. This board, which Radio Shack sells for $6.49 (catalog number 276-175), consists of 23 rows of 12 holes each. The outer vertical columns on the left and right can be used for ground and power buses.

Figure 10 shows the arrangement of the components on the prototype board. The resistor and capacitor leads can be cut to length and then pushed into the proper holes without soldering or wire wrapping. The LM3900N op amp can also be pushed into the board—the holes are properly spaced.

The microphone used in this project is really a crystal microphone cartridge, available from Radio Shack for $1.59 (catalog number 270-095). Two wires must be soldered to the cartridge. Then the other ends of the wires are coated with solder and plugged into the board as shown.

Three wires go from the board directly into the Color Computer's right joystick DIN jack, as shown in figure 10. One wire attaches to ground (pin 3), one attaches to +5 V (pin 5), and one attaches to the X channel (pin 1).

All parts are available from Radio Shack or other electronics stores and should cost under $10. See table 1 for a parts list.

Operation of the Voice System

Now to see (er, *hear*) some results. Plug the completed circuit into the right joystick jack. Turn on the Color Computer and *quietly* execute the

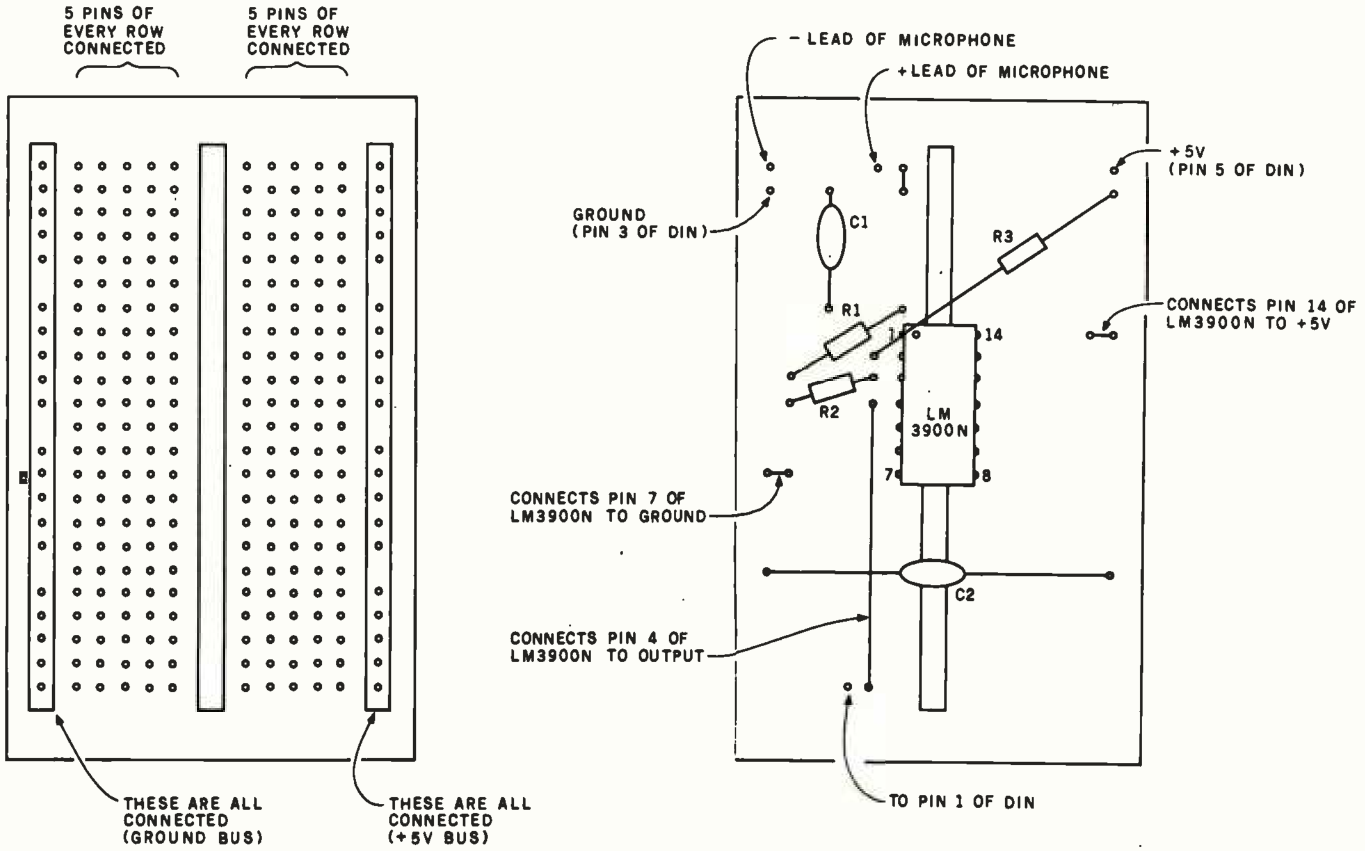

Figure 10: *The project uses an inexpensive prototype circuit board, which allows the six components to be connected without soldering or wire-wrapping.*

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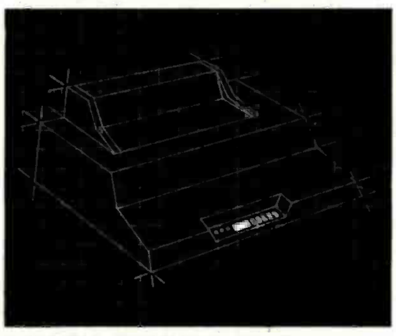

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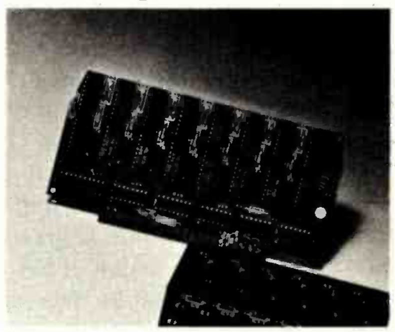

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Circle 227 on inquiry card.

following program:

```
100  PRINT JOYSTK (0)
110  GOTO 100
```

You should now see a continuous display of a number close to 30. The number displayed represents the voltage input from the microphone circuit, in units of 4.6/64 V. Thirty multiplied by 4.6/64 is approximately 2.3, which is the correct voltage when you are *not* talking into the microphone. Actually, values from 26 to 34 indicate an acceptable bias level. If the displayed numbers are out of this range, the audio signals will be clipped on either the top or bottom, as shown in figure 11, resulting in distorted sound. If the value is greater than 34, decrease the value of R3 in figure 9; if it is less than 26, increase the value of R3.

Talk into the microphone while running the program. You should see the values change, although the pattern isn't predictable. Look for lows close to 0 and highs close to 63.

If everything looks satisfactory, load the program shown in listing 3 and execute it. When the message "RECORD (R) OR PLAY (P)?" is displayed, type R. At the same time, speak loudly into the microphone element while holding it close to your mouth. Speaking off to the side eliminates voice "pops," You have about 1⅓ seconds to record the message. (Sorry, Texans, you'll have to adopt a speedy California vocal attitude here.) You'll have time for such messages as "Help! computer failure!" "Twas brillig and the slithy . . . ," and "Input error, dummy!"

The program will record the audio and then return to the prompt message again. Enter P to play back the message through the television audio. You can play back a recorded message repeatedly by looping back to the P USR call.

The fidelity of the sound played back is excellent, even though its duration is short. (Short but sweet, to coin a phrase . . . .)

Condensing the Data

That's the basic hardware and software for acquiring and playing back the data. Now comes the problem of condensing the data. Three approaches can be used here: altering the sampling parameters during acquisition of the data, processing the data after acquisition, and a combination of the two.

Altering the Sampling Parameters. The program just described records data at about 7700 samples per second. The rate can be reduced by putting in a time delay after the "STB ,X+" in the INPUT routine. A simple routine like the one shown in listing 4 would do the trick. It would delay the acquisition of data by about 5.62 × Xμs. Sampling rates for various values of X are shown in table 2. The

Part	Number Required
Crystal microphone cartridge (Radio Shack Cat. No. 270-095 or equivalent)	1
LM3900N operational amplifier (Radio Shack Cat. No. 276-1713 or equivalent	1
0.1-μF capacitor—C1, C2	2
100-kΩ resistor—R1	1
1-MΩ resistor—R2	1
2-MΩ resistor—R3	1
Prototype circuit board (Radio Shack Cat. No. 276-175 or equivalent)	1

Table 1: *Parts list for the microphone input circuit.*

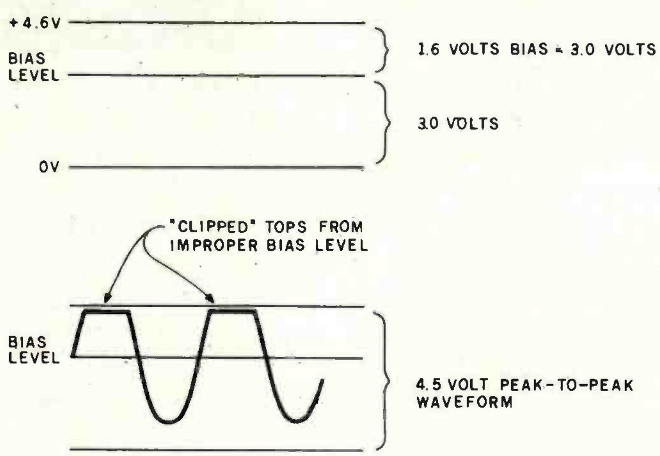

Figure 11: *Clipping off the top or bottom of the waveforms may result from an improper bias setting. Bias should be set to approximately 2.3 V.*

x	Samples per Second
1	7410
2	7114
3	6841
4	6587
5	6414
10	5390
20	4137
30	3357

Table 2: *The sampling rate of the input routine can be reduced by adding a time delay loop after the STB ,X+ in INPUT (listing 1). A simple loop is described in the text. Rates as low as 6000 samples per second should still produce intelligible speech.*

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Circle 223 on inquiry card.

Listing 4: *A simple routine that puts a time delay after the "STB ,X+" in the INPUT routine.*

```
          LDA     #X         CONSTANT
LOOP      DECA               DECREMENT
          BNE     LOOP       LOOP IF NOT ZERO
```

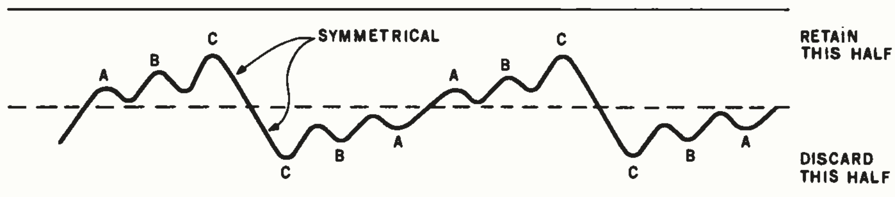

Figure 12: *One method of data compression is to keep only the top or bottom half of the waveform; the other half can be synthesized by the OUTPUT program at the proper time.*

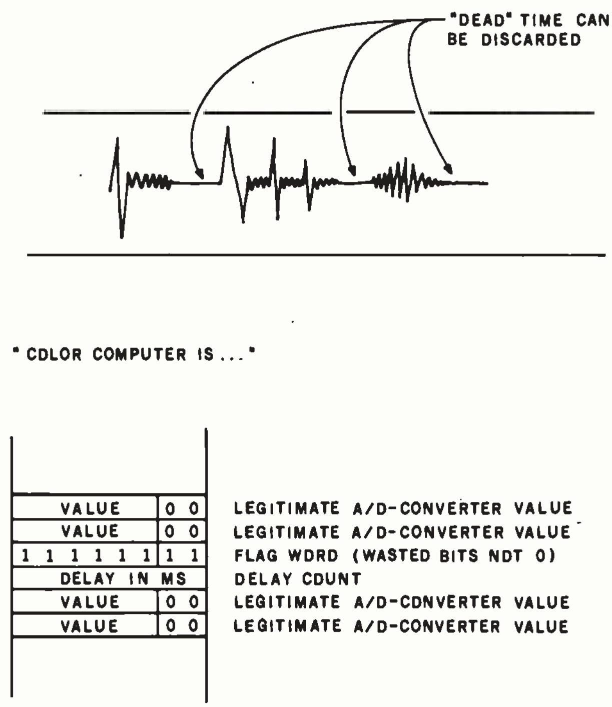

Figure 13: *Another method of compressing the data involves recognizing dead space between words. Instead of storing these silent periods, a flag-word may be stored in the data sequence, followed by a delay count to be used during the output process.*

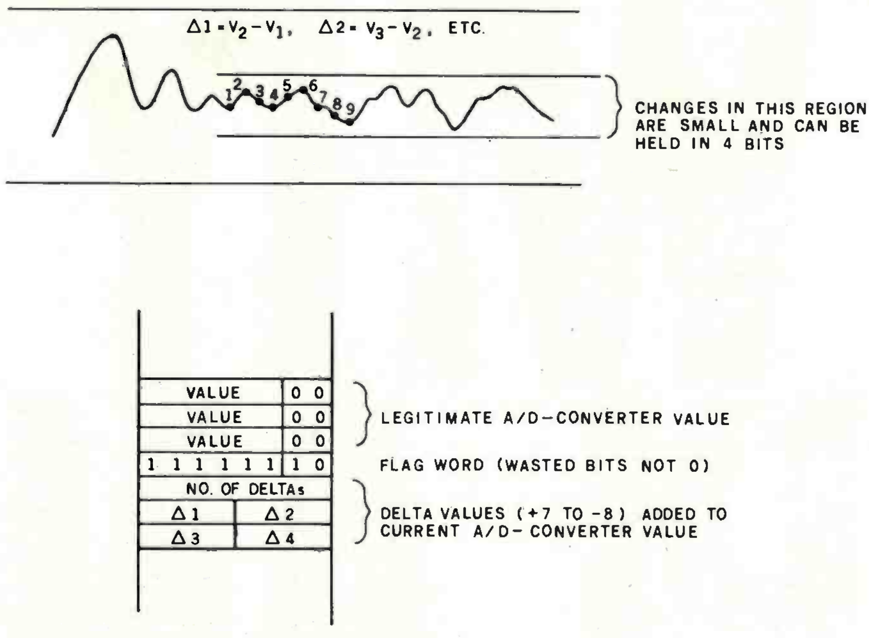

Figure 14: *Data that repeat or change only minutely may be compressed by using 4-bit values. The values are added to the current ADC value to generate a new DAC output value.*

program must be reassembled if this change is made, because the displacement values for the branches in some cases are no longer valid. Judging from the quality of the speech at the 7700 samples-per-second rate, sampling rates as low as 6000 per second will probably be acceptable.

Another parameter that can be varied in acquisition is the resolution of the ADC. I used a 6-bit ADC, allowing for 64 different levels. Certainly one or two bits could be deleted from this resolution without too much degradation. If two bits were deleted, twice as much data could be stored in memory by packing two nibbles per byte in memory. This would call for a little more overhead in the INP070 area as the values were stored, but the net effect would probably be to maintain the same sampling rate (or better), since the instructions from INP050 through INP070 could be deleted.

Data Processing after Acquisition. In most compression methods, the ADC values are post-processed by an analysis program. The waveforms are symmetrical about the horizontal axis. Therefore, I can keep one half and throw the other away, as shown in figure 12. The trick here is recognizing repetitions of the cycle.

Another possibility is to delete the dead time between words. In a string of words, large areas where there is no sound are a waste of storage. For such cases, the dead space could be stored as a special flag value, indicating that a delay of *n* milliseconds could be performed based on the value following the flag value, as shown in figure 13.

A third compression technique is to look for portions of the data that change slowly. Certain sounds, such as vowels, have a much lower level than consonants like "P" that almost explode over a wide dynamic range. If the change is small enough, it can be held in four bits instead of eight, further reducing memory requirements. Again, a flag value can be used on output to get into this "slow change" mode, as shown in figure 14.

I hope I've stimulated your imagination with this article. Half the battle is getting the data digitized. The rest is mere programming! ■

References

1. Barden, William, Jr. "Color Computer from A to D," December 1981 BYTE, page 134.
2. Barden, William, Jr. "Build a Joystick A-to-D Converter for the TRS-80 Model I or III," January 1982 BYTE, page 160.

Pascal NOW

Let Pascal Balance Your NOW Account

Thomas E. Doyle
5222 Big Bow Rd.
Madison, WI 53711

Pascal NOW sounds like an impassioned plea to adopt the Pascal language. While that would be a worthwhile topic, it is not the subject of this article. NOW (Negotiable Order of Withdrawal) is a term used to describe a wide variety of interest-bearing checking accounts.

Pascal NOW is a Pascal program designed to help manage one of these accounts. This article describes the program and some of the features of Pascal. I also provide a few hints to help a person who already knows BASIC begin to "think in Pascal." Such a person resembles one who knows the English system of weights and measures but wants to learn the metric system. The metric system is often learned as a translation system—one thinks in the English system, then converts to metric units. This is entirely different from "thinking in metric." The same problem can arise in learning Pascal. To capitalize on the features of Pascal, one must begin to "think in Pascal" rather than "think in BASIC" and then translate to Pascal.

About the Author

Thomas E. Doyle has taught computer programming at the technical college level for seven years.

The difference between a regular checking account and a NOW account is that the latter earns interest. A personal finance program must include the capability of handling this additional income correctly. My first impulse was to modify a BASIC program I've been using to manage my checking accounts. I've also received several suggestions for improvements to the program, so I decided to rewrite the program in Pascal, incorporating those improvements.

Using the Program

Above all, a checkbook program should be easy to use. The program should provide the following functions:

- add items to the file
- remove items from the file
- sort the items by date
- dump the updated file to disk
- load the file from disk
- print the file contents
- balance the account and print totals by item category
- quit (return to operating system)

Each of the eight functions is specified by typing the first letter of the function name: A, R, S, D, L, P, B, or Q (upper or lowercase).

Each item in the file has five descriptors:

1. item number
2. dollar amount
3. date
4. description of item
5. item category

For checks, the item number would be the check number. You can assign sequential numbers to items such as deposits, NOW interest, or electronic funds transfers. Since most checks start numbering at or above 100, at least 99 numbers would remain for that purpose. This method works best if item numbers for noncheck transactions are recorded right in the checkbook.

Modification

The exact nature of the item category list will vary depending on your expenditures. Almost everyone

will have the common expense categories of food, shelter, transportation, and clothing. The program listing shows possible categories, but I'm sure everyone will want to modify it to reflect specific needs.

If you want to change specific category titles, modify the assignment statements in the procedure "initialize" (see listing 1). The program is set up for a total of 50 categories. To change the total number of categories, modify the assignment statement in the constant declaration statement that sets "max__codes" to 50. The first ten category codes are set up for items that will *add* to the balance; the remaining codes are reserved for items that will reduce it. If you want more codes for income categories, change the constant declaration that sets "max__add__code" to 10. The item category is accessed and stored by number, which speeds item entry and minimizes storage space requirements. If you need instructions, the program will list the item categories and their descriptions.

One important aspect of selecting item categories is deciding how specific to make the categories. For example, consider automobile expenses. Your first thought might be to lump all auto-related expenses together. Another method would be to classify auto expenses in more specific categories: insurance, repairs, monthly payments, etc. By using the second method, it's easier to do other types of analysis. For instance, if you wanted to know how much you were spending on insurance policies, you could group auto with health, life, and other types of insurance. A good way to determine the exact nature of your expense categories is to review the checks you've written in the last year or two.

The specific data file name "A:tom81" is set in the constant

Text continued on page 304

Listing 1: *The source listing for Pascal NOW written in Pascal/MT+, version 5.2.*

```
PROGRAM checks;
{ Pascal/MT+ Version }

CONST max_items = 300;
      max_codes = 50;
      max_add_code = 10;
      disk_file = 'A:tom81';

TYPE
    item_data = RECORD
                    item_number : INTEGER;
                    month : INTEGER;
                    day : INTEGER;
                    year : INTEGER;
                    amount : REAL;
                    description : STRING[30];
                    code : INTEGER;
                END;


VAR command : CHAR;
    code_description : ARRAY [1..max_codes] OF STRING[15];
    items : ARRAY [1..max_items] OF item_data;
    item_last : 1..max_items;
    data_file : FILE of item_data;
    lines_printed : 0..80;
    code_amount : ARRAY [1..max_codes] OF REAL;
    entry_year : INTEGER;
    swaped : BOOLEAN;
    answer : CHAR;
    result : INTEGER;
```

Listing 1 continued on page 294

Listing 1 continued:

```
PROCEDURE initialize;
{ set initial values }
VAR count : 0..max_items;
BEGIN
    item_last := 1;
    FOR count := 1 TO max_codes DO
      code_description[count] := '                   ';
    code_description[1]   := 'Balance forward';
    code_description[2]   := 'Deposit        ';
    code_description[3]   := 'NOW interest   ';
    code_description[11]  := 'House payment  ';
    code_description[12]  := 'Car payment    ';
    code_description[13]  := 'Gas & Electric ';
    code_description[14]  := 'Gasoline       ';
    code_description[15]  := 'Credit cards   ';
    code_description[16]  := 'Auto insurance ';
    code_description[17]  := 'Entertainment  ';
    code_description[18]  := 'Telephone      ';
    code_description[19]  := 'Auto maint.    ';
    code_description[20]  := 'Subscriptions  ';
    code_description[21]  := 'Clothing       ';
    code_description[22]  := 'Computer parts ';
    code_description[23]  := 'Travel         ';
    code_description[24]  := 'Contributions  ';
    code_description[25]  := 'Misc. auto     ';
    code_description[26]  := 'Investments    ';
    code_description[27]  := 'Education      ';
    code_description[28]  := 'Water & sewer  ';
    code_description[29]  := 'Taxes          ';
    code_description[30]  := 'Books          ';
    code_description[31]  := 'Food           ';
    code_description[32]  := 'Drugs          ';
    code_description[33]  := 'Medical service';
    code_description[34]  := 'Tyme withdrawl ';
    code_description[35]  := 'Misc. insurance';
    code_description[36]  := 'Dental         ';
    code_description[37]  := 'Professional   ';
    code_description[38]  := 'Sewing/knitting';
    code_description[50]  := 'Misc. expenses ';
END;

PROCEDURE newpage;
{ print form-feed and 2 blank lines }
BEGIN
    WRITELN(CHR(12));
    WRITELN;
    WRITELN;
    lines_printed := 0;
END;

PROCEDURE instructions;
{ print description of program operation }
VAR answer : CHAR;
    count : INTEGER;
BEGIN
    newpage;
    WRITELN(' Checkbook program - T.E. Doyle ');
    WRITELN(' Version 1.23 ');
    WRITELN;
    WRITE(' Want instructions ? ');
```

Listing 1 continued on page 296

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```
    READ(answer);
    WRITELN;
    IF (answer = 'Y') OR (answer = 'y') THEN
      BEGIN
        newpage;
        WRITELN(' -- Commands --');
        WRITELN;
        WRITELN(' A  -  Add an item');
        WRITELN(' R  -  Remove an item');
        WRITELN(' P  -  Print all items');
        WRITELN(' B  -  Print balance');
        WRITELN(' S  -  Sort by date');
        WRITELN(' D  -  Dump to disk');
        WRITELN(' L  -  Load from disk');
        WRITELN(' Q  -  Quit');
        WRITELN;
        WRITELN;
        WRITELN('Code          Description');
        FOR count := 1 TO 27 DO
          WRITE('-');
        WRITELN;
        FOR count := 1 TO 50 DO
          IF code_description[count] <> '                    ' THEN
             WRITELN(count:3,'          ',code_description[count]);
      END;
END;

PROCEDURE heading;
{ print heading for new page of item printout }
VAR  count : 0..79;
BEGIN
    WRITE(' Item     Date       Amount                   Description');
    WRITE('                      Code');
    WRITELN;
    FOR COUNT := 1 TO 79 DO WRITE('-');
    WRITELN;
END;

PROCEDURE item_print( count : INTEGER);
{ print data on one item }
BEGIN
    WITH items[count] DO
    BEGIN
    WRITE(item_number:5);
    WRITE(month:5,'/');
    IF day < 10 THEN
       WRITE('0',day:1)
    ELSE
       WRITE(day:2);
    WRITE('/',year:2);
    WRITE(amount:11:2);
    WRITE('   ',description);
    WRITE('    ',code_description[code]);
    END;
END;

PROCEDURE print_all;
{ print data for all items in file }
VAR count : INTEGER;
BEGIN
  newpage;
```

Listing 1 continued on page 298

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Listing 1 continued:

```
   heading;
     FOR count := 1 TO item_last-1 DO
     BEGIN
     IF lines_printed = 55 THEN
       BEGIN
        newpage;
        heading;
       END;
     item_print(count);
     WRITELN;
     END;
   WRITELN;
 END;

 PROCEDURE balance;
 { Print totals by categories and net balance }
 VAR item : 1..max_items;
     balance : REAL;
 BEGIN
   FOR item := 1 TO max_codes DO
     code_amount[item] := 0.00;
   balance := 0.00;
   FOR item := 1 TO item_last-1 DO
     WITH items[item] DO
     code_amount[code] := code_amount[code] + amount;
   FOR item := 1 to max_add_code DO
     balance := balance + code_amount[item];
   FOR item := max_add_code+1 TO max_codes DO
     balance := balance - code_amount[item];
   newpage;
   WRITELN('   Category                Amount');
   FOR item := 1 TO 32 DO
     WRITE('-');
   WRITELN;
   FOR item := 1 to max_codes DO
     IF code_amount[item] <> 0.00 THEN
       WRITELN(code_description[item],'  -',code_amount[item]:14:2);
   FOR item := 1 TO 32 DO
     WRITE('-');
   WRITELN;
   WRITELN('Balance          -',balance:14:2);
   WRITELN;
 END;

 PROCEDURE remove;
 { remove item from file }
 VAR remove : CHAR;
     found,item : INTEGER;
     item_remove : INTEGER;
 BEGIN
   found :=0;
   WRITELN;
   WRITE(' Remove item number - ');
   READ(item_remove);
   FOR item := 1 TO item_last-1 DO
     IF items[item].item_number = item_remove THEN
       found := item;
   WRITELN;
   IF found <> 0 THEN
     BEGIN
       heading;
       item_print(found);
```

Listing 1 continued on page 300

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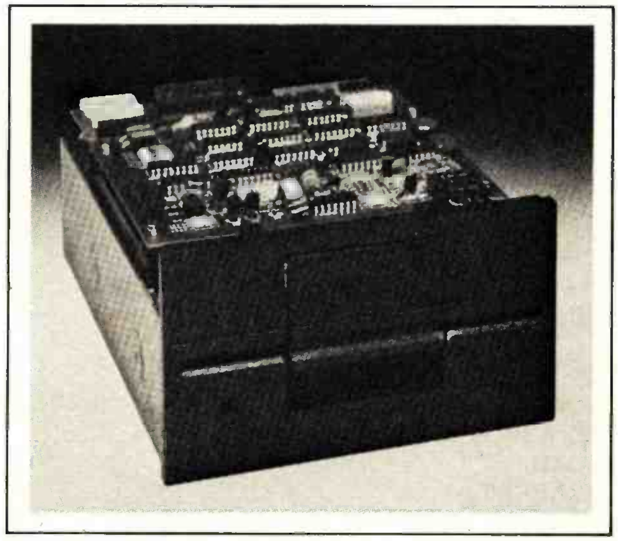
The Data Trak™ 5



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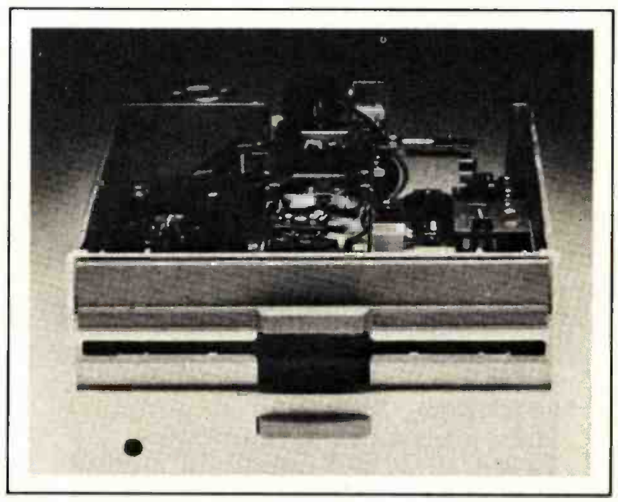
---

The Data Trak™ 8



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Listing 1 continued:

```
      WRITELN;
      WRITELN;
      WRITE(' Remove ? ');
      READ(remove);
      IF (remove = 'Y') OR (remove = 'y') THEN
        BEGIN
          FOR item := found TO item_last-1 DO
            items[item] := items[item+1];
          item_last := item_last-1;
        END;
    END;
  IF found = 0 THEN
    WRITELN(' Item not in list ....');
END;

PROCEDURE entry;
{ console entry of check/deposit data }
VAR ch : CHAR;
BEGIN
  REPEAT
   WITH items[item_last] DO
     BEGIN
       description := '                              ';
       WRITELN;
       WRITE(' Item number ? ');
       READLN(item_number);
       WRITE(' Month ? ');
       READ(month);
       WRITE(' Date ? ');
       READ(day);
       WRITE(' Amount ? ');
       READ(amount);
       WRITELN('               ______________________________');
       WRITE(' Description ? ');
       READLN(description);
       WHILE LENGTH(description) <> 30 DO
         description := CONCAT(description,' ');
       WRITE(' Code ? ');
       READ(code);
       year := entry_year;
       WRITELN;
     END;
    heading;
    item_print(item_last);
    WRITELN;
    WRITELN;
    WRITE(' Correct ? ');
    READ(ch);
  UNTIL (ch = 'y') OR (ch = 'Y');
  items[item_last+1] := items[item_last];
  items[item_last+1].item_number := 0;
  item_last := item_last+1;
  WRITELN;
END;

PROCEDURE swap_items(item : integer ; VAR swaped : BOOLEAN);
{ exchange file data at location with location+1 }
BEGIN
  items[max_items] := items[item];
  items[item] := items[item+1];
```

Listing 1 continued on page 302

Listing 1 continued:

```
  items[item+1] := items[max_items];
  swaped := TRUE
END;

PROCEDURE date_sort;
{ sort data file by date }
VAR finish , item : 0..max_items;
    date_first , date_second : REAL;
    item_first , item_second : INTEGER;
BEGIN
  finish := item_last-2;
  REPEAT
    swaped := FALSE;
    FOR item := 1 TO finish DO
      BEGIN
        WITH items[item] DO
          BEGIN
            date_first := year * 10000.0 + month * 100.0 + day;
            item_first := item_number;
          END;
        WITH items[item+1] DO
          BEGIN
            date_second := year * 10000.0 + month * 100.0 + day;
            item_second := item_number;
          END;
        IF date_first > date_second THEN
          swap_items(item,swaped);
        IF (date_first = date_second) AND (item_first > item_second) THEN
            swap_items(item,swaped);
      END;
    IF finish > 2 THEN
      finish := finish -1;
  UNTIL NOT swaped
END;
PROCEDURE dump;
{ write file of item information to disk }
VAR count : INTEGER;
BEGIN
  ASSIGN(data_file,disk_file);
  REWRITE(data_file);
  FOR count := 1 TO item_last DO
    BEGIN
      data_file^ := items[count];
      PUT(data_file);
    END;
  CLOSE(data_file,result);
END;

PROCEDURE read_disk;
{ load data from disk to file }
BEGIN
  WRITELN;
  ASSIGN(data_file,disk_file);
  RESET(data_file);
  item_last := 1;
  REPEAT
    items[item_last] := data_file^;
    GET(data_file);
    WRITE('.');
    IF item_last MOD 10 = 0 THEN
      WRITELN;
```

```
    item_last := item_last + 1;
  UNTIL items[item_last -1].item_number = 0;
    item_last := item_last -1;
    WRITELN;
    CLOSE(data_file,result);
END;

PROCEDURE prog_commands;
{ console entry of program command }
BEGIN
    WRITELN;
    WRITE(' Command ? ');
    READ(command);
    CASE command OF
      'A','a' : entry;
      'B','b' : balance;
      'P','p' : print_all;
      'R','r' : remove;
      'S','s' : date_sort;
      'D','d' : dump;
      'L','l' : read_disk;
      ELSE
      IF (command = 'Q') OR (command = 'q') THEN
        WRITELN(' Leaving Program')
      ELSE
        WRITELN(' Invalid command .....')
    END;
END;

{ mainline program }
BEGIN
    initialize;
    instructions;
    WRITELN;
    WRITE(' Enter year " 2-digit " for new entries - ');
    READ(entry_year);
    WRITELN;
    WRITELN;
    read_disk;
    REPEAT
      prog_commands;
    UNTIL (command = 'q') OR (command = 'Q');
    WRITELN;
    WRITE(' Save file ? ');
    READ(answer);
    IF (answer = 'Y') OR (answer = 'y') THEN
      dump;
END.

A>
```

Text continued from page 292:

declaration section. Change this statement to your specific file name. If you're keeping track of several NOW accounts, you'll find it more convenient to compile separate versions of the program for each account and maintain each version on a different disk. The program is set up to load the data file automatically when the program is run. This poses a problem the first time you run it. How do you load a file that doesn't exist? The best way to handle this problem is to first compile a version of the program without the "read_disk" statement in the mainline section. Run this version, add one item to the file, and do a write to disk. Recompile the program with the "read_disk" statement in the mainline section and use that version thereafter. This may take a little extra effort initially, but it makes the program much more convenient.

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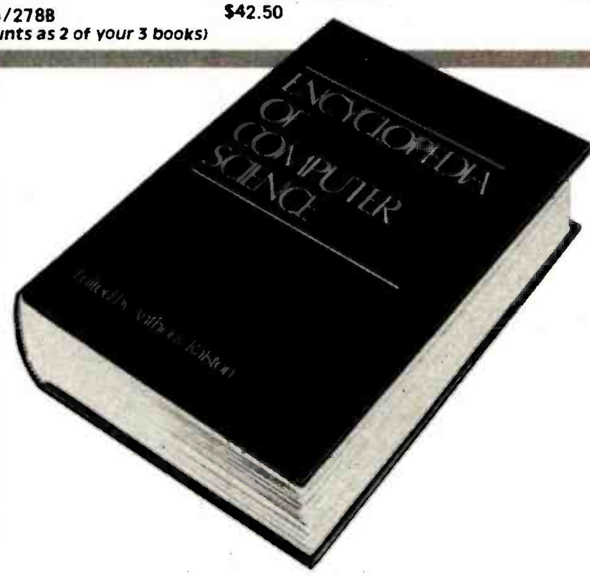

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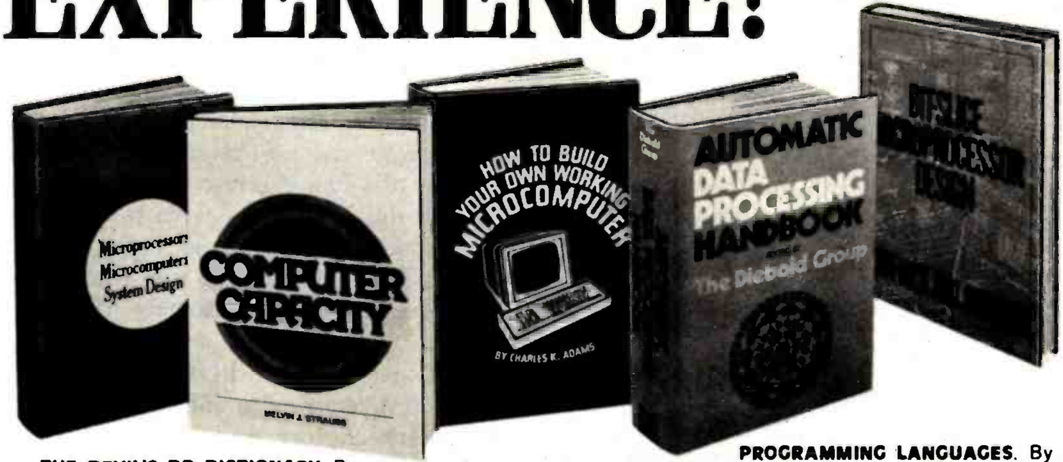

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Managing Data

An interesting aspect of data management programs is that, in most cases, a number of specific descriptors may refer to the same item. In the Pascal NOW program, five descriptors refer to each item. Four are numerical, and the fifth, "description," is a string of characters.

Consider these descriptors as having two identities. The first consists of belonging to a group of similar descriptors (e.g., an item number belonging to the group of all item numbers). Most languages have the capability for this type of grouping through the use of arrays. Membership in a group of descriptors referring to a specific item, such as a check, forms the second identity. BASIC and many other languages do *not* have ways to indicate this type of grouping.

In BASIC, you can indicate a general relationship of this sort by considering that array members with like index numbers refer to the same item. To illustrate, assume that the first element in the item-number array and that in the date array refer to the same check. This sort of grouping is an illusion. One realizes this when swapping items during a sorting. You cannot simply include a line in a BASIC program that will swap all the descriptors referring to one item with all the descriptors referring to another.

One way of circumventing this problem is to group all the descriptors into a long string, then pick out certain fields within the string to obtain the specific descriptor information. This enables the program to reference all descriptors that relate to a specific item. Unfortunately, the item descriptors lose their identity as being members of the similar descriptors' group. BASIC programs using this technique become cluttered with MID$ statements.

Enter Pascal

Pascal has the RECORD data type to handle this problem. The easiest way to visualize the RECORD data type is to consider how most BASIC programs store descriptor information on disk. Descriptor information for a specific item is stored in a common record in the disk file. The commonality is lost when the data is read from the disk and the specific descriptor information is sent to the array. In Pascal, it is possible to maintain the relationship between descriptors through the use of a RECORD data type.

The Pascal NOW program defines "item_data" as a RECORD that consists of seven descriptors referring to a common item. There are actually seven descriptors, rather than the five mentioned earlier, because the date is broken down into month, day, and year. We then define a variable "items" as an array of "item_data". Notice that "items" is not simply seven arrays but is an array of

Text continued on page 318

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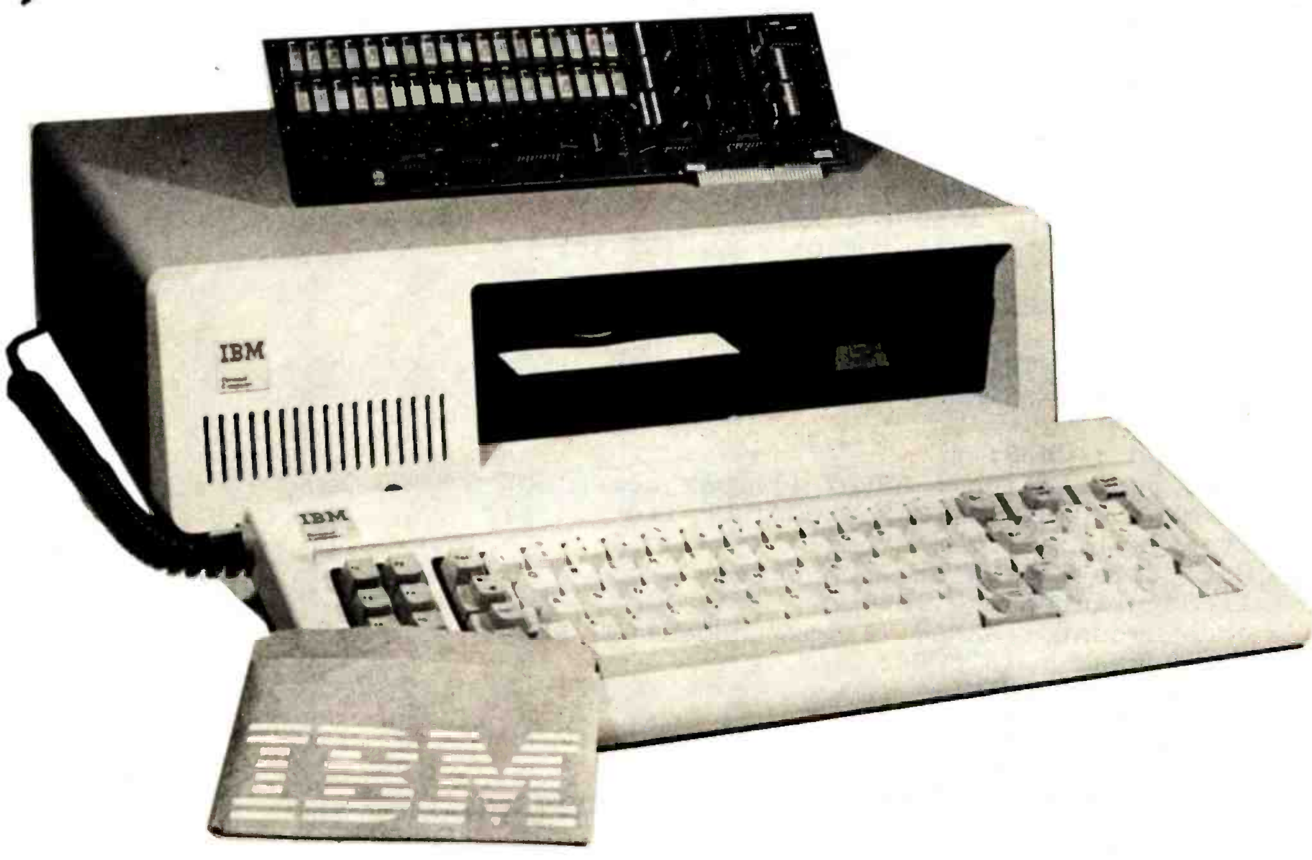

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Circle 59 on inquiry card.

Listing 2: *The changes needed in order to run Pascal NOW under Pascal/Z, version 3.0. Substitute listing 2a for all the material from TYPE until (but not including) the "initialize" in listing 1. Substitute 2b, 2c, and 2d for equivalent procedures within listing 1.*

(2a)

```
TYPE
    item_data = RECORD
                   item_number : INTEGER;
                   month : INTEGER;
                   day : INTEGER;
                   year : INTEGER;
                   amount : REAL;
                   description : STRING 30;
                   code : INTEGER;
                END;

    $STRING0 = STRING 0;
    $STRING255 = STRING 255;

VAR command : CHAR;
    code_description : ARRAY [1..max_codes] OF STRING 15;
    items : ARRAY [1..max_items] OF item_data;
    item_last : 1..max_items;
    data_file : FILE of item_data;
    lines_printed : 0..80;
    code_amount : ARRAY [1..max_codes] OF REAL;
    entry_year : INTEGER;
    swaped : BOOLEAN;
    answer : CHAR;
    result : INTEGER;

FUNCTION LENGTH(x:$STRING255) : INTEGER; EXTERNAL;
```

(2b)

```
PROCEDURE heading;
{ print heading for new page of item printout }
VAR  count : 0..79;
BEGIN
    WRITE(' Item     Date          Amount                   Description');
    WRITE('                   Code');
    WRITELN;
    FOR COUNT := 1 TO 79 DO WRITE('-');
    WRITELN;
END;

PROCEDURE item_print( count : INTEGER);
{ print data on one item }
BEGIN
    WITH items[count] DO
    BEGIN
    WRITE(item_number:5);
    WRITE(month:5,'/');
    IF day < 10 THEN
       WRITE('0',day:1)
    ELSE
       WRITE(day:2);
    WRITE('/',year:2);
    WRITE(amount:14:2);
    WRITE(' ',description);
    WRITE('  ',code_description[code]);
    END;
END;
```

Listing 2 continued on page 310

Computer Exchange

927

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48K or 64K	CALL
Disk II W/3.3 DOS	CALL
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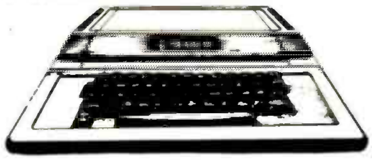

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	NEW 9" Green	$ 159	31%
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	NEW 12" Green	$ 229	30%
	13" Color	$ 399	28%
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ZENITH	12" Green	$ 119	20%

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Memorex	$ 25	45%

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ALS: Smarterm	$ 269	30%

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Parallel Interface 7720A	$ 99	20%
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Keyboard Company: Joystick II	$ 45	10%
Game Paddle	$ 25	17%
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Mountain: CPS Multifunction Card	$ 209	13%
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Orange Micro Grappler	$ 129	21%
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★ ALS: Smarterm 80 Col Card	$ 269	30%
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Listing 2 continued:

(2c)

```
PROCEDURE entry;
{ console entry of check/deposit data }
VAR ch : CHAR;
BEGIN
  REPEAT
   WITH items[item_last] DO
     BEGIN
       description := '                              ';
       WRITELN;
       WRITE(' Item number ? ');
       READLN(item_number);
       WRITE(' Month ? ');
       READ(month);
       WRITE(' Date ? ');
       READ(day);
       WRITE(' Amount ? ');
       READ(amount);
       WRITELN('               ______________________________');
       WRITE(' Description ? ');
       READLN(description);
       WHILE LENGTH(description) <> 30 DO
         APPEND(description,' ');
       WRITE(' Code ? ');
       READ(code);
       year := entry_year;
       WRITELN;
     END;
```

(2d)

```
PROCEDURE dump;
{ write file of item information to disk }
VAR count : INTEGER;
BEGIN
  REWRITE(disk_file,data_file);
  FOR count := 1 TO item_last DO
    WRITE(data_file,items[count]);
END;

PROCEDURE read_disk;
{ load data from disk to file }
BEGIN
  WRITELN;

  RESET(disk_file,data_file);
  item_last := 1;
  REPEAT
    READ(data_file,items[item_last]);
    WRITE('.');
    IF item_last MOD 10 = 0 THEN
      WRITELN;
    item_last := item_last + 1;
  UNTIL items[item_last -1].item_number = 0;
    item_last := item_last -1;
    WRITELN;
END;

PROCEDURE prog_commands;
{ console entry of program command }
BEGIN
    WRITELN;
    WRITE(' Command ? ');
```

Listing 2 continued on page 314

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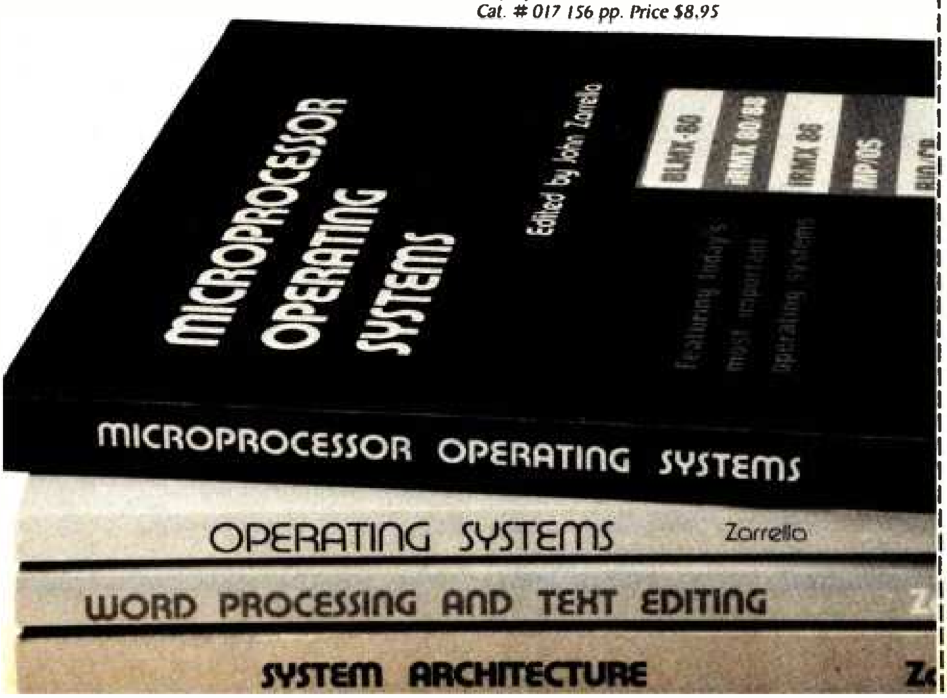

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Lear Siegler	ADM-31	Call for price
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320T12 .... $ .80
340T12 .... $ .75

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	1-9	10-24	25 up
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Circle 33 on inquiry card.

Listing 2 continued:

```
     READ(command);
     CASE command OF
       'A','a' : entry;
       'B','b' : balance;
       'P','p' : print_all;
       'R','r' : remove;
       'S','s' : date_sort;
       'D','d' : dump;
       'L','l' : read_disk;
       ELSE :
       IF (command = 'Q') OR (command = 'q') THEN
         WRITELN(' Leaving Program')
       ELSE
         WRITELN(' Invalid command .....')
     END;
END;
```

Listing 3: *A sample run of the Pascal NOW program.*

```
Checkbook program - T.E. Doyle
Version 1.23

Want instructions ? y

 -- Commands --

 A  -  Add an item
 R  -  Remove an item
 P  -  Print all items
 B  -  Print balance
 S  -  Sort by date
 D  -  Dump to disk
 L  -  Load from disk
 Q  -  Quit


Code           Description
---------------------------
  1          Balance forward
  2          Deposit
  3          NOW interest
 11          House payment
 12          Car payment
 13          Gas & Electric
 14          Gasoline
 15          Credit cards
 16          Auto insurance
 17          Entertainment
 18          Telephone
 19          Auto maint.
 20          Subscriptions
 21          Clothing
 22          Computer parts
 23          Travel
 24          Contributions
 25          Misc. auto
 26          Investments
 27          Education
```

Listing 3 continued on page 316

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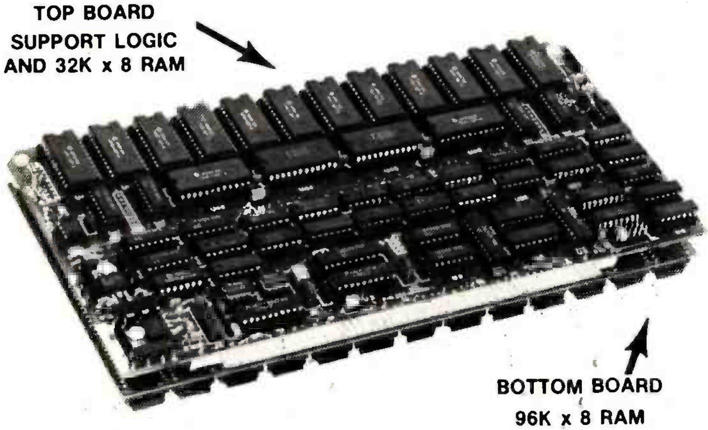

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  - Bank write protect } 32K / 16K Banks
  - Bank readdress } 32K / 16K Banks
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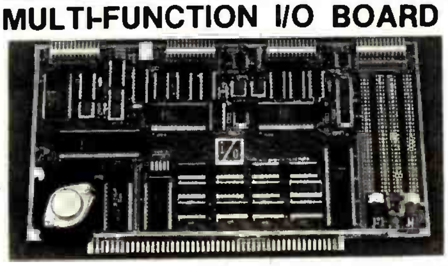

The multiple on-board functions allow for complete software and hardware I/O task(s) control. **Features:** Two independent SYNC/ASYNC serial ports (Software programmable with status read interface: RS-232-C or current loop — 20 or 60ma — or TTL with handshaking. Dedicated output connectors for each port) ■One strobed 8-bit parallel port with handshaking (Software status read) ■Three 8-bit parallel ports undedicated & user configured (Software programmable for input, output, plus input/output/bidirectional with handshaking or combinations thereof. Software status read for handshake logic) ■Three independent 16-bit timers (software programmable for 5 operating modes. Indiv. clock source input & gate control — int. or ext. Uninterrupted read. Two buffered outputs) ■Eight level priority interrupt controller (Software programmable highest interrupt level. 8080/Z80 auto restart command) ■Two software programmable baud rate generators with crystal controlled frequencies ± .01% ■Large prototyping area with access to regulated +5, +12, — 12VDC.

Assembled and Tested — P/N 52748-100-101 — $325, Kit P/N 52748-100 — $225, Bare Board P/N 52748-1XX — $85

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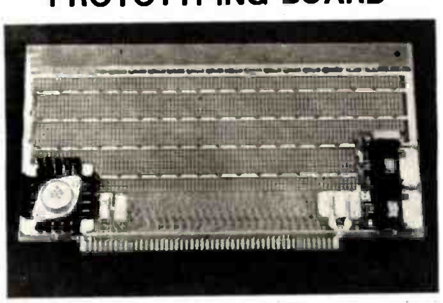

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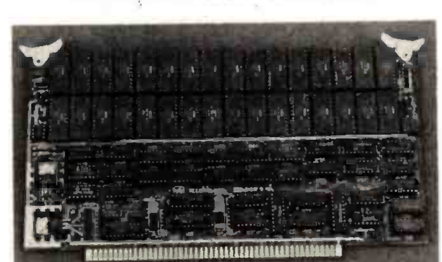

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Circle 424 on inquiry card.

Listing 3 continued:

```
 28          Water & sewer
 29          Taxes
 30          Books
 31          Food
 32          Drugs
 33          Medical service
 34          Tyme withdrawl
 35          Misc. insurance
 36          Dental
 37          Professional
 38          Sewing/knitting
 50          Misc. expenses

 Enter year " 2-digit " for new entries - 81


..

 Command ? p



Item      Date        Amount               Description                 Code
---------------------------------------------------------------------------------
   1     2/02/81      100.00    Balance from 1980               Balance forward

Command ? a
Item number ? 2
Month ? 3
Date ? 3
Amount ? 18.00
               ______________________________
Description ? Subscription to BYTE
Code ? 20

Item      Date        Amount               Description                 Code
---------------------------------------------------------------------------------
   2     3/03/81       18.00    Subscription to BYTE            Subscriptions

Correct ? y

Command ? b


   Category              Amount
--------------------------------
Balance forward  -      100.00
Subscriptions    -       18.00
--------------------------------
Balance          -       82.00


 Command ? a
 Item number ? 1
 Month ? 1
 Date ? 1
 Amount ? 12.34
               ______________________________
 Description ? Movie tickets
 Code ? 17
```

Listing 3 continued on page 318

Listing 3 continued:

```
Item      Date        Amount              Description                  Code
--------------------------------------------------------------------------------
   1     1/01/81       12.34    Movie tickets                     Entertainment

Correct ? y

Command ? p



Item      Date        Amount              Description                  Code
--------------------------------------------------------------------------------
   1     2/02/81      100.00    Balance from 1980                 Balance forward
   2     3/03/81       18.00    Subscription to BYTE              Subscriptions
   1     1/01/81       12.34    Movie tickets                     Entertainment


Command ? s
Command ? p



Item      Date        Amount              Description                  Code
--------------------------------------------------------------------------------
   1     1/01/81       12.34    Movie tickets                     Entertainment
   1     2/02/81      100.00    Balance from 1980                 Balance forward
   2     3/03/81       18.00    Subscription to BYTE              Subscriptions


Command ? b


   Category                Amount
----------------------------------
Balance forward    -        100.00
Entertainment      -         12.34
Subscriptions      -         18.00
----------------------------------
Balance            -         69.66


 Command ? w Invalid command .....

 Command ? q Leaving Program

 Save file ? y
```

Text continued from page 306:

records, with each element consisting of seven items. This concept is similar to multidimensional arrays. There's a major limitation to BASIC multidimensional arrays that would preclude their use in this application: they must have all elements of the same type. Integers, reals, and strings cannot be grouped into one array in BASIC.

Another advantage over multidimensional arrays is how elements are referenced. If you want to reference all the descriptors for a specific item, indicate "items[index]". To reference a specific descriptor of the item (e.g., the item's dollar amount), indicate "items[index].amount". You are thus able to reference all descriptors of a specific item as a group or to access a single descriptor. Pascal also allows use of long variable names, so statement meanings are usually apparent. It's fairly clear, for instance, that

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"items[index].year" refers to the year for the specific item.

Program Operation

There are a few differences in operation between the Pascal/Z and Pascal/MT+ programs. Pascal/MT+ version 5.2 offers the choice of BCD or floating-point format for real numbers. For this program, I used BCD numbers. Pascal/Z version 3.0 offers only floating-point format; therefore, an error of a penny or two will show up occasionally. Input of data from the keyboard is a little different in Pascal than in BASIC. If there's a variable with the type CHAR, it can hold a single character. A READ statement awaiting this variable will be satisfied when a single character is typed in. Pascal/MT+ does not require a carriage return to indicate that the character has been typed. So, when a key is pressed for a single-character command, the program will process the command immediately. Keyboard input in Pascal/Z is handled like keyboard input in BASIC. After you enter a single-character command, the program will wait for a carriage return. This variation has an interesting effect when entering the item description (a string with a maximum length of 30 characters).

In both versions of the program, typing a carriage return will terminate this string. In the Pascal/MT+ version, if the description is greater than 30 characters, the program will terminate the string when the 30th character is entered and then go on. In the Pascal/Z version, the string input is not processed until the carriage return is pressed. If the string entered is over 30 characters, Pascal/Z detects an error and abruptly terminates the program.

Observations: Basic vs. Pascal

One of the first things the BASIC user notices when using Pascal or other compiled languages is that compiling takes time. For example, when using Pascal/Z, the program must be compiled, assembled, and linked. For the Pascal NOW program, this process takes almost 8 minutes. When using Pascal/MT+, the program must be compiled and linked, a process

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that requires nearly 4 minutes. Both times are for a Z80-based system operating at 4 MHz.

In seven years of teaching computer programming, I've noticed a definite improvement in the quality of programs written by people using compiled languages. When working with BASIC, it's very tempting to write programs using the cut-and-try technique: if a program doesn't work, throw in a few GOTO statements to patch it up, then try it again. BASIC program changes can be incorporated and evaluated very quickly. This characteristic almost encourages an inelegant technique.

With a compiled language like Pascal, you're more apt to think through a problem because of the relatively long time required to incorporate changes. The available versions of Pascal are evolving, so I'd encourage you to make a very careful comparison of each version's features before making a selection.■

Pascal Standards

One of the problems plaguing BASIC is the lack of a standard. Pascal has a slightly different problem—it has several standards. At present, there appear to be three main "standards" for Pascal: the Jensen and Wirth standard, the UCSD standard, and the ISO standard. Some of the differences among these are very subtle, but other differences can hamper program transport between systems. I won't attempt to say which of these standards is "The Standard," but I will offer observations on the differences between some versions of Pascal.

While this program was being written, I had access to three versions of Pascal: Pascal/MT+, version 5.2, Pascal/Z, version 3.0, and UCSD Pascal, version 1.0 (pseudocode). The first two compilers are native code compilers, compiling the Pascal source code directly to 8080/Z80 machine code. The UCSD version is a pseudocode (p-code) compiler, compiling the Pascal source to an intermediate code (p-code) which is then interpreted. I ran a prime number program under all three versions as a benchmark and measured execution times. Because the p-code version took almost five times as long as the native code versions, I only wrote versions of the program in Pascal/MT+ and Pascal/Z.

The main difference between Pascal/MT+ and Pascal/Z lies in how they handle character strings. Jensen and Wirth define strings in a very limited sense and do not define any string functions or procedures. UCSD Pascal has set a de facto standard for strings, and Pascal/MT+ has incorporated these UCSD string functions and procedures into its version of Pascal. Pascal/Z defines its own string functions and procedures, which are not directly compatible with those of UCSD Pascal.

Disk input/output (I/O) is another area where Pascal/MT+ and Pascal/Z differ. Pascal/MT+ has incorporated full file buffer↑, GET, and PUT I/O and has kept its file I/O as close as possible to ISO and Jensen and Wirth standards. Pascal/Z has not implemented standard file buffer↑, GET, or PUT I/O, and as a result, the procedures that read and write to external files are a bit different. When printing real numbers, the field width specification for Pascal/Z did not work properly. Consequently, the sections of the program that print headings and real numbers were modified. By the time this article is published, the problem should be remedied.

The CASE statement, as defined by Jensen and Wirth, does not allow for exceptions. Both versions of Pascal incorporate extensions to handle exceptions. Pascal/MT+ uses the statement ELSE as it is used in IF-THEN-ELSE statements to identify the exceptions. Pascal/Z uses ELSE: to identify exceptions. It considers the ELSE as another case and, as a result, follows it with a colon.

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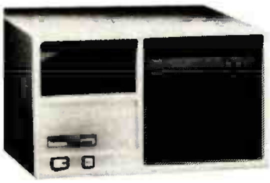

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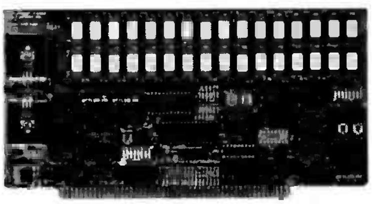

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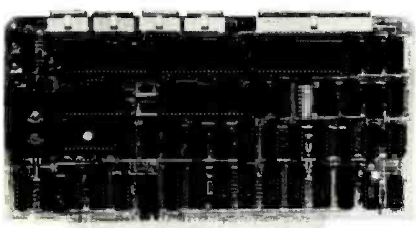

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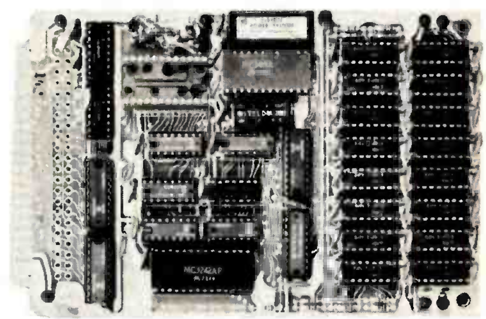

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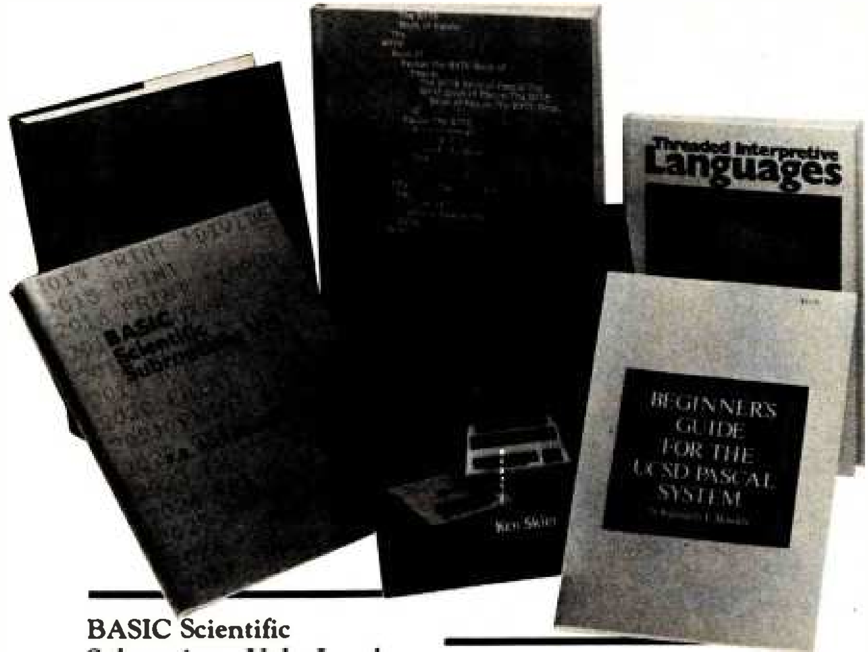

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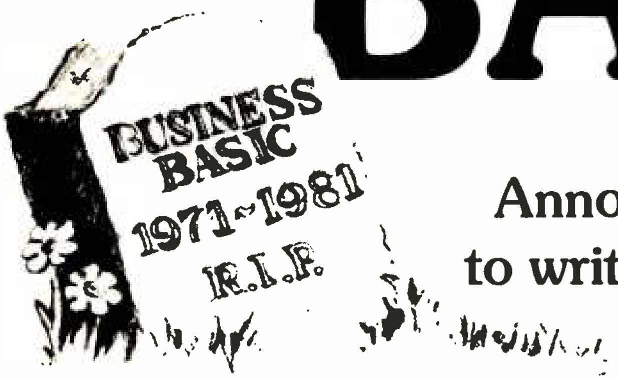

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Bugs Switch Photos and Figures

The two photographs on page 40 of Steve Ciarcia's article "Switching Power Supplies" were inadvertently transposed. (See the November 1981 BYTE.) The photograph above the caption for photo 3 is actually photo 4 and vice versa.

Gremlins also struck Chris Crawford's article, 'The Atari Tutorial, Part 3: Player-Missile Graphics." (See the November 1981 BYTE, page 312.) The color portions of Chris's figures 1 and 2b, which represented the video images, were omitted, and figure 4 appeared upside down. The corrected figures are shown here. ■

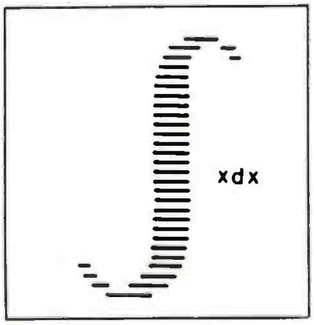

Figure 4

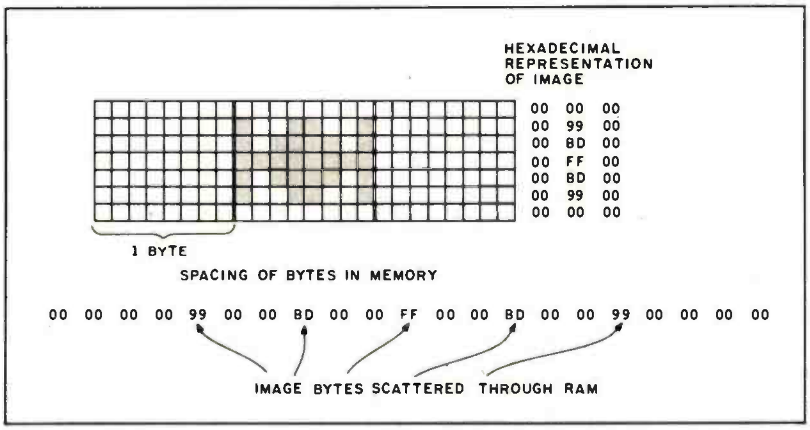

Figure 1

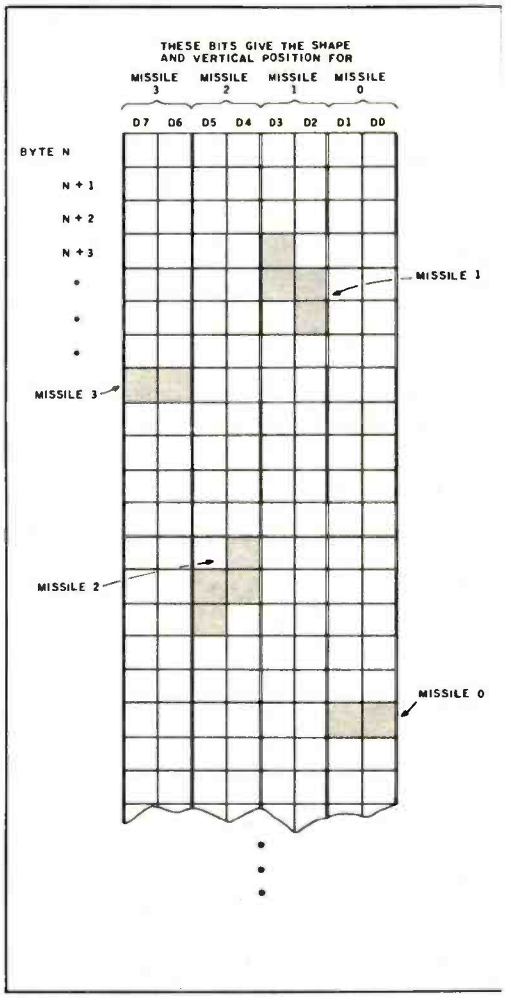

Figure 2b

News and Speculation About Personal Computing

Conducted by Sol Libes

Random Rumors: An Ada compiler for Z80-based systems is said to be in development by Supersoft Associates, Champaign, Illinois. Versions for Intel's 8086/8088, Motorola's 68000, and Zilog's Z8000 are expected by year's end. The Z80 version, a subset of Ada (the Department of Defense has still not frozen the complete Ada standard), will be upgraded to a completely validated version in subsequent releases. The Z80 Ada package will sell for $200 to $300. . . . American Express will market the Sinclair ZX81 via its mail-order business. . . . Digital Research may be working on a Visicalc look-alike. . . . Tandy is rumored planning, on its TRS-80 Model II desktop computer, to incorporate two Tandon 8-inch "thinline" floppy-disk drives and a Winchester drive in the spot now occupied by two 8-inch drives. . . .

Apple may introduce its 68000 machine in the second quarter of 1982; Apple is reported to be trying to purchase one million 68000 microprocessors at $10 each. Two versions of the 68000-based system are expected: a single-user desktop unit and a network controller for an Ethernet-type system. . . . Reports are that Intel is getting a mixed reception to the iAPX-432 32-bit microprocessor. In any event, the instruction set will be frozen, in microcode, early in 1982. Present owners of iAPX-432 chip sets will be able to trade them for the revised version. . . . Heath is said to be working on a completely new generation of computers. . . .

Several Japanese manufacturers are expected to introduce complete briefcase-size personal computers using CMOS (complementary metal-oxide semiconductor) and bubble memory. . . . Commodore's hoped-for Z80 processor board for the PET is a dead issue, as negotiations for an exclusive license from Small Systems Engineering, the supplier, have broken down. . . . Data General is rumored about to make available a CP/M-compatible version of its Enterprise system. . . . Corvus is reported about to introduce Xerox 820 and IBM Personal Computer interfaces for its Omninet local network system. . . . Alpha Micro may be developing a video-tape-recorder interface as a Winchester disk drive backup market.

Random News Bits: Zilog Corporation, Cupertino, California, and Seeq Technology, Campbell, California, have announced plans to manufacture a 16K-bit EEPROM (electrically erasable programmable read-only memory). Samples are expected by the end of the second quarter of 1982. Later this year, Zilog plans to introduce versions of the Z8, Z80, and Z800 microprocessors with on-board EEPROM memory. No mention of the ROM size. . . . DEC (Digital Equipment Corporation) announced that earnings for the quarter ending in October 1981 increased 58% ($88.8 million) on a 28% increase in sales ($839.3 million). . . . Condesin, of Cupertino, California, claims it will soon introduce a 4M-bit nonvolatile memory on a chip the size of a 64K-bit device using an "unpatterned charge-storage" technique. With an access time of 1 microsecond, it is viewed as a replacement for floppy disks. Condesin expects to be in production by the end of this year. It also expects to be able later to increase storage 16 times to 2^{36} bits on a single chip. . . .

Panasonic has introduced a hand-held computer using the 6502 microprocessor and 8K bytes of memory. . . . Bell Laboratories is field-testing Getset, a combination telephone handset, speakerphone, keyboard, and video display that can be used for store-and-forward switching, electronic mail, directory and dialing assistance, and database and personal-information retrieval. . . . Wolfdata, Ithaca, New York, has developed Wolfdata Artificial Intelligence Language (WAIL), which writes programs dynamically. . . . General Instrument Microelectronics, Hicksville, New York, has introduced a 16K-bit EEPROM requiring only one +5-volt supply. It is organized as 2K by 8 bits, can be erased in 10 milliseconds, retains data for 10 years, and features a pinout similar to the 2716 EPROM. Price is $40. . . .

The IEEE (Institute of Electrical and Electronics Engineers) has established a committee to draft a standand for the 8-bit STD bus. Currently 40 manufacturers produce STD-bus boards. The committee will also investigate 16-bit transfers on the bus and compatibility with the Eurocard format. . . . More than a hundred firms have already been licensed by Xerox to use Ethernet. A license costs $1200. . . . Radio Shack, preparing to launch its 16-bit computer, has increased its retail computer-marketing field force from 5 to 18 people. . . . A jury in San Francisco found Data General guilty of violating federal antitrust laws by illegally tying the sale of its operating-system software to its hardware. Plaintiffs were Fairchild Camera and Instrument Corporation and Digidyne Corporation. . . . Oki Semiconductor, Santa Clara, California, takes the prize for the largest ROM in production: a 4M-bit ROM.

IBM Watching: The most serious disadvantage of the new IBM Personal Computer is its limited disk storage. However, IBM is said to be working on adding 8-inch floppy-disk drives and a 14M-byte Winchester disk to the list of peripherals for the Personal Computer. IBM may also be working on a higher-density plug-in memory card to free one of the bus slots in the machine.

A few discount dealers are already offering discounts on the IBM system that are very small compared to discounts available for other systems. However, IBM is selling the system to its own employees at a 40% discount.

IBM will have to strengthen its distribution before it will have a serious impact on Apple and Tandy. After all, Apple and Tandy have extensive distribution systems that took several years to develop. Apple Computer Inc.

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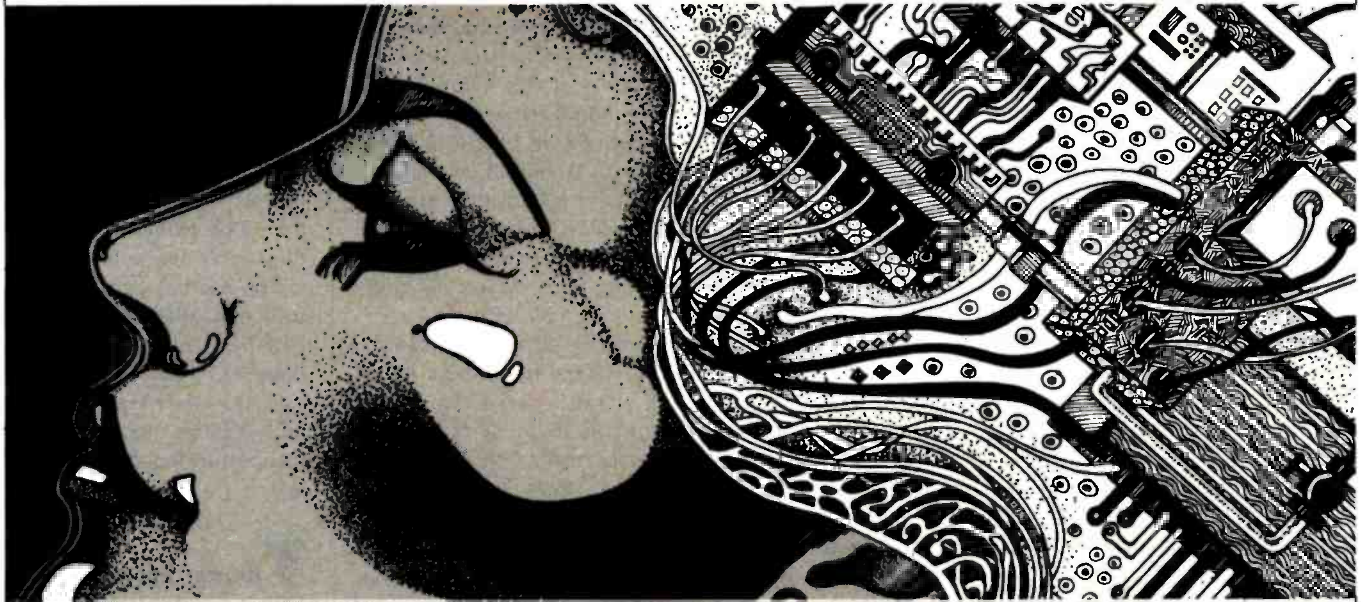

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has 2500 dealers and over 300 companies selling hardware and software for the Apple. Tandy Corporation's distribution is even larger. To increase distribution, IBM is expected to open a large number of retail outlets this year and add a large number of new distributors. IBM is said to be negotiating with industrial distributors to carry the Personal Computer. Many of these distributors are already carrying the IBM 3101 ASCII terminal and the 8-inch Piccolo Winchester drive. However, this distribution route will probably not begin to function until the second quarter.

Further, IBM has reorganized its internal marketing and manufacturing organization. IBM sales reps will now be able to sell the entire range of IBM products, where previously they have been limited to one or two specific product lines.

Portia Isaacson and Egil Juliussen of Future Computing, Richardson, Texas, recently released a market-research study titled *IBM's Billion-Dollar Baby: The Personal Computer* ($475 a copy), in which they predict that demand for the IBM Personal Computer will reach 100,000 units by the end of 1982, 250,000 units by the end of 1983, and 450,000 by the end of 1985.

DEC Enters Personal Computing Market: Capitalizing on the fact that 250,000 DEC VT-100 video terminals are already in operation, Digital Equipment Corporation (DEC) has entered the personal computer market by introducing a kit to upgrade a VT-100 to a full-blown personal computer system. In doing this the firm accomplished three things: (1) it capitalized on a closed, ready market; (2) it provided a system cost substantially below its competition (provided you already own a VT-100); and (3) it beat at least one company that was planning to introduce a VT-100 personal-computer upgrade to the punch. The $2400 kit upgrades a VT-100 (which typically costs $1300 to $1500, depending on options) by adding a Z80 microprocessor with 64K bytes of memory on a plug-in board and a 5¼-inch floppy-disk drive (160K bytes of storage) in a separate cabinet. CP/M costs another $250 and a second drive adds $1275.

DEC will be selling the system through its distributors, by direct telephone order, and through its 25 stores. No plans were disclosed for sales via computer stores.

Battle of the Operating Systems: When IBM announced that Digital Research's CP/M-86 disk operating system (DOS) would be supported by the IBM Personal Computer, visions of plentiful software danced in the heads of many potential purchasers, who were thinking of the legion of programs that are available for use under CP/M-80, the operating system that has become the de facto standard for users of 8-bit 8080-, 8085-, and Z80-based computers.

But the visions may soon be dancing to a different tune. Despite the similarity of the two DOSes, an operating system does not change the character of the hardware it runs on, and the hard fact remains that software written and compiled for the Z80 microprocessors cannot be immediately and easily run on the 8088 16-bit microprocessor. Programs must be converted and/or rewritten to be compatible, taking time and effort.

Meanwhile, confidence is increasing in IBM's Personal Computer DOS, which was written for IBM by Microsoft Inc., of Bellevue, Washington. As of this writing, all of the application software announced by IBM runs under this DOS, and many program authors report that converting CP/M-80 programs to run under the Microsoft system is easier than converting them to run under CP/M-86.

Microsoft will be releasing the operating system, which it will call "MS-DOS," to be run on 16-bit computer systems from other manufacturers. And Lifeboat Associates of New York City, the world's largest distributor of 8-bit CP/M software, has committed itself to support Microsoft's MS-DOS, under the name "SB-86," for the 16-bit world. Lifeboat plans to make SB-86 available for a wide variety of machines in the same way that it made CP/M-80 available off the shelf for close to 40 different 8-bit computers. Lifeboat says it will convert all of its current software packages to run under SB-86.

There is no doubt that CP/M-80 will continue to dominate the 8-bit DOS market. But the 16-bit race for dominance is still on, and CP/M-86 is in the pack along with MS-DOS and the multiuser operating systems: Digital Research's own MP/M-86, Oasis-86 from Phase One Systems, Multi-OS from Infosoft Systems, and Microsoft's Unix-like Xenix operating system.

32-Bit Bus Spec Agreed On: While the IEEE-896 committee continues to haggle over a standard for 32-bit microprocessors, three manufacturers have announced agreement on a 32-bit bus. Motorola, Mostek, and Signetics/Philips have announced the VME bus. Thompson CSF has also announced its support for the bus. The VME bus is a Eurocard-compatible subset of Motorola's Versabus and includes some of the features from the IEEE-896 group. However, the three companies, all with a large stake in the 32-bit 68000 market, felt they could wait no longer.

The bus has 192 pins in its fully expanded configuration with 64 available for user-defined I/O. The IEEE-896 design has fewer pins, but uses multiplexing, which lowers the performance of the system.

Tidbits From Japan: The Japanese government is investing $50 million in a program to develop a fifth-generation computer by 1985. The computer will offer more intelligent man/machine interfaces and will be more closely aligned with societal needs than its honorable ancestors. It will be based on VLSI (very-large-scale integration) devices, integration of new communications technology, parallel processing, software engineering, artificial intelligence, and pattern recognition.

Fujitsu has announced the development of a new high-performance integrated circuit using the company's HEMT (high-electron-mobility transistor) technology. The device has demonstrated a switching time of 17 ps (picoseconds, or 10^{-12} seconds) with a power dissipation of 0.96 milliwatts. This is about 30 times faster than conventional MOSFETs (metal-oxide semiconductor field-effect transistors) and is comparable to the 13-ps time of Josephson-junction devices. Fujitsu engineers hope to reduce this time to well under that of Josephson devices. One advantage of the HEMT devices is that they require less cooling—only to −196°C (the temperature of

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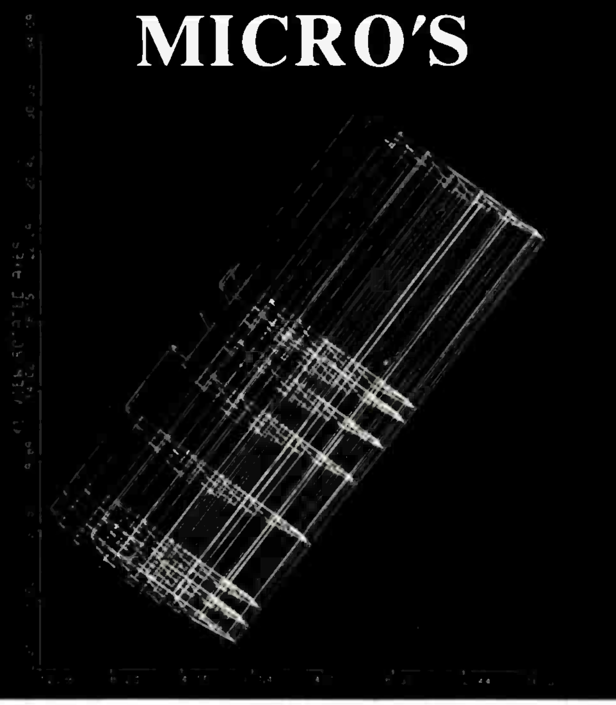

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liquid nitrogen) compared to −269°C (the temperature of liquid helium) for Josephson devices. Hence, HEMT-based computers should be more practical and less costly.

NEC (Nippon Electric Company) has disclosed that it is considering building a $100 million plant in Roseville, California, for fabrication and assembly of integrated circuits and electronic equipment. The plant is tentatively slated to go into production at the end of 1983.

Daisy-Wheel and Dot-Matrix Printer Status Report: In 1972, David Lee created the Diablo daisy-wheel printer. Until then, IBM dominated the word-processing impact-printer market with its Selectric printer. The daisy-wheel printer operated with many fewer parts, providing faster and more reliable operation. Further, sophisticated control electronics were added to provide intelligent printer operation.

Within a year, Xerox Corporation acquired the Diablo Company. Lee left the following year and formed Qume, which was later bought by Exxon. Qume introduced its own version of a daisy-wheel printer, and for the next five years Diablo and Qume shared the word-processing daisy-wheel market.

Then, in 1979, Ricoh, a Japanese supplier, entered the market as an OEM (original-equipment manufacturer) supplier to Tandy and Lanier. NEC (Nippon Electric Company) introduced a word-processing printer using a thimble-like printing element. And recently Fujitsu announced a daisy-wheel printer that operates at 80 characters per second, almost twice the speed of most U.S. models. Also, we can shortly expect Pertec, Brother, and Canon to introduce daisy-wheel printers.

Diablo and Qume have responded to the foreign competition by introducing new daisy-wheel printers having fewer parts, operating at lower speeds, and hence costing less. The Diablo and Qume share of the market has dropped to about 50%. However, the market has been growing at a rate of about 40% per year, and their business has continued to increase even though their market share decreased.

One other consideration in the word-processor market is that the quality of dot-matrix printers has been improving, and they are more and more being used for word-processing work. This trend can be expected to continue.

Although Americans have long expected a "Japanese invasion" in the personal computing market, this has not occurred. What has happened might be called an "infiltration," with the Japanese moving into selected segments of the market. The area where they have already scored a great success is in the under-$1000 dot-matrix printer market. (The low-cost floppy- and hard-disk markets could be next.)

The Japanese, who two years ago had virtually no U.S. printer sales, today have almost 75% of the under-$1000 printer market, estimated at $200 million (expected to grow to $950 million by 1985). Epson America is now the market leader. U.S. manufacturers, such as Centronics, Anadex, Tally, and Dataproducts, have abandoned the under-$1000 printer market and are now concentrating their efforts on the higher-speed, multi-mode (single-pass and multi-pass), and multi-font machines. The question is, "Will the Japanese be far behind?"

The Developing 16-Bit Market: What is faster than a speeding bullet and more powerful than a locomotive? The new Texas Instruments TMS99000 16-bit microprocessor, with 24-MHz clock rate and an instruction set that includes single-precision floating-point instructions, that sells for a modest $65 (100-piece price). And National Semiconductor, after many doubts and delays, is finally beginning to make available samples of its 16032 16-bit microprocessor.

The biggest news of the month is that AMD (Advanced Micro Devices) has signed a 10-year licensing agreement with Intel for the 8088, 8086, and iAPX-432 16- and 32-bit microprocessors. AMD was, until now, the prime second source for the Zilog Z8000 16-bit microprocessor and a developer of many of the Z8000 support chips. AMD has disclosed that, although it will continue to manufacture and support its current Z8000 products, it will not do any further development of them. Zilog had recently reduced prices on the Z8002 to $19.90 in 1,000-piece lots. The Intel 8086 is currently selling for $58.50 in lots of 100, with prices rising to $127.40 for the 10-MHz version. However, Japanese suppliers are entering the market with high-volume prices close to $23 and, for delivery 6 months from now, are quoting $14. Motorola is currently charging $91 for the 68000 processor in 25 to 99 quantities, and prices rise to $269 for a 10-MHz part.

The Zilog Z8000 appears to have been caught in a pincer movement between the 8086 and the 68000. The 8086's large base of software and support chips, large number of second sources, and attractive pricing, and the 68000's high-powered performance appear to be making the 16-bit market a two-device show, with the Z8000 getting a low third billing. It is rumored that Zilog's new 32-bit microprocessor will be a migration upward from the Z8000. This feature may prove attractive to system designers and put Zilog back in the race.

Floppy-Disk Format Chaos: The microcomputer industry has created a chaotic situation in 5¼-inch floppy-disk formats. The lack of a standard format has resulted in a multiplicity of disk formats such that disks created on one manufacturer's 5¼-inch disk system cannot be read on another manufacturer's 5¼-inch disk system. Thus, programs created using the CP/M operating system running on a Heath, Intertec, Apple, TRS-80, IBM, or North Star computer cannot be transferred easily from system to system. The problem is most acute for people who wish to copy public-domain software from the CPMUG and SIG/M user-group libraries.

Eight-inch floppy-disk users fortunately have a standard (the IBM 3740 format for single-density disks). Thus, 8-inch disk owners exchange software in single-density format. However, there is no standard for double-density formatting, and 8-inch disk owners are forced to use single density when copying disks and then convert them to their particular double-density format. Virtually every 8-inch disk-controller maker furnishes software for this converting process.

An additional problem has been created by manufacturers who have "improved" their versions of CP/M. In some cases these improvements cause the CP/M system to no longer be compatible

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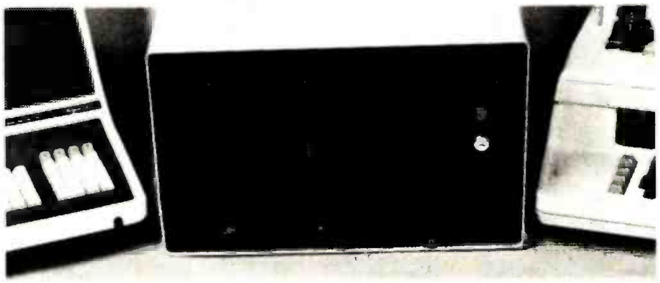

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with other CP/M systems.

The situation appears to be worsening because neither the IEEE nor the manufacturers appear to be concerned with the problem. Buyers of personal computers must be made aware that just because a particular computer uses the CP/M disk operating system, it does not mean that disks will be compatible with other systems that use CP/M. And if the system uses 5¼-inch disks, incompatibility is almost certain.

Amateur-Radio Computer News: The FCC (Federal Communications Commission) is presently considering authorizing amateur radio operators to transmit data not encoded in ASCII (American Standard Code for Information Interchange) or 5-bit (Baudot/Murray) code. This is being done in response to a petition from the ARRL (American Radio Relay League). The FCC is also considering allowing increased sending speeds for ASCII transmission within certain frequency bands.

The ARRL, AMRAD (Amateur Radio Research and Development Corporation), and AMSAT (Radio Amateur Satellite Corporation) recently conducted a conference on amateur-radio computer networking. The purpose was to recognize the innovative work already done by amateurs in the United States and Canada, to explore the possibilities of an integrated amateur packet network, and to set up the framework for orderly growth of a network.

According to Paul L. Rinaldo, chairman of the conference, a two-level approach to network organization is being planned. Local networks centering around VHF (very high frequency) repeater stations will be supplemented by more wide-ranging "backbone" networks. A backbone network is being formed along the eastern seaboard of North America from Norfolk, Virginia, to Montreal, Quebec, with a spur into the Boston, Massachusetts, area. Other centers of activity are Tucson, Arizona; San Francisco, California; and Vancouver, British Columbia.

Most of the testing has been done in the 2-meter and 220-MHz bands at a data rate of 1200 bps (bits per second). AMRAD is seeking a special temporary authorization from the FCC to experiment with higher data rates.

The proceedings of the conference are available for $5 from AMRAD, 1524 Springvale Ave., McLean, VA 22101.

Is "The Last One" The Last One? The Last One, the advertising claims, is "a computer program that writes computer programs" and, further, is "the last program you'll ever need."

The Last One asks the user programming questions and uses the answers to generate a "totally bug-free BASIC program" (to quote the ads). Versions that generate direct machine code and respond to continuous voice input are planned. The Last One was first demonstrated in April 1981 at the West Coast Computer Faire. The vendor, AI Systems, did not start filling orders until November 1981. It claims to have received orders for over 10,000 copies, worth over $6 million (a single copy is $600).

The question now is whether there can be a "last one." AI Systems says that it will require dealers to attend classes on the product and sign an agreement under which they will be fined if they misrepresent The Last One. The vendor admits that an unskilled user could make a mess of a program and that,

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although The Last One produces "error-free code," it may not produce an "error-free program." The vendor further admits that the manual requires considerable study, even for someone well versed in programming.

Hence, The Last One is really a program-generating tool. It does not solve a programming problem because it cannot define what it is that the user wants to do with the machine. Rather, it can, once a user is skilled in its use, substantially reduce coding time.

DEC Introduces Single-Chip LSI-11: Digital Equipment Corporation has made available a single-chip, 40-pin version of its popular 16-bit LSI-11 microprocessor (previously a 4-chip set). Unfortunately, hardware multiply and divide were not included. The device is used on a new single-board computer called the Falcon (or T-11). The board contains 4K bytes of read/write memory and sockets for 4K bytes more, as well as 32K bytes of ROM (or 16K bytes of ROM and 8K bytes of read/write memory). The board also contains two serial ports, 24 parallel I/O lines, a real-time clock, and DEC's standard LSI-11 bus interface.

Intel Enters the Microcomputer Business: It was inevitable—Intel has finally entered the computer systems business. Intel has had all the components but has never integrated them into a complete system. Now it has finally formed an "OEM Microcomputer Systems Division" to market the System 86/330. The complete system is intended to be sold by systems houses dealing in turnkey systems. In other words, Intel supplies everything but the actual application software.

The System 86/330 uses Intel's 8086 16-bit microprocessor in a Multibus housing with 320K bytes of programmable memory, 35M-byte Winchester disk, and 1M-byte floppy-disk drive, all housed in a desktop unit. Options include interfaces to IEEE-488, RS-232C, RS-422, RS-449, Ethernet, and more. Disk operating systems include iRMX-86, CP/M-86, MD-DOS, or Unix. Performance is claimed to cover the range from the DEC PDP-11/23 up to the PDP-11/70 products. Prices to OEMs start at $19,000 each. Watch out, DEC—Intel is coming on strong.

Apple Doings: A. C. "Mike" Markkula, President of Apple Computer Inc., at a recent computer-conference panel discussion, shocked the audience by telling them that Apple Computer will try to "diligently eliminate what is now commonly referred to as 'software protection.'" He stated that "users should be allowed to have as many copies of a software program as necessary to do the application." Ironically, seated at the panel table was a representative from Atari, which has been advertising that it will pursue and legally prosecute anyone caught unlawfully copying its software.

Apple has also announced

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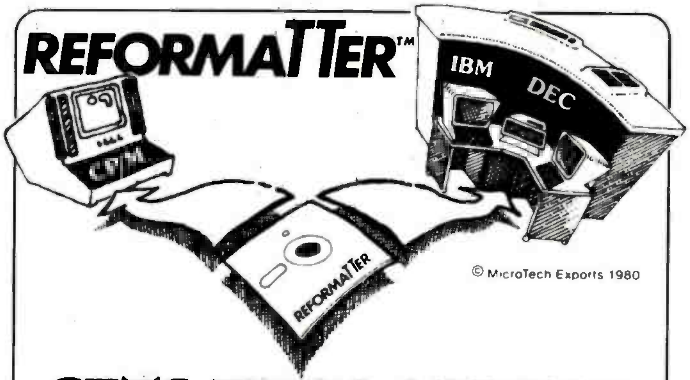

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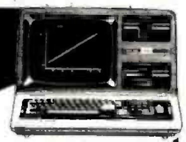

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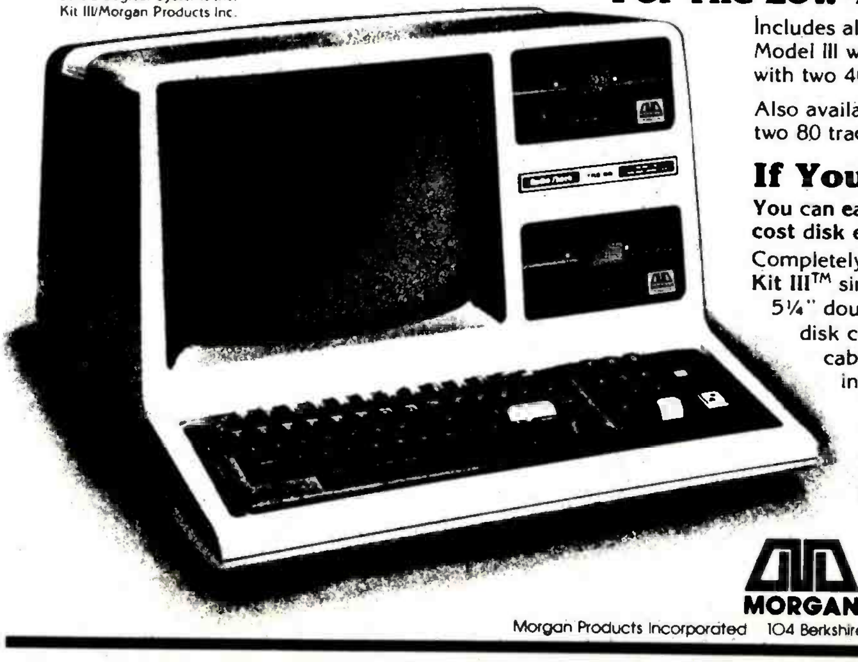

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BYTELINES

a 237% year-end increase in income, to $39.4 million on a 186% increase in sales (to $334.8 million). Expenditures for research and development in fiscal 1981 were $21 million, compared to $7.3 million in 1980.

Radio Shack's Own Information Service: Tandy Corporation, parent company of Radio Shack, has begun to operate its own electronic information database service. The Tandy Videotex System is as yet offered only in Tarrant County, Texas (wherein lies Fort Worth, site of Tandy's headquarters), but it provides subscribers with continuously updated information, on demand, around the clock.

Tandy is inviting providers of specialized information to join the venture, while launching the service with the generalized staple diet familiar to users of other videotex systems: general news from local, regional, and national sources; sports news; special events; business and financial news; and weather forecasts.

During the initial marketing test period, the databases will be maintained on TRS-80 Model II computers using the newly developed TRS-80 Communications Multiplexer.

Tandy is also in the process of installing TRS-80 disk-based computer systems in each of its 4000 company-owned retail stores in the U.S. Each system will do detached processing and then communicate inventory and billing information to the firm's central computers in Fort Worth.

Quote of the Month: "The current personal computer market is about the same size as the total potato-chip market. Next year it will be about half the size of the pet-food market and is fast approaching the total worldwide sales of panty hose." James Finke, President, Commodore International Ltd.

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.

Sol Libes
POB 1192
Mountainside, NJ 07092

BYTE's Bits

Software Authors' Association Formed

The Computer Writers' Association (CWA) has been formed to assist authors in situations involving legal rights, publishing standards, and a host of other difficulties that they confront when trying to sell software. The CWA is working on developing a standardized contract language between software writers and publishers, retaining legal counsel, publishing standards on plagiarism, and printing a regular newsletter. The CWA will offer new authors advice on how to break into the industry. A data bank will be established for members. Regular meetings will be held.

Anyone with resources, organizational skills and ideas should contact the Computer Writers' Association, POB 6312, Minneapolis, MN 55406, (612) 333-6060.

6809 Machine-Code Disassembler

Joseph L. Dubner
PSC Box 103
APO San Francisco, CA 96366

Any 6809-based system can use a resident disassembler whose purpose is to decipher various postbytes, relative addresses, and many op code mnemonics, thus making it easier for the assembly-language programmer to inspect the contents of memory. Although it produces no labels or machine-readable code that can be directly reassembled, the disassembler described here is fast and small (less than 2K bytes). In addition it is both reentrant and relocatable, allowing it to be placed anywhere in RAM (random-access memory) or ROM (read-only memory) while functioning normally. You can program this disassembler into an EPROM (erasable programmable read-only memory) and plug it into any EPROM socket with no change in operation.

A couple of techniques are used to make the program relocatable. First, program counter (PC) relative indexed addressing, rather than immediate addressing, is used to load the data-table starting addresses into an index register. During execution the index register is loaded with the program counter plus or minus the distance to the table, instead of with an absolute address. When relocating the program to another memory area, the program counter component of the address will still point to the table when added to the same offset. The assembler accomplishes the hard part of all of this—calculating the distance from the instruction to the table.

Another technique used for writing relocatable code is to store temporary variables on the stack rather than in absolute memory locations. The 6809, with its two stack pointer registers, makes this easy. First the user-stack register (U) is loaded with the current top-of-stack address. Next the system-stack pointer (S) is adjusted downward to leave room for the variables on the stack. This step is necessary to keep subroutine calls and interrupts from clobbering the variables on the stack. As long as the U register is not changed, variables can be referenced to their position on the U stack workspace simply by using constant offset indexed addressing (i.e., LDA VARIABLE1,U). As much stack space may be reserved as necessary, as long as the computer has RAM available. Of course the user workspace must be returned to the system stack at the completion of the routine.

Since all of the temporary variables are on the stack, and assuming the stack can grow in size as necessary, the program can be interrupted in midexecution and called by another user program without changing any of the temporary variables. This reentrant feature allows the program to appear to service two or more users simultaneously under interrupt control. Of course, when using a disassembler in this mode, multiple output devices should be provided, or the outputs will be mixed and meaningless.

What does all of this cost? Well, like anything else there's the usual trade-off of speed and memory usage. While PC relative and constant offset indexed instructions operate somewhat more slowly than their immediate and extended or direct addressed counterparts, the speed penalty is not noticeable when the program is I/O (input/output) limited, as is this one. And while an additional byte is necessary for the indexed mode's postbyte, the postbye can sometimes include the constant offset, resulting in a saving of 1 byte of memory over extended addressing.

Using these techniques, the disassembler program in listing 1 was written as a subroutine which disassembles one machine-code instruction (1 to 5 bytes) and returns to its calling program—perhaps a monitor or software breakpoint routine. The sample output of listing 2 shows a portion of the disassembler working on itself. The memory address as well as the machine code are shown, followed by the mnemonic of the op code. The mnemonic's operand is deciphered to make offsets, target addresses, and addressing modes more readable.

Text continued on page 362

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Circle 112 on inquiry card.

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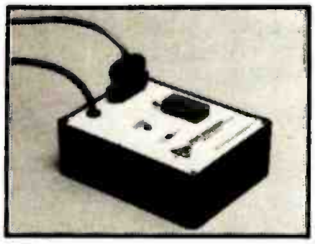
Listing 1: *The 6809 machine-code disassembler program.*

```
                    )*** DISAS9, 6809 MACHINE CODE DISASSEMBLER
                    )* VER 1.1, JUN 1981, J. DUBNER
                    )
                    )* THIS SUBROUTINE DISASSEMBLES 6809 MACHINE CODE TO THE
                    )* CONSOLE.  IT IS COMPLETELY POSITION INDEPENDENT AND
                    )* REQUIRES NO RAM OTHER THAN ABOUT 90 BYTES ON THE STACK.
                    )
                    )* ON ENTRY X:= ADDRESS TO BEGIN DISASSEMBLING, Y:= ADDRESS
                    )* OF MONITOR'S OUTPUT ROUTINE.
                    )* ON EXIT X:= ADDRESS OF NEXT INSTRUCTION TO DISASSEMBLE,
                    )* Y IS RESTORED
                    )
                    )* (+) AND (+) ARE MY PRINTER'S CHARACTERS FOR SQUARE
                    )* BRACKETS (ASCII $5B AND $5D) AND SIGNIFY INDIRECT
                    )* ADDRESSING
                    )
                    )*** USER STACK ORGANIZATION
                    )* TEMPORARY STORAGE
0000                )OUTCH  RMB    2        MONITOR'S OUTPUT CHARACTER ROUTINE
0002                )CURADR RMB    2        CURRENT DISASSEMBLY ADDRESS
0004                )WRKADR RMB    2        WORKING ADDRESS
0006                )LENGTH RMB    1        INSTRUCTION LENGTH
0007                )PAGE   RMB    1        OP CODE PAGE
0008                )OPCD   RMB    1        OP CODE
0009                )POSTB  RMB    1        OP CODE SECOND BYTE
000A                )BYTE1  RMB    1        MSB OF OPERAND
000B                )BYTE2  RMB    1        LSB OF OPERAND
000C                )INDFLG RMB    1        INDIRECT ADDRESSING FLAG
000D                )INDBYT RMB    1        INDEXED ADDRESSING BYTE
000E                )NXTBUF RMB    2        NEXT AVAILABLE BYTE OF OUTPUT BUFFER
                    )
                    )* OUTPUT BUFFER
     0010           )BUFFER EQU    *        START OF OUTPUT BUFFER
0010                )       RMB    4        ADDRESS
0014                )       RMB    1
0015                )       RMB    2        PAGE HEX BYTES
0017                )       RMB    2        OPCODE HEX BYTES
0019                )       RMB    2        POST BYTE HEX BYTES
001B                )       RMB    1
001C                )HEXB   RMB    4        OPERAND HEX BYTES
0020                )       RMB    2
0022                )MNEM   RMB    5        OP CODE MNEMONIC
0027                )       RMB    1
0028                )OPRAND RMB    21       OPERAND PLUS CR, LF, EOL
     003D           )ENDBUF EQU    *        END OF BUFFER
                    )
                    )       ORG    $0
                    )*** INITIALIZATION
0000 34    66       )DISAS  PSHS   A,B,Y,U  PRESERVE REGISTERS
0002 33E8  C3       )       LEAU   OUTCH-ENDBUF,S
0005 1F    34       )       TFR    U,S      SET UP WORKSPACE ON STACK
0007 AF    42       )       STX    CURADR,U SAVE ADDRESS TO DISASSEMBLE
0009 10AF  C4       )       STY    OUTCH,U  SAVE OUTPUT CHAR ROUTINE ADDRESS
                    )
000C 30    46       )       LEAX   LENGTH,U INITIALIZE TEMPORARY VARIABLES
000E C6    0A       )       LDB    #BUFFER-LENGTH
0010 6F    80       )INIT1  CLR    ,X+
0012 5A             )       DECB
0013 26    FB       )       BNE    INIT1
0015 86    20       )       LDA    #$20     INITIALIZE BUFFER WITH BLANKS
0017 C6    2D       )       LDB    #ENDBUF-BUFFER
0019 A7    80       )INIT2  STA    ,X+
001B 5A             )       DECB
001C 26    FB       )       BNE    INIT2
001E AE    42       )       LDX    CURADR,U INITIALIZE WORKING ADDRESS
0020 AF    44       )       STX    WRKADR,U
0022 6C    46       )       INC    LENGTH,U INSTRUCTION LENGTH AT LEAST 1 BYTE
                    )
                    )*** MAIN PROCEDURE
0024 E6    80       )       LDB    ,X+      GET FIRST BYTE OF MACHINE CODE
0026 C1    10       )       CMPB   #$10     PAGE 1?
0028 27    04       )       BEQ    MAIN1    YES
002A C1    11       )       CMPB   #$11     NO, PAGE 2?
002C 26    06       )       BNE    MAIN2    NO, MUST BE OP CODE
                    )
002E E7    47       )MAIN1  STB    PAGE,U   SAVE PAGE
0030 6C    46       )       INC    LENGTH,U LENGTH AT LEAST 2 BYTES
0032 E6    80       )       LDB    ,X+      GET OPCODE
```

Listing 1 continued on page 344

Circle 43 on inquiry card.

Model 953A EPROM PROGRAMMER



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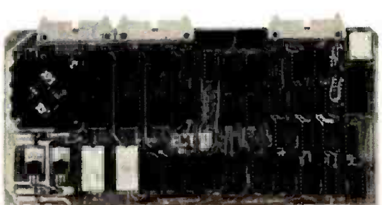

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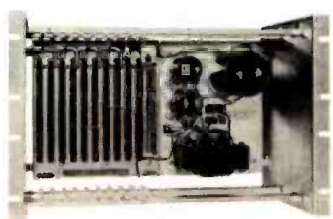

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Listing 1 continued:

```
                        >
0034 AF     44          >MAIN2   STX     WRKADR,U  SAVE WORKING ADDRESS
0036 E7     48          >        STB     OPCD,U    SAVE OPCODE
0038 C1     80          >        CMPB    #$80      OPCODES $80-FF?
003A 24     08          >        BHS     MAIN3     YES, CONVERT TO $40-4F
003C C1     40          >        CMPB    #$40      OPCODES $40-7F?
003E 25     08          >        BLO     MAIN4     NO
0040 C4     0F          >        ANDB    #$0F      YES, CONVERT TO $00-0F
0042 20     04          >        BRA     MAIN4
                        >
0044 C4     0F          >MAIN3   ANDB    #$0F      CONVERT TO $40-4F
0046 CA     40          >        ORB     #$40
                        >
0048 86     04          >MAIN4   LDA     #4        MULTIPLY BY 4 TO CALCULATE ADDRESS
004A 3D                 >        MUL                 OF ENTRY IN MNEMONIC TABLE
004B 30ED   051C        >        LEAX    MNTAB,PC
004F 30     8B          >        LEAX    D,X       X POINTS TO ENTRY IN TABLE
0051 31C8   22          >        LEAY    MNEM,U    Y POINTS TO SPACE IN BUFFER
0054 C6     04          >        LDB     #4
0056 A6     80          >MAIN5   LDA     ,X+       TRANSFER OPCODE MNEMONIC FROM TABLE
0058 A7     A0          >        STA     ,Y+         INTO BUFFER
005A 5A                 >        DECB
005B 26     F9          >        BNE     MAIN5
                        >
005D 30C8   28          >        LEAX    OPRAND,U  POINT TO OPERAND POSITION IN BUFFER
0060 AF     4E          >        STX     NXTBUF,U
                        >
0062 A6C8   22          >        LDA     MNEM,U    GET FIRST CHAR OR MNEMONIC
0065 81     2A          >        CMPA    #'*       ILLEGAL OPCODE?
0067 1027   02B7        >        LBEQ    ILEGOP    YES
                        >
                        >* SELECT APPLICABLE PROCESSING ROUTINES
006B A6     48          >        LDA     OPCD,U
006D 81     C0          >        CMPA    #$C0
006F 1024   0247        >        LBHS    OPC0
```

Listing 1 continued on page 346

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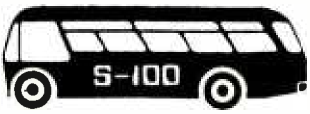

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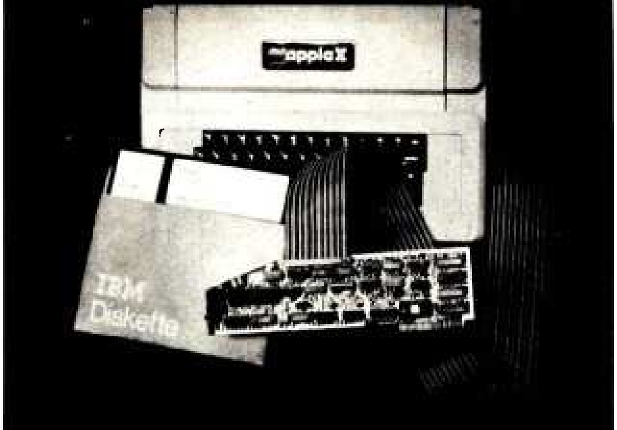

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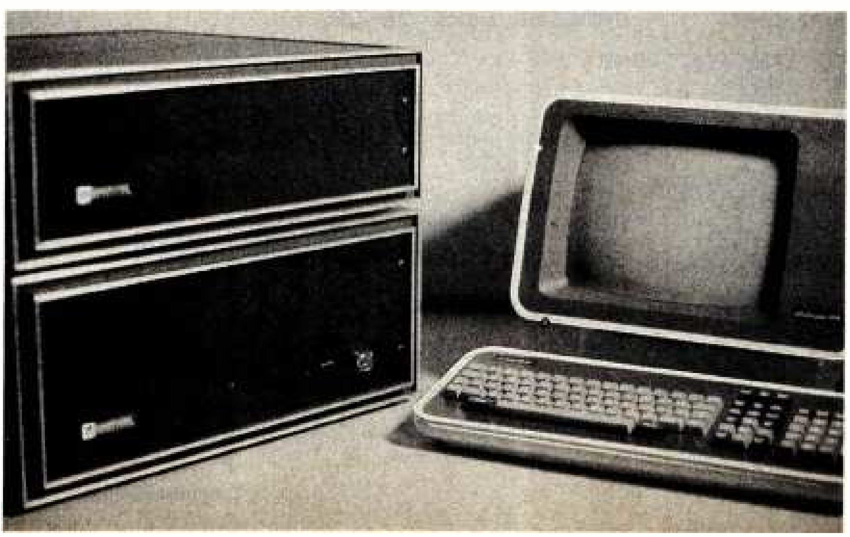

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Listing 1 continued:

```
0073 81   80    >         CMPA    #$80
0075 1024 0182  >         LBHS    OP80
0079 81   40    >         CMPA    #$40
007B 24   12    >         BHS     OP00
007D 81   30    >         CMPA    #$30
007F 1024 00F5  >         LBHS    OP30
0083 81   20    >         CMPA    #$20
0085 1024 00BD  >         LBHS    OP20
0089 81   10    >         CMPA    #$10
008B 24   3C    >         BHS     OP10
008D 20   00    >         BRA     OP00
                >
                >*** OPCODES 00-0F AND 40-7F
                >* TRAP ILLEGAL OPCODES
008F 6D   47    >OP00     TST     PAGE,U     MUST BE PAGE 0
0091 26   08    >         BNE     OP01
0093 81   4E    >         CMPA    #$4E       $4E AND $5E NOT VALID
0095 27   04    >         BEQ     OP01
0097 81   5E    >         CMPA    #$5E
0099 26   03    >         BNE     OP02
009B 16   0284  >OP01     LBRA    ILEGOP     ILLEGAL OPCODE EXIT
                >
                >* REGISTER ADDRESSING
009E 84   F0    >OP02     ANDA    #$F0
00A0 C6   41    >         LDB     #'A
00A2 81   40    >         CMPA    #$40       A-REG?
00A4 27   06    >         BEQ     OP03       YES
00A6 81   50    >         CMPA    #$50       B-REG?
00A8 26   07    >         BNE     OP04       NO
00AA C6   42    >         LDB     #'B        YES
00AC E7C8 25    >OP03     STB     MNEM+3,U   PUT REGISTER INTO MNEMONIC
00AF 20   15    >         BRA     OP07
                >
                >* INDEXED ADDRESSING
00B1 81   60    >OP04     CMPA    #$60
00B3 26   05    >         BNE     OP05
00B5 17   0285  >         LBSR    INDEX      PROCESS INDEXED MODE
00B8 20   0C    >         BRA     OP07
                >
                >* EXTENDED ADDRESSING
00BA 81   70    >OP05     CMPA    #$70
00BC 26   05    >         BNE     OP06
00BE 17   03C1  >         LBSR    EXTEND     PROCESS EXTENDED MODE
00C1 20   03    >         BRA     OP07
                >
                >* DIRECT ADDRESSING
00C3 17   03AE  >OP06     LBSR    DIRECT     PROCESS DIRECT ADDRESSING MODE
00C6 16   041B  >OP07     LBRA    FINISH     FINISH UP
                >
                >*** OPCODES 10-1F
                >* TRAP ILLEGAL OPCODES
00C9 E6   47    >OP10     LDB     PAGE,U     MUST BE PAGE 0
00CB 27   03    >         BEQ     OP12
00CD 16   0252  >OP11     LBRA    ILEGOP
                >
                >* PROCESS LONG BRANCHES
00D0 81   16    >OP12     CMPA    #$16
00D2 27   04    >         BEQ     OP13
00D4 81   17    >         CMPA    #$17
00D6 26   03    >         BNE     OP14
00D8 16   0080  >OP13     LBRA    OP23       PROCESS LIKE 20-2F
                >
                >* PROCESS CC INSTRUCTIONS
00DB 81   1A    >OP14     CMPA    #$1A
00DD 27   09    >         BEQ     OP15
00DF 81   1C    >         CMPA    #$1C
00E1 26   10    >         BNE     OP17
00E3 86   43    >         LDA     #'C        FIX 'ANDCC'
00E5 A7C8 26    >         STA     MNEM+4,U
00E8 86   23    >OP15     LDA     #'#
00EA 17   03F0  >         LBSR    PUTCH      PRINT AS IMMEDIATE MODE
00ED 17   0384  >         LBSR    DIRECT     PROCESS LIKE DIRECT ADDRESSING
00F0 16   03F1  >OP16     LBRA    FINISH
                >
                >* PROCESS REGISTER TRANSFER INSTRUCTIONS
00F3 81   1E    >OP17     CMPA    #$1E
00F5 25   F9    >         BLO     OP16       PROCESS REMAINING 1-BYTE INSTRUCTIONS
00F7 6C   46    >         INC     LENGTH,U
00F9 E6D8 04    >         LDB     ↑WRKADR,U← GET POST BYTE
00FC E7   4A    >         STB     BYTE1,U
00FE C4   88    >         ANDB    #$88       CHECK BOTH REGISTERS SAME SIZE
```

Listing 1 continued on page 348

Listing 1 continued:

```
0100 27    04    >        BEQ    OP18
0102 C1    88    >        CMPB   #$88
0104 26    C7    >        BNE    OP11        ILLEGAL OPCODE IF NOT SAME
                 >
0106 E6    4A    >OP18    LDB    BYTE1,U
0108 54          >        LSRB               SHIFT IN SOURCE NIBBLE
0109 54          >        LSRB
010A 54          >        LSRB
010B 54          >        LSRB
010C 8D    13    >        BSR    REG         GET SOURCE REGISTER
010E 81    2A    >        CMPA   #'*         CHECK FOR INVALID REGISTER
0110 27    BB    >        BEQ    OP11
0112 86    2C    >        LDA    #',         PUT COMMA IN BUFFER
0114 17    03C6  >        LBSR   PUTCH
0117 E6    4A    >        LDB    BYTE1,U
0119 8D    06    >        BSR    REG         GET DESTINATION REGISTER
011B 81    2A    >        CMPA   #'*         CHECK FOR INVALID REGISTER
011D 27    AE    >        BEQ    OP11
011F 20    CF    >        BRA    OP16
                 >
0121 C4    0F    >REG     ANDB   #$0F        MASK OFF HIGH NIBBLE
0123 30ED  042C  >        LEAX   REGTAB,PC
0127 A6    85    >        LDA    B,X         GET REGISTER NAME FROM TABLE
0129 17    03B1  >        LBSR   PUTCH
012C C1    05    >        CMPB   #$05
012E 26    04    >        BNE    REG1
0130 86    43    >        LDA    #'C         FIX 'PC'
0132 20    0E    >        BRA    REG3
0134 C1    0A    >REG1    CMPB   #$0A
0136 26    04    >        BNE    REG2
0138 86    43    >        LDA    #'C         FIX 'CC'
013A 20    06    >        BRA    REG3
013C C1    0B    >REG2    CMPB   #$0B
013E 26    05    >        BNE    REG4
0140 86    50    >        LDA    #'P         FIX 'DP'
0142 17    0398  >REG3    LBSR   PUTCH
0145 39          >REG4    RTS
                 >
                 >*** OPCODES 20-2F
                 >* TRAP ILLEGAL OPCODES
0146 E6    47    >OP20    LDB    PAGE,U
0148 C1    11    >        CMPB   #$11        MUST BE PAGE 0 OR 1
014A 27    08    >        BEQ    OP21
014C 81    20    >        CMPA   #$20        'BRA' MUST BE PAGE 0
014E 26    07    >        BNE    OP22
0150 C1    00    >        CMPB   #$00
0152 27    03    >        BEQ    OP22
0154 16    01CB  >OP21    LBRA   ILEGOP
                 >
                 >* PROCESS LONG BRANCHES
0157 C1    10    >OP22    CMPB   #$10        LONG BRANCHES ON PAGE 1
0159 26    18    >        BNE    OP26
015B C6    03    >OP23    LDB    #3          CHANGE MNEMONIC TO LONG BRANCH FORM
015D 30C8  24    >        LEAX   MNEM+2,U
0160 A6    80    >OP24    LDA    ,X+
0162 A7    84    >        STA    X
0164 30    1E    >        LEAX   -2,X
0166 5A          >        DECB
0167 26    F7    >        BNE    OP24
0169 86    4C    >        LDA    #'L
```

Listing 1 continued on page 350

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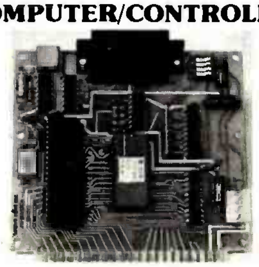

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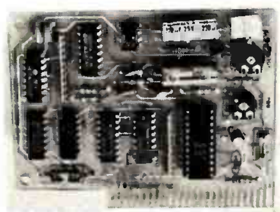

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MICRO MINT

Listing 1 continued:

```
016B A7     01      >         STA     1,X
016D 17     0342    >         LBSR    REL16     PROCESS RELATIVE ADDRESS
0170 16     0371    >OP25     LBRA    FINISH
                    >
                    >* PROCESS SHORT BRANCHES
0173 17     031E    >OP26     LBSR    REL8
0176 20     F8      >         BRA     OP25
                    >
                    >*** OPCODES 30-3F
                    >* TRAP ILLEGAL OPCODES
0178 E6     47      >OP30     LDB     PAGE,U
017A 81     3F      >         CMPA    #$3F      MUST BE PAGE 0 EXCEPT 'SWI'
017C 27     67      >         BEQ     OP301
017E C1     00      >         CMPB    #0
0180 27     03      >         BEQ     OP32
0182 16     019D    >         LBRA    ILEGOP
                    >
                    >* PROCESS 'LEA' INSTRUCTIONS
0185 81     33      >OP32     CMPA    #$33
0187 22     06      >         BHI     OP34
0189 17     01B1    >         LBSR    INDEX     CAN ONLY BE INDEXED MODE
018C 16     0355    >OP33     LBRA    FINISH
                    >
                    >* PROCESS STACK INSTRUCTIONS
018F 81     3C      >OP34     CMPA    #$3C      CHECK FOR 'CWAI'
0191 27     5D      >         BEQ     OP302
0193 81     37      >         CMPA    #$37
0195 22     F5      >         BHI     OP33      PROCESS REMAINING 1-BYTE INSTRUCTIONS
0197 6C     46      >         INC     LENGTH,U
0199 A6D8   04      >         LDA     ↑WRKADR,U← GET POSTBYTE
019C A7     4A      >         STA     BYTE1,U
019E A7     4B      >         STA     BYTE2,U   TEMPORARY STORAGE
                    >
01A0 5F             >         CLRB
01A1 68     4B      >OP35     LSL     BYTE2,U   SHIFT BIT INTO CARRY
01A3 24     33      >         BCC     OP300     NO REGISTER IF BIT NOT SET
01A5 30ED   03BA    >         LEAX    STKTAB,PC
01A9 A6     85      >         LDA     B,X       GET REGISTER FROM TABLE
                    >
01AB 81     53      >         CMPA    #'S       DECIDE ON 'U' OR 'S' FOR STACK
01AD 26     07      >         BNE     OP36
01AF A1C8   25      >         CMPA    MNEM+3,U  COMPARE TO LAST CHARACTER
01B2 26     02      >         BNE     OP36        OF MNEMONIC
01B4 86     55      >         LDA     #'U       REPLACE REGISTER CHARACTER
                    >
01B6 17     0324    >OP36     LBSR    PUTCH
01B9 81     50      >         CMPA    #'P       FIX 'PC' AND 'CC'
01BB 27     04      >         BEQ     OP37
01BD 81     43      >         CMPA    #'C
01BF 26     07      >         BNE     OP38
01C1 86     43      >OP37     LDA     #'C
01C3 17     0317    >         LBSR    PUTCH
01C6 20     0B      >         BRA     OP39
                    >
01C8 81     44      >OP38     CMPA    #'D       FIX 'DP'
01CA 26     07      >         BNE     OP39
01CC 86     50      >         LDA     #'P
01CE 17     030C    >         LBSR    PUTCH
01D1 20     00      >         BRA     OP39
                    >
01D3 86     2C      >OP39     LDA     #',       PUT COMMA IN BUFFER
01D5 17     0305    >         LBSR    PUTCH
01D8 5C             >OP300    INCB
01D9 C1     08      >         CMPB    #8
01DB 26     C4      >         BNE     OP35
01DD AE     4E      >         LDX     NXTBUF,U  REMOVE LAST COMMA FROM BUFFER
01DF 30     1F      >         LEAX    -1,X
01E1 AF     4E      >         STX     NXTBUF,U
01E3 20     A7      >         BRA     OP33
                    >
                    >* PROCESS 'SWI'
01E5 C1     00      >OP301    CMPB    #0
01E7 27     A3      >         BEQ     OP33      DONE IF PAGE 0
01E9 CB     21      >         ADDB    #$21      ADD $21 TO CONVERT PAGE INTO
01EB E7C8   25      >         STB     MNEM+3,U    ASCII CHARACTER
01EE 20     9C      >         BRA     OP33
                    >
                    >* PROCESS 'CWAI'
01F0 86     23      >OP302    LDA     #'#       PRINT AS IMMEDIATE MODE
01F2 17     02E8    >         LBSR    PUTCH
01F5 17     027C    >         LBSR    DIRECT    PROCESS LIKE DIRECT
01F8 16     02E9    >         LBRA    FINISH
```

Listing 1 continued on page 352

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Circle 253 on inquiry card.

Listing 1 continued:

```
                    >
                    >*** OPCODES 80-BF
                    >* PROCESS 'BSR' AS SPECIAL CASE
01FB E6   47        >OP80   LDB    PAGE,U
01FD 81   8D        >       CMPA   #$8D
01FF 26   11        >       BNE    OP81
0201 C1   00        >       CMPB   #$00      MUST BE ON PAGE 0
0203 1026 011B      >       LBNE   ILEGOP
0207 86   42        >       LDA    #'B       CHANGE 'JSR' TO 'BSR'
0209 A7C8 22        >       STA    MNEM,U
020C 17   0285      >       LBSR   REL8      PROCESS LIKE SHORT BRANCH
020F 16   02D2      >       LBRA   FINISH
                    >
                    >* GET MNEMONIC AS REQUIRED BY PAGE
0212 84   8F        >OP81   ANDA   #$8F
0214 81   83        >       CMPA   #$83      FIX SUBD/CMPD/CMPU
0216 26   20        >       BNE    OP83
0218 C1   00        >       CMPB   #$00
021A 27   4C        >       BEQ    OP800
021C 86   43        >       LDA    #'C
021E A7C8 22        >       STA    MNEM,U
0221 86   4D        >       LDA    #'M
0223 A7C8 23        >       STA    MNEM+1,U
0226 86   50        >       LDA    #'P
0228 A7C8 24        >       STA    MNEM+2,U
022B 86   44        >       LDA    #'D
022D C1   10        >       CMPB   #$10
022F 27   02        >       BEQ    OP82
0231 86   55        >       LDA    #'U
0233 A7C8 25        >OP82   STA    MNEM+3,U
0236 20   30        >       BRA    OP800
                    >
0238 81   8C        >OP83   CMPA   #$8C      FIX CMPX/CMPY/CMPS
023A 26   11        >       BNE    OP85
023C C1   00        >       CMPB   #$00
023E 27   28        >       BEQ    OP800
0240 86   59        >       LDA    #'Y
0242 C1   10        >       CMPB   #$10
0244 27   02        >       BEQ    OP84
0246 86   53        >       LDA    #'S
0248 A7C8 25        >OP84   STA    MNEM+3,U
024B 20   1B        >       BRA    OP800
                    >
024D 81   8E        >OP85   CMPA   #$8E      FIX LDX/LDY AND STX/STY
024F 25   11        >       BLO    OP86
0251 C1   11        >       CMPB   #$11      CANNOT BE PAGE 2
0253 1027 00CB      >       LBEQ   ILEGOP
0257 C1   00        >       CMPB   #$00
0259 27   0D        >       BEQ    OP800
025B 86   59        >       LDA    #'Y
025D A7C8 24        >       STA    MNEM+2,U
0260 20   06        >       BRA    OP800
                    >
0262 C1   00        >OP86   CMPB   #$00      ALL REMAINING OPCODES MUST BE
0264 1026 00BA      >       LBNE   ILEGOP      ON PAGE 0
                    >
                    >*** JOINTLY PROCESS 80-BF AND C0-FF
                    >* TRAP ILLEGAL OPCODES
0268 A6   48        >OP800  LDA    OPCD,U
026A 84   BF        >       ANDA   #$BF
026C 81   87        >       CMPA   #$87      STORE OPCODES NOT ALLOWED IN
026E 27   08        >       BEQ    OP801       IMMEDIATE MODE
0270 81   8D        >       CMPA   #$8D
0272 27   04        >       BEQ    OP801
0274 81   8F        >       CMPA   #$8F
0276 26   03        >       BNE    OP802
0278 16   00A7      >OP801  LBRA   ILEGOP
                    >
                    >* PROCESS EXTENDED ADDRESSING
027B A6   48        >OP802  LDA    OPCD,U
027D 84   30        >       ANDA   #$30
027F 81   30        >       CMPA   #$30
0281 26   06        >       BNE    OP803
0283 17   01FC      >       LBSR   EXTEND
0286 16   025B      >       LBRA   FINISH
                    >
                    >* PROCESS INDEXED ADDRESSING
0289 81   20        >OP803  CMPA   #$20
028B 26   06        >       BNE    OP804
028D 17   00AD      >       LBSR   INDEX
0290 16   0251      >       LBRA   FINISH
                    >
```

Listing 1 continued on page 354

Circle 297 on inquiry card.

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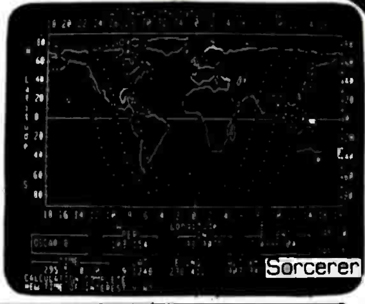

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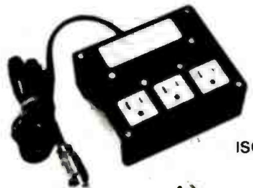

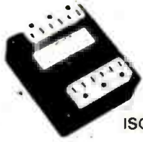

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Circle 214 on inquiry card.

Listing 1 continued:

```
                    >* PROCESS DIRECT ADDRESSING
0293 81    10       >OP804   CMPA    #$10
0295 26    06       >        BNE     OP805
0297 17    01DA     >        LBSR    DIRECT
029A 16    0247     >        LBRA    FINISH
                    >
                    >* PROCESS IMMEDIATE ADDRESSING
029D 86    23       >OP805   LDA     #'#
029F 17    023B     >        LBSR    PUTCH
02A2 A6    48       >        LDA     OPCD,U
02A4 84    8F       >        ANDA    #$8F
02A6 81    83       >        CMPA    #$83     OPCODES 83 AND 8C-8F HAVE 2-BYTE
                                                OPERANDS
02A8 27    0A       >        BEQ     OP806
02AA 81    8C       >        CMPA    #$8C
02AC 24    06       >        BHS     OP806
02AE 17    01C3     >        LBSR    DIRECT   PROCESS 1-BYTE OPERAND LIKE
02B1 16    0230     >        LBRA    FINISH     DIRECT
02B4 17    01CB     >OP806   LBSR    EXTEND   PROCESS 2-BYTE OPERAND LIKE
02B7 16    022A     >        LBRA    FINISH     EXTENDED
                    >
                    >*** OPCODES C0-CF
                    >* CHANGE MNEMONICS AND TRAP ILLEGAL OPCODES
02BA E6    47       >OPC0    LDB     PAGE,U
02BC 84    CF       >        ANDA    #$CF
02BE 81    CB       >        CMPA    #$CB     CHANGE 'A' TO 'B' IN MNEMONICS
02C0 22    29       >        BHI     OPC3
02C2 81    C3       >        CMPA    #$C3     FIX 'ADDD'
02C4 26    12       >        BNE     OPC0A
02C6 86    41       >        LDA     #'A
02C8 A7C8  22       >        STA     MNEM,U
02CB 86    44       >        LDA     #'D
02CD A7C8  23       >        STA     MNEM+1,U
02D0 A7C8  24       >        STA     MNEM+2,U
02D3 A7C8  25       >        STA     MNEM+3,U
02D6 20    0D       >        BRA     OPC2
```

Listing 1 continued on page 356

Listing 1 continued:

```
                   >
02D8 30C8  24      >OPC0A    LEAX    MNEM+2,U
02DB A6    84      >         LDA     X
02DD 81    41      >         CMPA    #'A
02DF 27    02      >         BEQ     OPC1
02E1 30    01      >         LEAX    1,X
02E3 6C    84      >OPC1     INC     X          CHANGE 'A' TO 'B' IN MNEMONIC
                   >
02E5 C1    00      >OPC2     CMPB    #$00       MUST BE PAGE 0
02E7 27    36      >         BEQ     OPC8
02E9 20    37      >         BRA     ILEGOP
                   >
02EB 81    CD      >OPC3     CMPA    #$CD
02ED 22    21      >         BHI     OPC6
02EF 26    16      >         BNE     OPC5
02F1 86    53      >         LDA     #'S        FIX 'STD'
02F3 A7C8  22      >         STA     MNEM,U
02F6 86    54      >         LDA     #'T
02F8 A7C8  23      >OPC4     STA     MNEM+1,U
02FB 86    44      >         LDA     #'D
02FD A7C8  24      >         STA     MNEM+2,U
0300 86    20      >         LDA     #$20
0302 A7C8  25      >         STA     MNEM+3,U
0305 20    DE      >         BRA     OPC2       CHECK FOR PAGE 0
                   >
0307 86    4C      >OPC5     LDA     #'L        FIX 'LDD'
0309 A7C8  22      >         STA     MNEM,U
030C 86    44      >         LDA     #'D
030E 20    E8      >         BRA     OPC4
                   >
0310 C1    11      >OPC6     CMPB    #$11       PAGE 2 NOT ALLOWED FOR CE-CF
0312 27    0E      >         BEQ     ILEGOP
0314 86    55      >         LDA     #'U
0316 C1    00      >         CMPB    #$00       FIX LDU/LDS AND STU/STS
0318 27    02      >         BEQ     OPC7
031A 86    53      >         LDA     #'S
031C A7C8  24      >OPC7     STA     MNEM+2,U
031F 16    FF46    >OPC8     LBRA    OP800      PROCESS LIKE 80-BF
                   >
                   >*** ILLEGAL OPCODE ROUTINE
0322 30ED  0249    >ILEGOP   LEAX    MNILEG,PC  POINT TO '*** '
0326 31C8  22      >         LEAY    MNEM,U
0329 C6    04      >         LDB     #4
032B A6    80      >ILOP1    LDA     ,X+        STORE '***' IN OPCODE MNEMONIC
032D A7    A0      >         STA     ,Y+
032F 5A            >         DECB
0330 26    F9      >         BNE     ILOP1
0332 30    21      >         LEAX    1,Y        POINT TO NEXT AVAILABLE POSITION IN
0334 AF    4E      >         STX     NXTBUF,U     BUFFER AFTER OPCODE MNEMONIC
0336 86    01      >         LDA     #1         SET INSTRUCTION LENGTH TO 1
0338 A7    46      >         STA     LENGTH,U
033A 16    01A7    >         LBRA    FINISH     CONTINUE
                   >
                   >*** PROCESS INDEXED ADDRESSING MODE
033D 6C    46      >INDEX    INC     LENGTH,U
033F AE    44      >         LDX     WRKADR,U   BUMP WORKING ADDRESS POINTER
0341 E6    80      >         LDB     ,X+          AND GET POSTBYTE
0343 AF    44      >         STX     WRKADR,U
0345 E7    4D      >         STB     INDBYT,U
0347 E7    4A      >         STB     BYTE1,U
                   >
                   >* CHECK FOR INDIRECT ADDRESSING
0349 C4    90      >         ANDB    #$90
034B C1    90      >         CMPB    #$90       BITS 4 AND 7 SET?
034D 26    07      >         BNE     IND1       NO, NOT INDIRECT
034F 63    4C      >         COM     INDFLG,U   YES, SET FLAG
0351 86    5B      >         LDA     #'+        OUTPUT '+'
0353 17    0187    >         LBSR    PUTCH
                   >
                   >* AUTO INCREMENT/DECREMENT ADDRESSING
0356 E6    4D      >IND1     LDB     INDBYT,U
0358 C4    8F      >         ANDB    #$8F       MASK OFF REGISTER AND INDIRECT BITS
035A C1    80      >         CMPB    #$80       AUTO INC/DEC?
035C 25    39      >         BLO     IND5       NO
035E C1    83      >         CMPB    #$83
0360 22    35      >         BHI     IND5       NO
0362 A6    4D      >         LDA     INDBYT,U   GET POSTBYTE
0364 84    11      >         ANDA    #$11       CHECK FOR INC/DEC BY 1 AND
0366 81    10      >         CMPA    #$10         INDIRECT ADDRESSING
0368 27    B8      >         BEQ     ILEGOP     ILLEGAL OPERATION
                   >
036A 86    2C      >         LDA     #',        PUT COMMA IN BUFFER
036C 17    01EE    >         LBSR    PUTCH
036F C1    81      >         CMPB    #$81       AUTO INC?
0371 22    12      >         BHI     IND3       NO
```

Listing 1 continued:

```
0373 17    00D8    >          LBSR   GETREG    PUT REGISTER INTO BUFFER
0376 86    2B      >          LDA    #'+
0378 17    0162    >          LBSR   PUTCH
037B C1    81      >          CMPB   #$81      INCREMENT BY 2?
037D 26    03      >          BNE    IND2      NO
037F 17    015B    >          LBSR   PUTCH
0382 16    00E6    > IND2     LBRA   INDEND
                   >
0385 86    2D      > IND3     LDA    #'-       AUTO DEC
0387 17    0153    >          LBSR   PUTCH
038A C1    83      >          CMPB   #$83      DECREMENT BY 2?
038C 26    03      >          BNE    IND4      NO
038E 17    014C    >          LBSR   PUTCH
0391 17    00BA    > IND4     LBSR   GETREG    PUT REGISTER INTO BUFFER
0394 16    00D4    >          LBRA   INDEND
                   >
                   >* ACCUMULATOR OFFSET
0397 86    41      > IND5     LDA    #'A
0399 C1    86      >          CMPB   #$86
039B 27    0C      >          BEQ    IND6
039D 86    42      >          LDA    #'B
039F C1    85      >          CMPB   #$85
03A1 27    06      >          BEQ    IND6
03A3 86    44      >          LDA    #'D
03A5 C1    8B      >          CMPB   #$8B
03A7 26    0E      >          BNE    IND7
                   >
03A9 17    0131    > IND6     LBSR   PUTCH     OUTPUT OFFSET REGISTER
03AC 86    2C      >          LDA    #',
03AE 17    012C    >          LBSR   PUTCH
03B1 17    009A    >          LBSR   GETREG    OUTPUT INDEX REGISTER
03B4 16    00B4    >          LBRA   INDEND
                   >
                   >* CONSTANT OFFSET FROM PC
03B7 C1    8D      > IND7     CMPB   #$8D
03B9 27    04      >          BEQ    IND8
03BB C1    8C      >          CMPB   #$8C
03BD 26    24      >          BNE    IND10
03BF A6    4D      > IND8     LDA    INDBYT,U  GET POSTBYTE
03C1 A7    49      >          STA    POSTB,U
03C3 0C    06      >          INC    LENGTH    ACCOUNT FOR IT
                   >
03C5 C1    8D      >          CMPB   #$8D
03C7 27    15      >          BEQ    IND9
03C9 17    00C8    >          LBSR   REL8      PROCESS 8-BIT OFFSET
03CC 86    2C      > IND8A    LDA    #',       OUTPUT ',PC'
03CE 17    010C    >          LBSR   PUTCH
03D1 86    50      >          LDA    #'P
03D3 17    0107    >          LBSR   PUTCH
03D6 86    43      >          LDA    #'C
03D8 17    0102    >          LBSR   PUTCH
03DB 16    008D    >          LBRA   INDEND
                   >
03DE 17    00D1    > IND9     LBSR   REL16     PROCESS 16-BIT OFFSET
03E1 20    E9      >          BRA    IND8A
                   >
                   >* CONSTANT OFFSET (ZERO)
03E3 C1    84      > IND10    CMPB   #$84
03E5 26    0D      >          BNE    IND12
03E7 4F            >          CLRA
03E8 17    00DB    > IND11    LBSR   PUT2H
03EB 86    2C      >          LDA    #',       ',R'
03ED 17    00ED    >          LBSR   PUTCH
03F0 8D    5C      >          BSR    GETREG
03F2 20    77      >          BRA    INDEND
                   >
                   >* 5-BIT OFFSET
03F4 C5    80      > IND12    BITB   #$80      5-BIT OFFSET IF BIT 7=0
03F6 26    18      >          BNE    IND13
03F8 6D    4C      >          TST    INDFLG,U  INDIRECT ADDRESSING NOT ALLOWED
03FA 26    4F      >          BNE    IND18
03FC E6    4D      >          LDB    INDBYT,U
03FE C4    1F      >          ANDB   #$1F      GET OFFSET BITS
0400 C5    10      >          BITB   #$10      TEST SIGN BIT
0402 27    08      >          BEQ    IND12A    POSITIVE
0404 86    2D      >          LDA    #'-
0406 17    00D4    >          LBSR   PUTCH
0409 CA    E0      >          ORB    #$E0      SET HIGH ORDER BITS
040B 50            >          NEGB             CONVERT TO POSITIVE NUMBER
040C 1F    98      > IND12A   TFR    B,A
040E 20    D8      >          BRA    IND11
                   >
```

Listing 1 continued on page 358

Listing 1 continued:

```
                   >* 8-BIT OFFSET
0410 A6   4D       >IND13  LDA    INDBYT,U GET POSTBYTE
0412 A7   49       >       STA    POSTB,U
0414 C1   88       >       CMPB   #$88
0416 26   13       >       BNE    IND15
                   >
0418 6C   46       >       INC    LENGTH,U
041A E6D8 04       >       LDB    ↑WRKADR,U← GET OFFSET BYTE
041D E7   4A       >       STB    BYTE1,U
041F 2A   06       >       BPL    IND14    TEST SIGN OF OFFSET
0421 86   2D       >       LDA    #'-
0423 17   00B7     >       LBSR   PUTCH
0426 50            >       NEGB            CONVERT TO POSITIVE NUMBER
0427 1F   98       >IND14  TFR    B,A
0429 20   BD       >       BRA    IND11
                   >
                   >* 16-BIT OFFSET
042B C1   89       >IND15  CMPB   #$89
042D 26   10       >       BNE    IND16
042F 6C   46       >       INC    LENGTH,U
0431 6C   46       >       INC    LENGTH,U
0433 ECD8 04       >       LDD    ↑WRKADR,U←
0436 ED   4A       >       STD    BYTE1,U
0438 17   008B     >       LBSR   PUT2H
043B 1F   98       >       TFR    B,A
043D 20   A9       >       BRA    IND11
                   >
                   >* EXTENDED INDIRECT
043F A6   4D       >IND16  LDA    INDBYT,U
0441 81   9F       >       CMPA   #$9F
0443 26   06       >       BNE    IND18
0445 A7   49       >       STA    POSTB,U
0447 8D   39       >       BSR    EXTEND   PROCESS LIKE ENTENDED
0449 20   20       >       BRA    INDEND
                   >
                   >* TRAP ILLEGAL INDEX MODES
044B 16   FED4     >IND18  LBRA   ILEGOP
                   >
                   >* GET INDEX REGISTER
044E 34   04       >GETREG PSHS   B
0450 E6   4D       >       LDB    INDBYT,U GET POSTBYTE
0452 86   58       >       LDA    #'X
0454 C4   60       >       ANDB   #$60
0456 27   0E       >       BEQ    GETR1
0458 86   59       >       LDA    #'Y
045A C1   20       >       CMPB   #$20
045C 27   08       >       BEQ    GETR1
045E 86   55       >       LDA    #'U
0460 C1   40       >       CMPB   #$40
0462 27   02       >       BEQ    GETR1
0464 86   53       >       LDA    #'S
0466 8D   75       >GETR1  BSR    PUTCH    OUTPUT REGISTER
0468 35   04       >       PULS   B
046A 39            >       RTS
                   >
                   >* FINISH UP INDEXED PROCESSING
046B 6D   4C       >INDEND TST    INDFLG,U INDIRECT MODE?
046D 27   04       >       BEQ    INDEN1   NO
046F 86   5D       >       LDA    #'←
0471 8D   6A       >       BSR    PUTCH
0473 39            >INDEN1 RTS
                   >
                   >*** PROCESS DIRECT ADDRESSING MODE
0474 6C   46       >DIRECT INC    LENGTH,U
0476 86   24       >       LDA    #$24     PUT '$' IN BUFFER
0478 8D   63       >       BSR    PUTCH
047A A6D8 04       >       LDA    ↑WRKADR,U← OUTPUT 1-BYTE ADDRESS
047D A7   4A       >       STA    BYTE1,U
047F 8D   45       >       BSR    PUT2H
0481 39            >       RTS
                   >
                   >*** PROCESS EXTENDED ADDRESSING MODE
0482 8D   F0       >EXTEND BSR    DIRECT   OUTPUT FIRST BYTE
0484 6C   46       >       INC    LENGTH,U
0486 6C   45       >       INC    WRKADR+1,U
0488 26   02       >       BNE    EXT1
048A 6C   44       >       INC    WRKADR,U
048C A6D8 04       >EXT1   LDA    ↑WRKADR,U←
048F A7   4B       >       STA    BYTE2,U
0491 8D   33       >       BSR    PUT2H    OUTPUT 2ND BYTE
0493 39            >       RTS
                   >
```

Listing 1 continued:

```
                   >*** PROCESS RELATIVE ADDRESSING MODES
0494 6C    46      >REL8    INC    LENGTH,U
0496 86    28      >        LDA    #'(       PUT '(' INTO BUFFER
0498 8D    43      >        BSR    PUTCH
049A A6D8  04      >        LDA    ↑WRKADR,U← OUTPUT 1-BYTE OFFSET
049D 1F    89      >        TFR    A,B
049F A7    4A      >        STA    BYTE1,U
04A1 1D            >        SEX
04A2 C3    0001    >        ADDD   #1
04A5 E3    44      >REL8A   ADDD   WRKADR,U
04A7 8D    1D      >        BSR    PUT2H     OUTPUT RELATIVE ADDRESS
04A9 1F    98      >        TFR    B,A
04AB 8D    19      >        BSR    PUT2H
04AD 86    29      >        LDA    #')
04AF 8D    2C      >        BSR    PUTCH
04B1 39            >        RTS
                   >
04B2 6C    46      >REL16   INC    LENGTH,U
04B4 6C    46      >        INC    LENGTH,U
04B6 86    28      >        LDA    #'(       PUT '(' INTO BUFFER
04B8 8D    23      >        BSR    PUTCH
04BA ECD8  04      >        LDD    ↑WRKADR,U← OUTPUT 2-BYTE OFFSET
04BD A7    4A      >        STA    BYTE1,U
04BF E7    4B      >        STB    BYTE2,U
04C1 C3    0002    >        ADDD   #2
04C4 20    DF      >        BRA    REL8A
                   >
                   >*** OUTPUT ROUTINES
                   >* PUT 2 HEX CHARACTERS FROM A REG INTO BUFFER
04C6 34    02      >PUT2H   PSHS   A
04C8 8D    05      >        BSR    PUT2HL
04CA 35    02      >        PULS   A
04CC 8D    05      >        BSR    PUT2HR
04CE 39            >        RTS
                   >
04CF 44            >PUT2HL  LSRA             SHIFT LEFT NIBBLE INTO RIGHT
04D0 44            >        LSRA
04D1 44            >        LSRA
04D2 44            >        LSRA
```

Listing 1 continued on page 360

Listing 1 continued:

```
04D3 84    0F       >PUT2HR ANDA   #$F        CONVERT NIBBLE INTO ASCII
04D5 8B    30       >       ADDA   #'0
04D7 81    39       >       CMPA   #'9
04D9 23    02       >       BLS    PUTCH      OUTPUT NIBBLE
04DB 8B    07       >       ADDA   #7
                    >
                    >* PUT ASCII CHARACTER INTO BUFFER AND BUMP BUFFER POINTER
04DD AE    4E       >PUTCH  LDX    NXTBUF,U
04DF A7    80       >       STA    ,X+
04E1 AF    4E       >       STX    NXTBUF,U
04E3 39             >       RTS
                    >
                    >*** END OF JOB ROUTINE
                    >* TERMINATE BUFFER WITH CR-LF
04E4 86    0D       >FINISH LDA    #$0D       CR
04E6 8D    F5       >       BSR    PUTCH
04E8 86    0A       >       LDA    #$0A       LF
04EA 8D    F1       >       BSR    PUTCH
04EC 86    15       >       LDA    #$15       EOL
04EE 8D    ED       >       BSR    PUTCH
                    >
                    >* PUT CURRENT ADDRESS AND OPCODE BYTES INTO BUFFER
04F0 30C8  10       >       LEAX   BUFFER,U
04F3 AF    4E       >       STX    NXTBUF,U
04F5 A6    42       >       LDA    CURADR,U GET MSB OF ADDRESS
04F7 8D    CD       >       BSR    PUT2H
04F9 A6    43       >       LDA    CURADR+1,U LSB
04FB 8D    C9       >       BSR    PUT2H
04FD 86    20       >       LDA    #$20       BLANK
04FF 8D    DC       >       BSR    PUTCH
                    >
0501 A6    46       >       LDA    LENGTH,U PRESERVE INSTRUCTION LENGTH
0503 34    02       >       PSHS   A
0505 A6    47       >       LDA    PAGE,U     OUTPUT PAGE BYTE IF APPLICABLE
0507 27    04       >       BEQ    EOJ1
0509 8D    BB       >       BSR    PUT2H
050B 6A    46       >       DEC    LENGTH,U
050D 30C8  17       >EOJ1   LEAX   BUFFER+7,U
0510 AF    4E       >       STX    NXTBUF,U POINT TO OPCODE
0512 A6    48       >       LDA    OPCD,U     OUTPUT OPCODE
0514 8D    B0       >       BSR    PUT2H
0516 6A    46       >       DEC    LENGTH,U
0518 A6    49       >       LDA    POSTB,U    OUTPUT OPCODE POSTBYTE IF APPLICABLE
051A 27    04       >       BEQ    EOJ2
051C 8D    A8       >       BSR    PUT2H
051E 6A    46       >       DEC    LENGTH,U
                    >
                    >* OUTPUT OPERAND BYTES
0520 30C8  1C       >EOJ2   LEAX   HEXB,U     POINT TO OPERAND FIELD
0523 AF    4E       >       STX    NXTBUF,U
0525 6D    46       >       TST    LENGTH,U
0527 27    0C       >       BEQ    EOJ4
0529 A6    4A       >       LDA    BYTE1,U    OUTPUT MSB OF OPERAND
052B 8D    99       >       BSR    PUT2H
052D 6A    46       >       DEC    LENGTH,U
052F 27    04       >       BEQ    EOJ4
0531 A6    4B       >       LDA    BYTE2,U    OUTPUT LSB
0533 8D    91       >       BSR    PUT2H
                    >
                    >* OUTPUT ENTIRE BUFFER TO CONSOLE
0535 30C8  10       >EOJ4   LEAX   BUFFER,U POINT TO START OF BUFFER
0538 A6    80       >EOJ5   LDA    ,X+
053A 34    52       >       PSHS   A,X,U      SAVE REGISTERS
053C AD    D4       >       JSR    ↑OUTCH,U←  OUTPUT CHARACTER
053E 35    52       >       PULS   A,X,U
0540 81    15       >       CMPA   #$15       EOL?
0542 26    F4       >       BNE    EOJ5
                    >
                    >* SET UP FOR NEXT LINE OF DISASSEMBLY
0544 35    04       >       PULS   B          GET INSTRUCTION LENGTH
0546 1D             >       SEX
0547 E3    42       >       ADDD   CURADR,U CALCULATE START OF NEXT INSTRUCTION
0549 ED    42       >       STD    CURADR,U
                    >
054B AE    42       >       LDX    CURADR,U
054D 32C8  3D       >       LEAS   ENDBUF-OUTCH,U RESTORE STACK
0550 35    66       >       PULS   A,B,Y,U    RESTORE REGISTERS
0552 39             >       RTS               DONE, RETURN TO CALLING ROUTINE
                    >
                    >*** TRANSFER INSTRUCTION REGISTER TABLE
0553 44             >REGTAB FCC    /DXYUSP**ABCD****/
                    >
                    >*** STACK REGISTER TABLE
```

```
0563 50          >STKTAB FCC     /PSYXDBAC/
                 >
                 >*** MNEMONIC TABLE
056B 4E          >MNTAB  FCC     /NEG     /
056F 2A          >MNILEG FCC     /***     /  ILLEGAL OPCODE
0573 2A          >       FCC     /***     /
0577 43          >       FCC     /COM     /
057B 4C          >       FCC     /LSR     /
057F 2A          >       FCC     /***     /
0583 52          >       FCC     /ROR     /
0587 41          >       FCC     /ASR     /
058B 41          >       FCC     /ASL     /
058F 52          >       FCC     /ROL     /
0593 44          >       FCC     /DEC     /
0597 2A          >       FCC     /***     /
059B 49          >       FCC     /INC     /
059F 54          >       FCC     /TST     /
05A3 4A          >       FCC     /JMP     /
05A7 43          >       FCC     /CLR     /
05AB 2A          >       FCC     /***     /
05AF 2A          >       FCC     /***     /
05B3 4E          >       FCC     /NOP     /
05B7 53          >       FCC     /SYNC/
05BB 2A          >       FCC     /***     /
05BF 2A          >       FCC     /***     /
05C3 42          >       FCC     /BRA     /
05C7 42          >       FCC     /BSR     /
05CB 2A          >       FCC     /***     /
05CF 44          >       FCC     /DAA     /
05D3 4F          >       FCC     /ORCC/
05D7 2A          >       FCC     /***     /
05DB 41          >       FCC     /ANDC/
05DF 53          >       FCC     /SEX     /
05E3 45          >       FCC     /EXG     /
05E7 54          >       FCC     /TFR     /
05EB 42          >       FCC     /BRA     /
05EF 42          >       FCC     /BRN     /
05F3 42          >       FCC     /BHI     /
05F7 42          >       FCC     /BLS     /
05FB 42          >       FCC     /BHS     /
05FF 42          >       FCC     /BLO     /
0603 42          >       FCC     /BNE     /
0607 42          >       FCC     /BEQ     /
060B 42          >       FCC     /BVC     /
060F 42          >       FCC     /BVS     /
0613 42          >       FCC     /BPL     /
0617 42          >       FCC     /BMI     /
061B 42          >       FCC     /BGE     /
061F 42          >       FCC     /BLT     /
0623 42          >       FCC     /BGT     /
0627 42          >       FCC     /BLE     /
062B 4C          >       FCC     /LEAX/
062F 4C          >       FCC     /LEAY/
0633 4C          >       FCC     /LEAS/
0637 4C          >       FCC     /LEAU/
063B 50          >       FCC     /PSHS/
063F 50          >       FCC     /PULS/
0643 50          >       FCC     /PSHU/
0647 50          >       FCC     /PULU/
064B 2A          >       FCC     /***     /
064F 52          >       FCC     /RTS     /
0653 41          >       FCC     /ABX     /
0657 52          >       FCC     /RTI     /
065B 43          >       FCC     /CWAI/
065F 4D          >       FCC     /MUL     /
0663 2A          >       FCC     /***     /
0667 53          >       FCC     /SWI     /
066B 53          >       FCC     /SUBA/
066F 43          >       FCC     /CMPA/
0673 53          >       FCC     /SBCA/
0677 53          >       FCC     /SUBD/
067B 41          >       FCC     /ANDA/
067F 42          >       FCC     /BITA/
0683 4C          >       FCC     /LDA     /
0687 53          >       FCC     /STA     /
068B 45          >       FCC     /EORA/
068F 41          >       FCC     /ADCA/
0693 4F          >       FCC     /ORA     /
0697 41          >       FCC     /ADDA/
069B 43          >       FCC     /CMPX/
```

Listing 1 continued on page 362

Listing 1 continued:

```
069F 4A            >          FCC     /JSR      /
06A3 4C            >          FCC     /LDX      /
06A7 53            >          FCC     /STX      /
                   >
06AB               >          END

00000 ERRORS

BUFFER 0010  BYTE1  000A  BYTE2  000B  CURADR 0002  DIRECT 0474  DISAS  0000
ENDBUF 003D  EOJ1   050D  EOJ2   0520  EOJ4   0535  EOJ5   0538  EXT1   048C
EXTEND 0482  FINISH 04E4  GETR1  0466  GETREG 044E  HEXB   001C  ILEGOP 0322
ILOP1  032B  IND1   0356  IND10  03E3  IND11  03E8  IND12  03F4  IND12A 040C
IND13  0410  IND14  0427  IND15  042B  IND16  043F  IND18  044B  IND2   0382
IND3   0385  IND4   0391  IND5   0397  IND6   03A9  IND7   03B7  IND8   03BF
IND8A  03CC  IND9   03DE  INDBYT 000D  INDEN1 0473  INDEND 046B  INDEX  033D
INDFLG 000C  INIT1  0010  INIT2  0019  LENGTH 0006  MAIN1  002E  MAIN2  0034
MAIN3  0044  MAIN4  0048  MAIN5  0056  MNEM   0022  MNILEG 056F  MNTAB  056B
NXTBUF 000E  OP00   008F  OP01   009B  OP02   009E  OP03   00AC  OP04   00B1
OP05   00BA  OP06   00C3  OP07   00C6  OP10   00C9  OP11   00CD  OP12   00D0
OP13   00D8  OP14   00DB  OP15   00E8  OP16   00F0  OP17   00F3  OP18   0106
OP20   0146  OP21   0154  OP22   0157  OP23   015B  OP24   0160  OP25   0170
OP26   0173  OP30   0178  OP300  01D8  OP301  01E5  OP302  01F0  OP32   0185
OP33   018C  OP34   018F  OP35   01A1  OP36   01B6  OP37   01C1  OP38   01C8
OP39   01D3  OP80   01FB  OP800  0268  OP801  0278  OP802  027B  OP803  0289
OP804  0293  OP805  029D  OP806  02B4  OP81   0212  OP82   0233  OP83   0238
OP84   0248  OP85   024D  OP86   0262  OPC0   02BA  OPC0A  02D8  OPC1   02E3
OPC2   02E5  OPC3   02EB  OPC4   02F8  OPC5   0307  OPC6   0310  OPC7   031C
OPC8   031F  OPCD   0008  OPRAND 0028  OUTCH  0000  PAGE   0007  POSTB  0009
PUT2H  04C6  PUT2HL 04CF  PUT2HR 04D3  PUTCH  04DD  REG    0121  REG1   0134
REG2   013C  REG3   0142  REG4   0145  REGTAB 0553  REL16  04B2  REL8   0494
REL8A  04A5  STKTAB 0563  WRKADR 0004
```

Listing 3 is a sample routine that demonstrates how to use the disassembler. First, the X register is loaded with the address where disassembly should begin by calling a monitor routine that asks for a 4-digit hexadecimal address. Then the Y register is loaded with the address of the monitor routine, which outputs the ASCII (American Standard Code for Information Exchange) character in the A register. This address can point to the console's or hard-copy device's output routine as desired. Next, the disassembler is called, and it outputs one line on the output device. A counter is used to output 19 lines (for my 20-line terminal), and then the keyboard input is checked. Disassembly continues for any input character other than an ESC (hexadecimal 1B); an ESC causes a return to the monitor.

The disassembler begins at DISAS by setting the U and S pointers, as described earlier. Next, the parameters passed in the X and Y registers are stored, and the temporary variables and output buffer are initialized. Then the first byte of code to be disassembled is examined. If it is not an op-code page byte (hexadecimal 10 or 11), it is looked up in the mnemonic table MNTAB to find its corresponding mnemonic. The mnemonic table is compressed from a maximum of 256 different entries to only 80 by converting op codes 40 through 7F to 00 through 0F, and 80 through FF to 40 through 7F (hexadecimal), since the op-code mnemonic stem is similar in these cases.

Op codes are processed according to their first hexadecimal digit and again according to their addressing mode. Subroutines are provided for indexed (including indirect), direct, extended, and relative addressing. Immediate addressing is processed like direct or extended

Text continued on page 364

Listing 2: *A portion of the output of the disassembler working on itself.*

```
E000   34    66    PSHS  U,Y,B,A
E002   33E8  C3    LEAU  -3D,S
E005   1F    34    TFR   U,S
E007   AF    42    STX   02,U
E009 10AF    C4    STY   00,U
E00C   30    46    LEAX  06,U
E00E   C6    0A    LDB   #$0A
E010   6F    80    CLR   ,X+
E012   5A          DECB
E013   26    FB    BNE   (E010)
E015   86    20    LDA   #$20
E017   C6    2D    LDB   #$2D
E019   A7    80    STA   ,X+
E01B   5A          DECB
E01C   26    FB    BNE   (E019)
E01E   AE    42    LDX   02,U
E020   AF    44    STX   04,U
E022   6C    46    INC   06,U
E024   E6    80    LDB   ,X+
E026   C1    10    CMPB  #$10
E028   27    04    BEQ   (E02E)
E02A   C1    11    CMPB  #$11
E02C   26    06    BNE   (E034)
E02E   E7    47    STB   07,U
E030   6C    46    INC   06,U
E032   E6    80    LDB   ,X+
E034   AF    44    STX   04,U
E036   E7    48    STB   08,U
E038   C1    80    CMPB  #$80
E03A   24    08    BHS   (E044)
E03C   C1    40    CMPB  #$40
E03E   25    08    BLO   (E048)
E040   C4    0F    ANDB  #$0F
E042   20    04    BRA   (E048)
E044   C4    0F    ANDB  #$0F
E046   CA    40    ORB   #$40
E048   86    04    LDA   #$04
E04A   3D          MUL
E04B   30ED  051C  LEAX  (E56B),PC
E04F   30    8B    LEAX  D,X
E051   31C8  22    LEAY  22,U
E054   C6    04    LDB   #$04
E056   A6    80    LDA   ,X+
E058   A7    A0    STA   ,Y+
E05A   5A          DECB
E05B   26    F9    BNE   (E056)
E05D   30C8  28    LEAX  28,U
E060   AF    4E    STX   0E,U
E062   A6C8  22    LDA   22,U
E065   81    2A    CMPA  #$2A
E067 1027    02B7  LBEQ  (E322)
E06B   A6    48    LDA   08,U
E06D   81    C0    CMPA  #$C0
E06F 1024    0247  LBHS  (E2BA)
E073   81    80    CMPA  #$80
E075 1024    0182  LBHS  (E1FB)
E079   81    40    CMPA  #$40
E07B   24    12    BHS   (E08F)
E07D   81    30    CMPA  #$30
E07F 1024    00F5  LBHS  (E178)
E083   81    20    CMPA  #$20
E085 1024    00BD  LBHS  (E146)
E089   81    10    CMPA  #$10
E08B   24    3C    BHS   (E0C9)
E08D   20    00    BRA   (E08F)
E08F   6D    47    TST   07,U
E091   26    08    BNE   (E09B)
E093   81    4E    CMPA  #$4E
E095   27    04    BEQ   (E09B)
E097   81    5E    CMPA  #$5E
E099   26    03    BNE   (E09E)
E09B   16    0284  LBRA  (E322)
E09E   84    F0    ANDA  #$F0
E0A0   C6    41    LDB   #$41
E0A2   81    40    CMPA  #$40
```

Listing 3: *This short routine is an example of how to use the disassembler.*

```
                         >* EXAMPLE OF HOW TO USE THE DISASSEMBLER
                         >
     0000                >DISAS   EQU    $0        DISASSEMBLER STARTING ADDRESS
     FFB5                >BADDR   EQU    $FFB5     BUILD HEX ADDRESS IN X-REG
     FFA3                >OUTCH   EQU    $FFA3     OUTPUT CHARACTER IN A-REG
     FFA0                >INCH    EQU    $FFA0     INPUT CHARACTER INTO A-REG
     FFA6                >MONITR  EQU    $FFA6     MONITOR RE-ENTRY POINT
                         >
                         >        ORG    $0700     CAN BE IN ROM WITH DISASSEMBLER
0700 BD     FFB5         >        JSR    BADDR     GET STARTING ADDRESS
0703 108E   FFA3         >        LDY    #OUTCH    POINT TO OUTPUT ROUTINE
0707 C6     13           >LOOP    LDB    #19       DISASSEMBLE 19 LINES
0709 17     F8F4         >LOOP1   LBSR   DISAS
070C 5A                  >        DECB
070D 26     FA           >        BNE    LOOP1
070F BD     FFA0         >        JSR    INCH      GET CHARACTER FROM KEYBOARD
0712 81     1B           >        CMPA   #$1B      ESCAPE?
0714 26     F1           >        BNE    LOOP
0716 7E     FFA6         >        JMP    MONITR    YES, EXIT
0719                     >        END
```

Text continued from page 362:
addressing, depending on the number of bytes in the operand. If the program detects an illegal op code, page byte, or combination of the two, or an illegal indexed addressing postbyte, an illegal op-code routine is called to output "***" in place of the mnemonic.

By the time the program arrives at the end of job routine FINISH, the output buffer has been loaded with the op-code mnemonic and operand. The memory address location and the bytes of machine code are then placed into the buffer, and the entire buffer is output, along with a CR-LF (carriage return-line feed) sequence. I use a Control U (hexadecimal 15) to erase a line on my video terminal, and this character acts as the terminator for the output sequence. Before exiting the program, the index registers are restored to facilitate further calls, and the S pointer is adjusted upward to release the user stack workspace.

In summary, this disassembler offers the advantages of speed and small size, while being both reentrant and relocatable. This flexibility makes it an ideal addition for a 6809 system. ■

Ask BYTE

Conducted by Steve Ciarcia

Thoughts on TRS-80 EPROMs

Dear Steve,

It may be good to add some details to your thoughts on using 2K-byte 2716 EPROMs (erasable programmable read-only memories) with the TRS-80 Model I. (See "In Need of a Way to the PROM," in the October 1981 BYTE, page 318.) In the case of a Model I with standard peripherals, Mr. Fitzgerald's circuit must be changed, because there are not quite 2K addresses available. Expansion boxes for the Model I—which use the peripheral drivers in ROM (read-only memory) A—need eight addresses distributed within the 16-byte range 37E0 through 37EF hexadecimal. An EPROM, such as the one shown in your figure (page 318), extending up into these same addresses would create direct contention on the data bus. The peripherals would not work.

There are two possible solutions to the problem. One is to use a smaller EPROM. The second is to disable the 2716 when conflicting addresses occur. The two-device circuit in your figure enables all but the 2716's last 32 bytes (a compromise to save integrated circuits); there is no conflict when an expansion box is used, and 2016 bytes of EPROM are still available. The circuit also adds an $\overline{RD}$ signal from the control bus in a way recommended exclusively for the 2716 by its manufacturers.

Adding an EPROM to the Model III is a bit different. A corresponding system PROM, C, is already there (and is disabled in a way similar to the circuit shown here in figure 1, but only at 37E8 and 37E9 hexadecimal (*Radio Shack Service Manual*, stock number 26-1061, page 14). In a 48K-byte system, no address space is free, and an EPROM would have to share space on the 16 available lines. Any of the three PROMs could be further qualified to accomplish this. The circuit would vary a lot, depending on when and how one wished to select between the two ROMs. But it would not be difficult. What would be challenging in designing such a "phantom" EPROM circuit for the Model III would be avoiding any conflicts arising from memory references to the PROM whose space is shared.

Paul Fuller
New York, NY

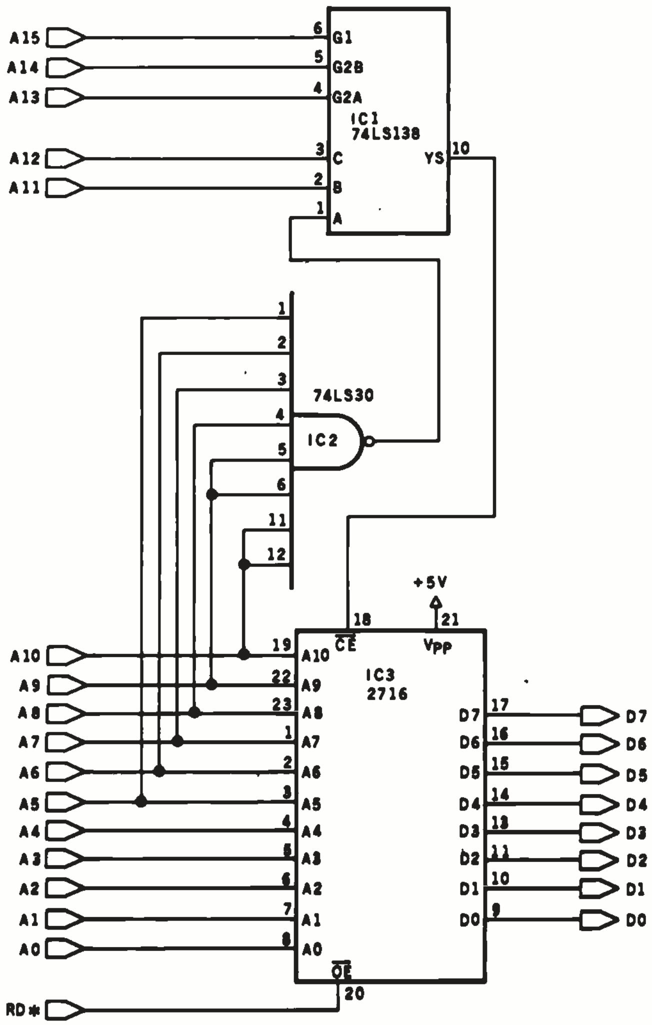

Figure 1

Number	Type	+5 V	GND
IC1	74LS138	16	8
IC2	74LS30	14	7
IC3	2716	24	12

Thank you for the information. . . . **Steve**

The Printer Connection

Dear Steve,

When I bought my TRS-80 microcomputer just about three years ago, I also bought Radio Shack's Quick Printer II. Since then I've realized that I need a larger printer, so now the Q. P. II is sitting in a corner unused. The Q. P. II has three inputs, TRS-80 bus, TRS-80 Expansion Interface, and an RS-232C connection. Using the serial interface, the Q. P. II needs a 600 bps (bits per second) signal with 7 data bits, even or odd parity, and 1 or 2 stop bits; or 7 data bits, no parity, and 2 stop bits; or 8 data bits, no parity, and 1 or 2 stop bits. I would like to interface this printer to a Texas Instruments TI-58C calculator, but I do not have any information on the TI-58C's interface pins (in the battery compartment). Any help you could give me would be greatly appreciated.

Michael W. E. Britt
Fayetteville, NC

For technical information on the TI-58C you should try calling Texas Instruments directly. The two numbers to call for technical information are (800) 858-1802 and (806) 741-2633.

One note, unless the outputs of the TI-58C calculator are either BCD (binary-coded decimal) or binary, it may be rather difficult to convert them to ASCII (American Standard Code for Information Interchange). The reason for this is that many printing calculators contain all the printer-control electronics on the same chip as the cal-

culator itself. The output they produce is multiplexed for a thermal or a 5-wire-matrix impact printhead. (This is what you have in your Q. P. II.)

In any event, it will be interesting to see how things turn out (imagine a remote numerical-entry terminal for your computer that also calculates?). . . . **Steve**

ROM-Based BASIC

Dear Steve,

I am looking for a ROM-based BASIC (equivalent to TRS-80's level II) that I could implement on an Intel 8085-based microcomputer. Do you know of any vendor that could supply such an item with good documentation, including a memory map and/or source listing?

Richard P. Gabric
Christchurch, New Zealand

A ROM-based 8K-byte Microsoft BASIC is available from:

Netronics Research
and Development, Ltd.
333 Litchfield Rd.
New Milford, CT 06776

It costs $99.95 plus $2 shipping and insurance. Netronics sells a complete line of 8085-related products and is your best bet.

Microsoft does not publish its source code for BASIC (for obvious reasons). However, virtually every issue of Dr. Dobb's Journal *published in 1976 had some article on Tiny BASIC, and these may be of some help. Contact the Hayden Book Co., 50 Essex St., Rochelle Park, NJ 07662, for a complete book of reprints of Volume I. . . .* **Steve**

Power Backup

Dear Steve,

I am using a Commodore PET to control my solar-heating system, but I've run into a small problem. In our area, it is not uncommon to have momentary power failures that are long enough to result in the computer losing the data stored in memory. (Power-line "glitches" that simply disrupt operation are less usual.) The vast majority of these outages last for two or three seconds only. Is there some way I can use a large capacitor, or perhaps rechargeable batteries, to handle this power problem for as long as five seconds?

Albert C. Pollard
Irvington, VA

Generally speaking, it is not a good idea to increase the capacitance in a power supply to try to make up for more than a few milliseconds of power loss. Just for the heck of it, I decided to do some quick computations to see how much of a capacitor it would require if it were feasible. The general equation for this calculation is:

$$C = I\frac{dt}{dv}$$

In this case, C is in farads, I is in amperes, v is in volts, and t is in seconds.

The following assumptions are made: one is that the computer requires about 4 amps; the other is that the nominal voltage within a power supply is 9 volts into the regulator, which cannot maintain its full output voltage when the input voltage falls below 7½ volts. Therefore, the allowable voltage drop is only 1½ volts. So dv would then equal 1.5 volts; dt is equal to 5 seconds as per your request.

Solving the equation results in a huge capacitor value of 13.33 farads! As you can see, this is not feasible. It also could lead to burning out your power supply on turn-on because this gigantic capacitor would appear to the rectifier like a short circuit as it was charging up.

My recommendation is, rather than messing around with the power supply inside your PET, that you look toward providing an uninterruptible power source on the 115-volt power line. Many companies sell such items. One product that seems to be aimed primarily at the personal computer market is MayDay from Sun Technology.

I hope you solve your power loss problems without major expenses. . . . **Steve**

Control Sources

Dear Steve,

I am at present designing an automatic home-control system. I would appreciate any information and data that you may be able to offer.

Faris Alamat
South Yorkshire, England

One of the main focuses of my articles over the years has been in the area of home control and security. In Ciarcia's Circuit Cellar, Volume II, *there are four articles that may be of particular interest to you. Three concern the developing of a computer-controlled security system with emphasis on home control and data acquisition. The fourth article is on the design of a computer interface to the BSR X-10 AC remote-control system. This should be an integral part of any inexpensive home controller that you would be using. The book is available for $12.95 from BYTE Books, 70 Main St., Peterborough, NH 03458. . . .* **Steve**

Search for Apple-to-North Star Compiler

Dear Steve,

Do you know of a compiler that allows programs written for an Apple to run on a North Star? If so, please advise on where I can obtain this. If not, any suggestions? Thanks.

Harold Walton
Pleasant Hill, CA

To my knowledge there is no compiler that allows you to go directly from Apple software to North Star.

If the Apple software is written in a higher-level lan-

guage such as BASIC, Pascal, PL/I or FORTRAN, however, you have a better chance of getting it to run on your North Star (if it also runs these languages). The inconvenience lies in finding language incompatibilities and correcting the statements to work on the North Star.

One possibility is an emulator. This is software, written for one processor, that emulates the program execution of another.

When it comes to direct use of machine-language programs, you are out of luck. The Apple uses the 6502 microprocessor, while the North Star uses the Z80A—they have incompatible instruction sets.

Finally, be aware that both types of programs, high-level and machine-language, will have instructions that manipulate the Apple I/O. The address and procedures for using cassette ports, keyboard, and video display are different between the Apple II and North Star, and also that some Apple software routines are in ROM. . . . **Steve**

Custom-Made System

Dear Steve,

I want to assemble my own custom computer system. I plan to use the S-100 bus since it appears to allow the most versatile system. I am most concerned with expandability, and I've noticed that a very large number of S-100 circuit cards are available.

I need a good high-level (preferably universal) language; but I need also the capability of programming in assembly language if the situation calls for it. I plan to use a Z80-based processor board.

One of my long-range goals is to have a multidisk system. I want to have two each of three or four types of drives (i.e., 35-track, 40-track, single-sided, etc.) This way I

won't have to worry about disk-to-drive compatibility when I buy software. I also want to be able to copy from drive to drivė in any combination. For example, I may want to copy a 40-track disk into a 77-track disk. I would appreciate any hints or information you can give me.
Ron Frazier
Milledgeville, GA

Your concept of a custom computer system sounds fine to me. The S-100 bus has become a de facto standard and will give you all the versatility you desire, but . . . the multiple-drive approach may be quite expensive. Keep in mind a few facts about floppy-disk drives.

A double-density disk drive and controller can usually read single-density disks, and a 40-track, 5¼-inch disk drive only requires different software to work with 35-track disks. Unfortunately, there are many different formats for 5¼-inch disks, and most of them are mutually incompatible (an Apple II computer won't read disks from a TRS-80, which won't read Heath H-8 disks, and so on). Fortunately, most S-100 computers use 77-track 8-inch disks, and the IBM 3740 standard has been developed to ensure single-density compatibility. Most software is available in this format, which makes for a very versatile system. . . . **Steve**

Assembly Language

Dear Steve,

I am 14 years old and have my own 48K-byte Radio Shack TRS-80. I have mastered BASIC, and am trying to learn to program in assembly language. Unfortunately, after eight months, I am still trying. Even after studying books over and over, I can't seem to get the hang of it. Do you have any hints on how to learn assembly language, or do you know anybody near my home who could help me?
David Natter
Yonkers, NY

Sorry that you are having problems with assembly-language programming for the Z80 microprocessor. Here are some tips that may be of some help:

1. *Assembly language requires some knowledge of how the Z80 operates. If you look at the architecture (a fancy word for the block diagram) of the Z80, you will see the various registers and how they are connected.*
2. *With this block diagram as a guide, review the instruction set. Try to understand what is happening physically when a particular instruction is executed.*
3. *Understand that when certain instructions are executed, various flags (bits in a status register) are set or cleared. These flags can be tested, and their state can affect the action taken by the processor.*
4. *Try to understand routine programs that store data in memory and transfer memory contents to an output port.*
5. *Run short programs and understand what is happening. Certain locations are initialized at the start of a program and certain addresses have specific functions. Learn what they are and observe how they are called in other programs.*

Also, check suppliers of TRS-80 software for a "single-step" or "breakpoint" program. This is a special routine that allows you to step through a machine-language program one instruction at a time. After each step, you should be able to examine all the registers and see what has changed. This facility aids in debugging as well as learning.

You don't mention what books you are using but here are three that will help: TRS-80 Assembly-Language Programming *(Radio Shack),* Z80 Microprocessor Programming and Interfacing, Book 1, *by Joseph C. Nichols and Elizabeth A. Nichols. (Howard W. Sams and Co., 1979), and* Practical Microcomputer Programming: The Z80, *by W. J. Weller (Northern Technology Books, 1979; unfortunately, this book uses modified Intel mnemonics, not Zilog mnemonics).*

Finally, check your local computer store for the meeting dates of computer clubs in your area. You are bound to find some help there. . . .
Steve

Apple 16-bit Hookup

Dear Steve,

I am a student at the University of Georgia. I own an Apple computer and I am looking for an inexpensive way to change the Apple to 16 bits. Can a Motorola 68000 microprocessor be plugged into the socket that the 6502 is in? If not, what is a simple way to change to 16 bits? Also, how can you change the display to 80 columns? I found a resistor I think controls the number of

columns and it would seem to be easy to change the resistor to twice the value. Will this work?
Steve Albert
Athens, GA

I am sorry to say that there is no simple way to change the Apple II to a 68000-based computer. The 68000 is not pin-compatible with any other microprocessor. Also, the Apple's memory is configured 8 bits wide, and Apple's software in ROM is intended for the 6502 instruction set. There are, however, complete 68000-based systems on the market. There is an accessory board that contains an Intel 8088, which allows 16-bit software for Intel's 8086 microprocessor to run on the Apple; it costs about $1000. Contact: Metaphorphic Microsystems, POB 1541, Boulder, CO 80306, (303) 499-6502.

The display on the Apple II was set at 40 characters to enable an ordinary television receiver to be used as a monitor. I'm afraid that to obtain an 80-character line would require more than a resistor change. Again, there are plug-in boards available that convert the Apple to 80 characters (and to lowercase too). BYTE will be doing a comparison of these products soon. . . . Steve

Construction Tips

Dear Steve,

The only two computers I have used are a Commodore PET (in school) and a TRS-80 (at my local Radio Shack store). I have basic knowledge of electronics and microcomputers, and I have read many magazine articles and books (including yours) on building computers.

I have concentrated my study on Zilog's Z80 microprocessor and am interested in building a system around it. I want to use a video display and an ASCII keyboard to enter programs in BASIC, and a cassette tape recorder for storage. I also want some type of output for expansions (RS-232C, parallel, serial).

I would like to buy a TRS-80, but my budget is limited. Where can I get a book that has what I want? I was thinking of buying the 8K-byte floating-point super ROM (read-only memory) from Microace (see ad on page 359 of the August 1981 BYTE). Would that work instead of the monitor you described in your book? Would I need to change any circuits on the board?
Paul Perry
Orinda, CA

*It sounds like you've answered almost all your questions on your own. If you feel that my book (*Build Your Own Z80 Computer, BYTE Books, 1981*) does not have all the information you need, you might try looking at some of the other BYTE/McGraw-Hill books that are in print.*

As to adding the Microace 8K Super BASIC, yes, it is possible, but (the ever-present catch) you will have to modify the circuitry. The Microace, like the Sinclair ZX80, uses so-called "cheap video." This means that the Z80 processor is doing all of the timing for the video display (sync and character generation) itself. Unless the Microace uses a jump vector in programmable memory for the inputs and outputs (like the TRS-80) you may have to patch the ROM somehow. You could do this by copying all of the Microace ROM into an EPROM (erasable programmable read-only memory) and changing the appropriate sections of the program.

Very few of the ROM BASICs available are the same. Even when the ma-

chines use similar circuitry, they may use different addresses for I/O manipulations. This doesn't make it impossible to interface, just time consuming and aggravating.

Any of the kits on the market are excellent buys. The kit that is best for you depends on your budget and requirements.

In any event, have fun and good luck. . . . **Steve**

Selectric as Printer

Dear Steve,

I have an Atari 800 and would like to add a printer of some sort, but the cost of a quality unit is beyond my budget. My mom has an IBM Selectric typewriter, and I have seen ads for a device that enables a computer to use a Selectric as a printer. What do you know about this? How much will it cost? Do I need an expansion interface? Which typewriter functions can the computer control? How much memory does the software require. At what speeds will it be capable of typing?

Mike Sutherland
Appleton, WI

The IBM Selectric typewriter can be used as a printer for a computer only if the character selection solenoids are installed. Office Selectrics, which I assume is what your mother has, do not have these solenoids and thus cannot be driven by a computer. It is not practical to install these solenoids yourself.

The Selectric I/O (input-output) typewriter, currently available on the used-equipment market, has the necessary solenoids to be computer driven. In addition, these typewriters are of a heavier construction and quite durable. Consult the ads in BYTE for price and condition.

Escon Products, Inc., 12919 Alcosta Blvd., San Ramon, CA 94583, sells a unit to adapt an office-type Selectric to a computer, but it costs around $600, the price of a dot-matrix printer.

A line of universal electric-typewriter interfaces is made by Rochester Data Inc., 3000 South Winton Rd., Bldg. A, Rochester, NY 14623, (716) 224-7804. Different models cost $600 to $800.

You will need some kind of interface to take the TTL (transistor-transistor logic) signals from the computer and enable them to drive 30- or 48-volt solenoids.

The computer can enable all of the typewriter functions, if the solenoids are available for each function.

A computer program to drive the Selectric will take approximately 300 bytes including a look-up table for the type-ball codes.

Selectrics are rated for 13.4 cps (characters per second) maximum, but actual speed will depend on the driver program used.

For more information see "Interfacing the IBM Selectric Keyboard Printer" by Dan Fylstra in the June 1977 BYTE, page 46. It is an excellent article on interfacing the Selectric. . . . **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:

Ask BYTE
c/o Steve Ciarcia
POB 582
Glastonbury CT 06033

If you are a subscriber to The Source, send your questions by electronic mail or chat with Steve (TCE317) directly. Due to the high volume of inquiries, personal replies cannot be given. Be sure to include "Ask BYTE" in the address.

Redirection | Example: stat > status - sends "stat" output to file "status"
• Take Console Input from a File instead of the Keyboard

How to Become a Successful Computer Consultant

Leslie Nelson
Essex Publishing Company, Caldwell, NJ
1980, 135 pages
softcover $28

Reviewed by
Bruce Robert Evans,
16 Marwin Rd.
Pickering, Ontario
L1V 2N7, Canada

When I first received this book, I was convinced it was merely a rehash of the obvious. In addition, I was put off by its poorly bound, one-hundred plus pages: I felt that I'd wasted $28 on a collection of single-sided, photocopied ramblings. But after rereading it and reflecting, I've concluded it is a must for anyone considering a career as a computer consultant.

Nelson approaches his subject, *How to Become a Successful Computer Consultant*, in a straightforward, orderly fashion—he begins by defining what a computer consultant is, what he does, and where he does it. Next, he analyzes whether you should keep your present job (as a safety net) or whether you should jump into full-time consulting.

Next, Nelson proceeds to show how to package and market your services. Remember, you'll be trying to sell yourself to hard-nosed businessmen who might resent hiring an outside expert, so don't expect them to jump at the opportunity to consult a pink-cheeked, enthusiastic, former amateur. Nelson shows you, step by step, how to develop a resume and a marketing package, and explains where to get your leads and find business.

There's no point in running a business that pays you less than the minimum wage, even if the work is fun. *How to...* tells you how to negotiate fees and collect them. There are several charts showing what other con-

major projects: a quarterly newlsetter and a summer computer fair. Membership is free. Contact MACH, POB 13303, Omaha, NE 68113.

Pascal/MT+ Users Group

The Pascal/MT+ users group (MTPUG) is a newly formed organization promoting the use of Pascal as a programming language and serving as a vehicle for communications between users of the language. A quarterly newsletter with bug reports and fixes, programs, questions and answers, and items of interest is planned. Programs will be available on single-density 8-inch CP/M and 5¼-inch North Star or Heath/Zenith disks. Membership dues are $7 in the U.S., $8 in Canada or Mexico. All other countries, $10 surface mail, $16 air mail. Contact MTPUG, POB 192, Westmont, IL 60559. In Europe, contact MTPUG Europe, Schimmelmannstr, 37A, D-2070 Ahrensburg, West Germany.

TI-99/4 Users

A users group has been formed in the Cincinnati/

vited to attend. The club has an information exchange, a monthly newsletter, and frequent guest speakers. Visits to computer installations are organized. Contact Richard H. Williams, R.D.#1, Box 147, Hopewell, NJ 08525, (609) 466-2926.

Clubs and Newsletters Notes

Ham radio operators interested in starting a national Atari network should contact Sheldon Leemon, 14400 Elm St., Oak Park, MI 48237.

Larry Kamin would like to get in touch with any amateur computing club in New York City. Call (212) 389-3700, ext. 324.

Sinclair ZX81 users are in short supply in Switzerland. Mrs. Dane Kurth, Langgasse 51, CH-3292 Busswil, Switzerland would like to correspond with other ZX81 owners.

The Club Apple de Quebec has a new address. Contact Octavio Prieto-Cox, c/o Club Apple de Quebec, 1041 Jeanne Leber, Sainte-Foy, Quebec, Canada, G1W 4G7.

Graphics Group

Advanced Electronics Design (AED) has created a special-interest group for users of the AED512 color raster-graphics display system. Membership is free to anyone who purchases the system, and includes a free subscription to a newsletter, access to a library of user-submitted AED512 programs and software, and applications information from group members. Members will also be informed of the latest AED new products and will have the opportunity to participate in the yearly group meeting at SIGGRAPH. Contact Robin Ratajczak, Advanced Electronics Design, Inc., 440 Potrero Ave., Sunnyvale, CA 94086, (408) 733-3555.

Computers in Medical Offices

The *Micro Medical Newsletter* provides advice on the use and selection of applications for microcomputers in the medical office. Reviews of accounting and insurance-claim management systems, plus reviews of applications software for the Apple II and III, TRS-80, and CP/M-based computer systems have been published. One issue includes an article on the use of minicomputers versus microcomputers in medical offices. The current issue is free to physicians and other health professionals when the request is made on office stationery. For more details, contact Charles Mann and Associates, 7594 San Remo Trail, Yucca Valley, CA 92284, (714) 365-9718.

CSAA Hobbyists

The CSAA Computer Club is an active group of computer hobbyists and professionals. The club meets at 7:30 p.m. on the third Thursday of the month in the Student Center of the Medical College of Georgia, Laney Walker and 15th St., Augusta, Georgia. Dues are $6 per year. A newsletter is published. Contact the CSAA Computer Club, POB 284, Augusta, GA 30903. ■

BYTE's Bugs

Manager Corrected

Because of the way the TRS-80 Model III handles strings, two corrections need to be made to the program listing in Paul Swanson's article, "PDQ: A Data Manager for Beginners." (See the November 1981 BYTE, page 236.) Lines 640 and 950 of listing 1 should both be changed to read A$ = I$ + STRING$(CA(5),32). ■

Event Queue

February 1982

February
Public Courses, various sites throughout the U.S. Among the courses being offered by Ken Orr and Associates are "Structured Systems Design/Structured Program Design" and Structured Requirements Definition." For schedule of meeting times and places, contact Ken Orr and Associates Inc., 715 East 8th, Topeka, KS 66607, (800) 255-2459; in Kansas (913) 233-2349.

February-March
Hands-On Local Network Workshops, various sites throughout the U.S. This series of four-day workshops provides hands-on experience with a local computer network. File, printer, and electronic-mail servers, and various software and hardware components of a local-network computer system will be provided. The local network used as the example will consist of at least a Nestar Cluster One/Model A. Write to Architecture Technology Corp., POB 24344, Minneapolis, MN 55424.

February-April
Computer Network Design and Protocols, various sites throughout the U.S. Participants in this workshop will learn to determine network-system requirements and will perform design trade-offs, implement network-communication and control protocols, use packet- and message-switching techniques, evaluate network hardware and software components, interface local systems to networks, and design and build private networks. The course fee is $845. Contact Ruth Dordick, c/o Integrated Computer Systems, 3304 Pico Blvd., POB 5339, Santa Monica, CA 90405, (800) 421-8166; in California (800) 352-8251.

February-April
Fundamentals of Data Processing for Administrative Assistants and Office Support Staff, various sites throughout the U.S. The American Management Associations (AMA) has designed this three-day course for secretaries, assistants, supervisors, and other personnel desiring to learn the fundamentals of data processing and its use in offices. Computer hardware, software, programming languages, and technology will all be covered. The team fee for AMA members is $470 per individual and $550 for nonmembers. Individual fees are $550 for AMA members and $630 for nonmembers. For a schedule of dates and locations, contact the AMA, 135 West 50th St., New York, NY 10020, (212) 586-8100. To register by phone, call (212) 246-0800.

February-June
Datamation Institute Seminars on Information Management, various sites throughout the U.S. Databases and communications, systems performance, data-processing management, word processing, office automation, computer graphics, and topics of general interest are among the areas to be covered by these two-day seminars. Fees range from $495 to $595. For schedules of times and places, contact Karen Smolens, c/o the Center for Management Research, Datamation Institute Seminar Coordination Office, 850 Boylston St., Chestnut Hill, MA 02167, (617) 738-5020.

Event Queue

February-June

Intensive Two-day Seminars for Professional Development, various sites throughout New England. Among the seminars to be offered by Worcester Polytechnic Institute are "Fundamentals of Data Processing," "Distributed Systems: The Architecture and Utilization of This Revolutionary Technology," and "Microprocessors: Hardware, Software, and Applications." Registration fees range from $445 for a two-day program to $990 for a 7-day executive institute. For complete details, contact Ms. Ginny Bazarian, Office of Continuing Education, Worcester Polytechnic Institute, Worcester, MA 01609, (617) 793-5517.

February-June

One- and Two-day Professional Development Seminars, various sites in greater Boston. Among the courses being offered by Boston University are "Business Writing for Results," "Improving Customer Service," and "Assertive Management." Registration fees range from $295 for a one-day program to $445 for a two-day program. These seminars can be conducted within your company. For details, contact Ms. Joan Merrick, Center for Management Research, 850 Boylston St., Chestnut Hill, MA 02167, (617) 738-5020. For information on the in-company seminars, contact Ms. Elaine Dee at the same address.

February-June

Courses and Seminars from Sira Institute, various sites throughout England. Sira Institute is sponsoring seminars on a wide variety of subjects, ranging from microprocessor familiarization to design and development of microprocessor-based equipment. For details, contact Conferences & Courses Unit, Sira Institute Ltd., South Hill, Chislehurst, Kent BR7 5EH, England.

February 14-18

The Kuwait Information Management Exhibition: INFO Kuwait, Kuwait International Exhibition Center, Kuwait. Industrial executives from the Middle East are among those expected to attend this conference. Exhibits and speakers will be featured. Contact Clapp & Poliak International, 7315 Wisconsin Ave., Washington, DC 20014, (301) 657-3090.

February 18-19

Computer/Micrographics Interface, Stouffer's Greenway Plaza, Houston, TX. The Computer/Micrographics Interface is designed for information managers, systems analysts, micrographics systems analysts, records managers, and others who need information on computer and micrographic technologies. The course is presented by Battelle Research Institute. Contact Battelle Seminars and Studies Program, 4000 Northeast 41st, Seattle, WA 98105, (800) 426-6762; in Washington (206) 527-0542.

February 18-19

The Second Annual Talmis Conference and Exhibit, Chicago, IL. The Talmis Conference will focus on educational and reference media for the institutional, training, home-computer, and video markets. Local computer networks in education, the market for electronic educational and reference media in the home, software piracy, and other topics will be discussed. Exhibits of products and services will be featured. The registration fee is $450. For more information, contact Talmis, 115 North Oak Park Ave., Oak Park, IL 60301, (312) 848-4001.

February 18-20
The Ninth Annual Conference of the Mid-South Association for Educational Data Systems, Landmark Hotel, New Orleans, LA. The theme of the Ninth Annual Conference of the Mid-South Association for Educational Data Systems is "Computer Creativity." The conference will feature papers, workshops, and panel discussions on CAI (computer-aided instruction), CMI (computer-managed instruction), research developments, user/producer communications, and administrative applications. For details, contact Mike Schouest, Director, MIS Data Center, Louisiana State Dept. of Education, 3455 Florida Blvd., Baton Rouge, LA 70806, (504) 342-3762.

February 22-24
The Eighth Federal DP Expo, Sheraton Washington Hotel, Washington, D C. More than 150 computer industries will display and demonstrate hardware and software systems and services at the Federal DP Expo. Conferences on data processing and office automation will be held. Approximately 120 computer-industry experts are scheduled to speak. Contact The Interface Group, 160 Speen St., Framingham, MA 01701, (800) 225-4620; in Massachusetts, (617) 879-4502.

February 22-24
Oasis Level Two Training Seminars, Phase One Systems, Oakland, CA. Using a step-by-step approach to developing applications software with the multiuser Oasis operating system, this seminar begins with program design and proceeds to a careful study of the Oasis system. Topics to be covered are the Oasis BASIC interpreter and compiler, program segments, file structures and I/O (input/output), matrices and matrix I/O, multi-line branching structures, and subroutine and error handling.

The registration fee for this three-day session is $350. Some background in BASIC programming is recommended. Contact Phase One Systems, Suite 830, 7700 Edgewater Dr., Oakland, CA 94621, (415) 562-8085.

February 23-25
Computers and Automated Office Systems Exhibit for Caribbean Markets, Holiday Inn, Paradise Island, Nassau, Bahamas. This show is intended to bring together buyers and distributors within the industry. Exhibits of equipment for businesses in the Caribbean will be featured. For more details, contact Ormand Vee Co., 8852 Leslie Ln., Desplaines, IL 60016, (312) 635-7347.

February 26-28
Computer Expo '82, Tupperware Convention Center, Orlando, FL. Focusing on computers in education, business, industry, professional trades, and the home, Computer Expo '82 will feature exhibits of computers and peripherals. It is sponsored by Adventure International. General admission is $5. For details, contact Computer Expo '82, 377 East Highway 434, POB 1185, Longwood, FL 32750, (305) 339-1731.

March 1982

March
Courses and Seminars from George Washington University, Amsterdam, Netherlands; London, England; Long Island, NY; San Diego, CA; and Washington, DC. Among the courses and seminars to be presented are "Microcomputers in Control Systems," "Comparative Database Management Systems," and "Structured Programming and Software Engineering." For further information, contact The Director, Continuing Engineering Education, George Washington University, Washington, DC 20052, (800) 424-9773; in Washington, DC, (202) 676-6106.

March-June
National Computer Graphics Association Seminar Program, various sites throughout the U.S. The National Computer Graphics Association's (NCGA) Winter/Spring 1982 seminar program covers such topics as "Computer Graphics: Technology and Applications," "Successful Business Graphics," and "Applications of Computer Graphics to Transportation Problems." Seminar fees are $395 for association members and $425 for nonmembers. For complete details, contact Eloise Wenker, NCGA Seminar, 2033 M St., NW

Event Queue

#300, Washington, DC 20036, (202) 466-4102.

March 1-2

Sixth Annual Convention of the Michigan Association for Computers Users in Learning, Western Michigan University, Kalamazoo, MI. Featured will be presentations and sessions on various facets of computers in education. Also featured will be vendor demonstrations and displays. For further details, contact Carolyn Gilbreath, c/o Oakland Schools, 2100 Pontiac Lake Rd., Pontiac, MI 48054, (313) 858-1898.

March 1-4

Robots VI Conference and Exposition, Cobo Hall, Detroit, MI. An estimated 6000 manufacturing executives and engineers are expected to attend the Robots VI Conference, which features the latest in robotics technology and equipment. Among the topics to be addressed are assembly, foundry operations, aerospace applications, vision and handling, research and development, and sessions on human factors associated with robotics. Cincinnati Milacron, Unimation, and Hitachi America are a few of the companies that will be exhibiting. The show is being sponsored by Robotics International of the Society of Manufacturing Engineers (RI/SME). Contact RI/SME, One SME Dr., POB 930, Dearborn, MI 48128, (313) 271-1500, ext. 416.

March 2-4

The 1982 Vancouver Island Business Show, Empress Hotel, Victoria, British Columbia, Canada. The Vancouver Island Business Show features word-processing, communications, and office systems. The show provides the Vancouver Island business community with the opportunity to meet with many Canadian suppliers of computer equipment. For information, contact Southex Exhibitions, Suite 202, 2695 Granville St., Vancouver, British Columbia, V6H 3H4, Canada, (604) 736-3331. In eastern Canada, contact Judy Hurd, 1450 Don Mills Rd., Don Mills, Ontario, M3B 2X7, Canada, (416) 445-6641.

March 3-7

Microcomputer Week '82, Jersey City State College, Jersey City, NJ. The third annual Microcomputer Week conference will focus on microcomputers in education at the elementary, secondary, and college levels. Sixty-six seminars or short courses will be offered, many of which will involve hands-on experience. Special-interest groups, addresses, and reports will be included in the conference, along with exhibits and displays of educational microcomputer hardware, software, courseware, books, and periodicals. Enrollment fees range from $95 for one day to $73 per day for the entire five-day conference. A three-day executive computing course for school and college administrators costs $425. For details, contact Catalyst Conference, H 112, Jersey City State College, 2039 Kennedy Blvd., Jersey City, NJ 07305, (201) 434-2154 or (201) 547-3094.

March 7-10

The Eleventh Annual TI-MIX Symposium, Las Vegas Hilton, Las Vegas, NV. The TI-MIX, an organization for Texas Instruments computer users, will sponsor a symposium featuring exhibits, a business meeting, and a new products workshop. Individual presentations, panel discussions, and workshops are planned. Contact TI-MIX, M/S 2200, POB 2909, Austin, TX 78769, (512) 250-7151.

March 7-12
The Twenty-Eighth Audio-Visual Institute for Effective Communications, Indiana University, Bloomington, IN. The Institute provides audio-visual/video communicators with a comprehensive, practical overview of communication techniques and the opportunity to gain practical experience, exchange ideas, and receive individual instruction. Professionals will lead a series of lectures, discussions, and workshops. For details, contact Ed Richardson, c/o NAVA Institute, Audio-Visual Center, Indiana University, Bloomington, IN 47405.

March 9-11
The 1982 International Zurich Seminar on Digital Communications, Zurich, Switzerland. The theme of this seminar is "Man/Machine Interaction." Its aim is to present recent advances in theory and application of digital-communication systems. Services, facilities, ergonomics, and their impact on peripheral equipment, systems architecture and design, as well as I/O (input/output) concepts and principles will be covered. For details, contact Secretariat '82 IZS, Ms. M. Frey, EAE, Siemens-Albis AG, POB CH-8047, Zurich, Switzerland.

March 9-11
Understanding and Using Computer Graphics, Dallas Hilton Inn, Dallas, TX. The seminar is designed for those interested in the field of interactive computer graphics, including hardware, software, and applications. Headed by Carl Machover, the seminar provides a comprehensive overview of the state of the art in graphics systems. For details, contact Bob Sanzo, c/o Frost & Sullivan, Inc., 106 Fulton St., New York, NY 10038, (212) 233-1080.

Event Queue

March 9-12
Digital-Image Processing and Analysis, San Diego, CA. Integrated Computer Systems' course in digital-image processing is designed for engineers, scientists, technical managers, and other professionals responsible for specification, design, implementation, or application of digital-image processing systems. Among the topics to be covered are image acquisition, image-processing software and database structures, interactive two- and three-dimensional image processing and display, and real-time arrays. Some of the applications examples to be presented are quality assurance and robot vision. The course fee is $795; on-site courses are available on request. Contact Ruth Dordick, c/o Integrated Computer Systems, 3304 Pico Blvd., POB 5339,Santa Monica, CA 90405, (800) 421-8166; in California (800) 352-8251.

March 9-12
VIO–Voice Input/Output for Computers, Los Angeles, CA. VIO–Voice Input/Output for Computers is a four-day course designed for product development and design engineers, systems analysts, programmers, and technical managers involved in planning, design, and implementation of voice input/output systems. The topics to be covered include voice-processing algorithms and software, evaluating VIO hardware components and systems, utilizing speech synthesis techniques, and designing voice-recognition techniques. Participants will have the opportunity to work with devices that permit online generation of computer-voice output, data entry by means of voice input, and voice input for system control. The course fee is $795; on-site courses are available upon request. For information, contact Ruth Dordick, c/o Integrated Computer Systems, 3304 Pico Blvd., POB 5339, Santa Monica, CA 90405, (800) 421-8166; in California (800) 352-8251.

March 10-12
Cincinnati Business Show, Cincinnati Convention Center, Cincinnati, OH. The Cincinnati Business show features the latest in business technology, office systems, and products. Seminars will also be presented. For information, contact Ray G. Nemo, 5679 Creek Rd., Cincinnati, OH 45242, (513) 531-5959.

March 15-19
Short Course from UCLA, Boelter Hall, University of California-Los Angeles (UCLA), Los Angeles, CA. "Mechanical Reliability, Design by Reliability, Probabilistic Design—The Stress/Strength Interference Approach to Reliability Prediction" is a short course being presented by UCLA. The course fee is $795, which includes comprehensive course notes. For details, contact Dr. Dimitri Kececioglu, Aerospace and Mechanical Engineering Dept., University of Arizona, Tucson, AZ 85721, (602) 626-2495 or (602) 626-3901. In California, call Robert Rector at UCLA, (213) 825-1295 or (213) 825-3344.

March 16-18
Software/Expo-West, Anaheim Convention Center, Anaheim, CA. The Software/Expo-West is a conference and show devoted to packaged software. Exhibitors will display a wide range of software products. For additional information, contact Software/Expo-West, Suite 400, 222 West Adams St., Chicago, IL 60606, (312) 263-3131.

March 16-19
Digital Filters and Spectral Analysis, Boston, MA. Integrated Computer Systems (ICS) is presenting a four-day course on digital filters and spectral analysis for project and design engineers, programmers and technical managers responsible for implementing advanced digital signal-processing systems, and those who must understand them and their potential. Fundamentals of digital signal processing, fast Fourier transform (FFT) algorithms, and special- and general-purpose LSI/VLSI (large-scale and very large-scale integration) devices are among the topics to be addressed. The course fee is $795; on-site courses are available by request. Contact Ruth Dordick, c/o ICS, 3304 Pico Blvd., POB 5339, Santa Monica, CA 90405, (800)421-8166; in California (800) 352-8251.

March 19
The Eleventh Annual International Computer Programs Awards Ceremony and Executive Conference, Savoy Hotel, London, England. The annual International Computer Programs Inc. (ICP) awards ceremony and executive conference honors super software salespeople, advertising agencies, public relations firms, and achievements in the industry. The executive conference is one and a half days of discussion of the major issues and concerns of the industry. The fee for the executive conference is $250. For information, contact Carol Stumpf, 9000 Keystone Crossing, POB 40946, Indianapolis, IN 46240, (800) 428-6179; in Indiana (317) 844-7461. In England, contact International Computer Programs, Inc., 2 Deanery St., Park Lane, London WIY 5LH, England, Tel. 01 499 6621.

March 19-21
The Seventh West Coast Computer Faire, Civic Auditorium and Brooks Hall, San Francisco, CA. Attendance this year is expected to reach 35,000. More than 300 exhibitors and a wide assortment of seminars make this one of this largest annual computer shows. For more information, contact The Computer Faire, 333 Swett Rd., Woodside, CA 94062, (415) 851-7075.

March 22-23
Oasis Level Two Training Seminars, Phase One Systems, Oakland, CA. For details, see February 22-24.

March 22-25
Interface '82 Conference and Expo, Dallas Convention Center, Dallas, TX. Cosponsored by McGraw-Hill's *Business Week* and *Data Communications* magazines, Interface '82 is aimed at users of data-communication equipment, distributed-data processing, and various networks. For details, contact The Interface Group, POB 927, 160 Speen St., Framingham, MA 01701, (800) 225-4620; in Massachusetts (617) 879-4502.

March 22-26
Computers/Graphics in the Building Process, Washington, DC. Computers/Graphics in the Building Process is an international conference sponsored by the Advisory Board on the Built Environment (ABBE) of the National Academy of Sciences and by the World Computer Graphics Association (WCGA). The conference features tutorials, technical paper sessions, and exhibits that reflect the state of the art of computers and computer-graphics technology in the building industry. Sessions on case studies, current achievements, and research and development of com-

puter hardware, software, and database programs will be presented. Conference topics include computer aids to management, computer technology, and computer-aided synthesis in design development and construction documents. For further details, contact the WCGA, Suite 250, 2033 M St., NW, Washington, DC 20036, (202) 775-9556.

March 22-26
Tutorial Week East '82, Orlando Marriott Inn, Orlando, FL. Tutorial Week East is sponsored by the Institute of Electrical and Electronics Engineers (IEEE) and will consist of 15 tutorials arranged in 3 tracks: VLSI (very large-scale integration) microprocessor-interfacing techniques and graphics; aspects of software design, analysis, and techniques; and data communications, computer networking, and databases. Fees are $90 per tutorial, $400 all week, for IEEE members and $110 per tutorial, $500 all week, for nonmembers. For information, contact Tutorial Week East '82, POB 639, Silver Spring, MD 20901, (301) 589-3386.

March 23-25
Southcon '82, Sheraton Twin Towers Hotel, Orlando Hyatt Hotel, and Holiday Inn, International Drive, Orlando, FL. Among the topics to be presented at Southcon '82 will be artificial intelligence and robotics, office automation, computers and microprocessors, and software. For complete details, contact Robert Myers, Electronic Conventions Inc., Suite 410, 999 North Sepulveda Blvd., El Segundo, CA 90245, (213) 772-2965.

March 29-30
Information Utilities '82, Rye Town Hilton Hotel and Conference Center, Rye, NY. The Information Utilities conference will focus on videotex, transactional services, electronic publishing, online database services, cable advertising, and regulations concerning copyright, censorship, and communications. More than 60 speakers are scheduled. For details, contact Online, Inc., 11 Tannery Ln., Weston, CT 06883, (203) 227-8466.

March 29-April 1
INFOCOM '82, Las Vegas, NV. INFOCOM '82 is sponsored by the Institute of Electrical and Electronics Engineers (IEEE) Computer and Communications Societies. The conference theme is "Data Processing—Data Communications: The Illusory Boundary." Focusing on the convergence of computer and communication technology, this conference will explore the fine boundaries between the two disciplines. Discussions on programming-language and operating system design, performance evaluation and analysis of computer-communication networks and protocols, standards, and the design of distributed computing and database management systems will be held. Exhibits and tutorials are planned. Write to INFOCOM '82, POB 639, Silver Spring, MD 20901, (301) 589-3386.

March30-April 2
Digital-Image Processing and Analysis, Washington, D.C. For details, see March 9-12.

April 1982

April 1-2
The Eleventh Annual International Computer Programs

Awards Ceremony and Executive Conference, Marriott Mountain Shadows Resort, Scottsdale, AZ. The annual International Computer Programs (ICP) awards ceremony honors super software salesman, advertising agencies, public relations firms, and microcomputer software achievements. The executive conference discusses the main issues and concerns of the industry, such as productivity through proper use of people and machines, new software-piracy solutions, and how to get the most out of advertising dollars. The fee for the executive conference is $250. For detailed information, contact Carol Stumpf, 9000 Keystone Crossing, POB 40946, Indianapolis, IN 46240, (800) 428-6179; in Indiana (317) 844-7461.

April 2-3

Educational Computing—The Future Is Now, Anchorage, AK. The Educational Computing conference is sponsored by the Alaska Association for Computers in Education. Invited speakers, exhibits, and demonstrations of microcomputer products for educational purposes will be featured. Admission to the exhibition area is free of charge. For further details, contact Pat Stowers, '82 Educational Computing, Drawer 129, Healy, AK 99743, (907) 683-2278.

April 2-4

The Second Annual Eighty/Apple Computer Show, New York Statler Hotel, New York, NY. The Eighty/Apple Computer Show features products and services for the TRS-80 and Apple computer systems. More than 100 exhibitors of hardware, software, books, magazines, supplies, services, and accessories will attend. For more information, contact Ken Gordon, Kengore Corp., 3001 Rte. 27, Franklin Park, NJ 08823, (201) 297-2526.

April 13-16

Digital-Image Processing and Analysis, Boston, MA. For details, see March 9-12.

April 15-18

The Second Southwest Computer Show and Office Equipment Exposition, Market Hall, Dallas Market Center, Dallas, TX. The Southwest Computer Show and Office Equipment Exposition features mini- and microcomputers for business, education, government, industry, home, and personal use. Data- and word-processing equipment, office machines, computer peripherals, and office supplies will be displayed. General admission is $5. Contact National Computer Shows, 824 Boylston St., Chestnut Hill, MA 02167, (617) 739-2000.

April 20-22

D-COM, Hynes Auditorium, Boston, MA. A trade show for products and services compatible with Digital Equipment Corporation's products, D-COM will involve vendors and users. For information, contact Ron Davies, D-COM Inc., 7312 Burdette Court, Bethesda, MD 20817, (301) 469-7650.

April 20-23

VIO—Voice Input/Output for Computers, Boston, MA. For details, see March 9-12.

April 21-28

Hanover Fair '82, Hanover, West Germany. The annual Hanover Fair is one of the world's largest industrial and trade exhibitions. More than 330 American firms are expected to exhibit products, services, and technology at the Fair. Contact M.A. Delia, Hanover Fairs Information Center, POB 338, Whitehouse, NJ 08888, (800) 526-5978; in New Jersey, (201) 534-9044.

April 22-25

New York Computer Show and Office Equipment Exposition, Nassau Coliseum, Uniondale, NY. For details, see April 15-18. ■

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.

Software Received

Apple II

Escape from Arcturus, a graphics arcade game for the Apple II. Floppy disk, $35. Synergistic Software, 5221 120th Ave. SE, Bellevue, WA 98006.

Portware, a stock-portfolio-management system for the Apple II. Floppy disk, $195. Portware Inc., 5724 Tucker Ln., Edina, MN 55463.

Whizkit, a program package for converting units of measure for the Apple II Plus. Floppy disk, $39.95. P. V. Systems, POB 21577, San Jose, CA 95151.

Heath

Airport, a flight-controller simulation game for the Heath H-8/H-89. Floppy disk, $19.95. The Software Toolworks, 14478 Glorietta Dr., Sherman Oaks, CA 91423.

Ed-a-Sketch, a full-screen graphics editor for the Heath H-8/H-89 (will also run under CP/M). Floppy disk, $29.95. The Software Toolworks (see address above).

Introduction to BASIC Programming, a course in BASIC programming for the Heath H-8/H-89. Floppy disk, $29.95. The Software Toolworks (see address above).

Invaders, a graphics arcade game for the Heath H-8/H-89 (will also run under CP/M). Floppy disk, $19.95. The Software Toolworks (see address above).

Mychess, a computerized chess program for the Heath H-8/H-89 (will also run under CP/M). Floppy disk, $34.95. The Software Toolworks (see address above).

PIE 1.5, a full-screen text editor for the Heath H-8/H-89 (will also run under CP/M). Floppy disk, $29.95. The Software Toolworks (see address above).

Reach, a telecommunications terminal program for the Heath H-89 (will also run under CP/M). Floppy disk, $19.95. The Software Toolworks (see address above).

TRS-80

Color Maze, a graphics arcade game for the TRS-80 Extended BASIC Color Computer. Cassette, $10. Baranwear, POB 1448, Hayfork, CA 96041.

AC and DC Circuit Analysis Programs, analyzes AC and DC circuits for the TRS-80 Model I Level II. Cassette, $17.97. Computer Heroes, 1961 Dunn Rd., East Liverpool, OH 43920.

Multidos, a versatile disk operating system for the TRS-80 Models I and III. Floppy disk, $79.95. Cosmopolitan Electronics Corp., POB 234, Plymouth, MI 48170.

Whizkit, a program package for converting units of measure for the TRS-80 Models I and III. Floppy disk, $39.95. P. V. Systems, POB 21577, San Jose, CA 95151.

Other Computers

C/80, a compiler for the C programming language running under CP/M. 8-inch floppy disk, $39.95. The Software Toolworks, 14478 Glorietta Dr., Sherman Oaks, CA 91423.

Edit-11 Ver. 2.02, a screen-oriented text editor running under CP/M version 1.4 and the Oasis disk operating system. 8-inch floppy disk, $50. C. C. Software, 2564 Walnut Blvd., #106, Walnut Creek, CA 94598. ■

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.

Books Received

Advanced Programming and Problem Solving with Pascal, G.M. Schneider and S.C. Bruell. New York: John Wiley & Sons, 1981; 506 pages, 23 by 16 cm, hardcover, ISBN 0-471-07876-X, $23.95.

The Coattails of God, The Ultimate Spaceflight—The Trip to the Stars, Robert M. Powers. New York: Warner Books, 1981; 288 pages, 23 by 15.5 cm, hardcover, ISBN 0-446-51231-1, $15.95.

The Computer Establishment, Katherine Davis Fishman. New York: Harper & Row, 1981; 468 pages, 23.5 by 15.5 cm, hardcover, ISBN 0-06-011283-2, $20.95.

The Computerization of Society, A Report to the President of France, Simon Nora and Alain Minc. Cambridge, MA: The MIT Press, 1980; 186 pages, 19.5 by 13.5 cm, softcover, ISBN 0-262-64020-1, $4.95.

Developing a Data Dictionary System, J. Van Duyn. Englewood Cliffs, NJ: Prentice-Hall, 1982; 204 pages, 23 by 15 cm, hardcover, ISBN 0-13-204289-4, $25.

Digital Logic Design and Applications, An Experimental Approach, Lyle B. McCurdy and Albert L. McHenry. Englewood Cliffs, NJ: Prentice-Hall, 1981; 122 pages, 27.5 by 21.5 cm, softcover, ISBN 0-13-212381-9, $12.95.

Electronics and Instrumentation for Scientists, Howard V. Malmstadt, Christie G. Enke, and Stanley R. Crouch. Reading, MA: The Benjamin/Cummings Publishing Co., 1981; 543 pages, 23.5 by 21.5 cm, hardcover, ISBN 0-8053-6917-1, $24.95.

Elements of Structured COBOL Programming, 2nd edition, Jack L. Olson and Wilson T. Price. New York: Holt, Rinehart and Winston, 1982; 380 pages, 27 by 21 cm, softcover, ISBN 0-03-058052-8, $16.95.

50 More Programs in BASIC for the Home, School & Office, 2nd edition, Jim Cole. Woodsboro, MD: Arcsoft Publishers, 1981; 96 pages, 21 by 13.5 cm, softcover, ISBN 0-86668-502-2, $9.95.

Locate, Law Office Computer Applications, Techniques and Equipment, 1981 edition, Bruce D. Heintz and Lavina S. Dill, eds. Chicago, IL: American Bar Association, 1981; 27 by 21 cm, 113 pages, softcover, ISBN 0-89707-045-3, $28.

The Logic Design of Computers, M. Paul Chinitz. Indianapolis, IN: Howard W. Sams & Co., 1981; 413 pages, 13 by 21 cm, softcover, ISBN 0-672-21800-3, $15.95.

Microprocessor Operating Systems, John Zarrella, ed. Suisun City, CA: Microcomputer Applications, 1981; 166 pages, 22.5 cm by 15 cm, softcover, ISBN 0-935230-03-3, $11.95.

Natural Language Information Processing, A Computer Grammar of English and Its Applications, Naomi Sager. Reading, MA: Addison-Wesley Publishing, 1981; 399 pages, 21.5 by 23.5 cm, hardcover, ISBN 0-201-06769-2, $37.50.

Office Automation: The Productivity Challenge, Dimitris N. Chorafas. Englewood Cliffs, NJ: Prentice-Hall, 1982; 272 pages, 23.5 by 13 cm, hardcover, ISBN 0-13-631028-1, $24.95.

101 Pocket Computer Programming Tips & Tricks, Jim Cole. Woodsboro, MD: Arcsoft Publishers, 1981; 128 pages, 21 by 13.5 cm, softcover, ISBN 0-86668-004-7, $7.95.

Understanding Your VIC Volume 1: BASIC Programming, David E. Schultz. Los Alamos, NM: Total Information Services (POB 921), 1981; 140 pages, 27 by 21 cm, softcover, ISBN none, $11.95. ■

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.

Listing 8 continued from page 190:

```
   IF CH IN ['Q','q'] THEN EXIT(EDIT);
   WRITELN;
   EDIT_WHAT := CH;
 END;{edit_what}

 PROCEDURE ED_SEQUENT (FIRST,LAST:TLINE_NUM);
 {edit TLINES[first] to TLINES[last] unless the line is a calculated line}
 VAR              LN : TLINE_NUM;
  BEGIN
    FOR LN := FIRST TO LAST DO IF NOT (LN IN CALCSET)
          THEN BEGIN
                 EDIT_TLINE(LN);
                 GOTOXY(10,23);
                 WRITELN('ENTER <ESC> TO CONTINUE  <Q> TO QUIT');
                 REPEAT
                  READ(CH)
                 UNTIL CH IN ['Q','q',CHR(ESC)];
                 IF CH IN ['Q','q'] THEN EXIT(ED_SEQUENT);
               END;
 END;{ed_sequent}



 PROCEDURE ED_INDIVIDUAL;
 {select a single line to edit}
   VAR              OK : BOOLEAN;
   BEGIN
     REPEAT
       CLEAR;
       WRITE('ENTER LINE NUMBER TO BE CHANGED   0) for help ');
       REPEAT
         OK := FALSE;
         INT := READINT(2);
         IF INT = 0      {a request for help}
           THEN BEGIN
                  CLEAR;
                  CASE EDIT_CHAR OF
                    'A','a' : FOR LN := MINALINE TO MAXALINE DO
                                IF NOT (LN IN CALCSET)
                                  THEN WRITE((LN-MINALINE+1):8,TITLES[LN]:32);
                    'B','b' : FOR LN := MINBLINE TO MAXBLINE DO
                                IF NOT (LN IN CALCSET)
                                  THEN WRITE((LN-MINBLINE+1):8,TITLES[LN]:32);
                    'Z','z' : FOR LN := 8 TO MAXTLINE DO
                                IF NOT (LN IN CALCSET)
                                  THEN WRITE(LN:8,TITLES[LN]:32);
                    END;{case}
                  WRITELN;
                END{if int=0};
         CASE EDIT_CHAR OF       {convert from form line number to array index}
           'A','a'  : BEGIN
                        IF (INT > 0) AND (INT <= 41) THEN OK := TRUE;
                        LN := INT + MINALINE-1;
                      END;
           'B','b'  : BEGIN
                        IF (INT > 0) AND (INT <= 8) THEN OK := TRUE;
                        LN := INT + MINBLINE-1;
                      END;
           'Z','z'  : BEGIN
                        IF (INT > 7) AND (INT <= MAXTLINE) THEN BEGIN
                                                                  OK := TRUE;
                                                                  LN := INT;
                                                                END;{if}
```

```
                    END;{case of Z}
         END;{case}
      UNTIL OK;         {a valid line number has been requested}
      IF (LN IN CALCSET)
       THEN BEGIN
         CLEAR;
         WRITELN('LINE ',INT,' IS A CALCULATED VALUE AND MAY NOT BE EDITED ');
         WAIT;
        END
       ELSE EDIT_TLINE(LN);
      GOTOXY(0,0);EEOL;
      WRITE('        DO YOU WANT TO -->  C)ontinue   Q)uit');
      REPEAT
        READ(CH)
      UNTIL (CH IN ['C','c','Q','q'])
    UNTIL CH IN ['Q','q'];
END;{individual}

BEGIN{edit}
  REPEAT
    CLEAR;
    EDIT_CHAR := EDIT_WHAT;            {what form should be edited?}
    IF EDIT_CHAR IN ['F','f']
      THEN EDIT_SPEC
      ELSE BEGIN
             CLEAR;
             WRITE(' EDIT COMMAND-->');
             WRITE('  S)equentially      I)ndividual lines   Q)uit ');
             REPEAT
               READ(CH)
             UNTIL (CH IN ['S','s','I','i','Q','q']);
             CASE CH OF

               'S','s' : BEGIN
                           CASE EDIT_CHAR OF
                             'A','a'       : ED_SEQUENT(MINALINE,MAXALINE);
                             'B','b'       : ED_SEQUENT(MINBLINE,MAXBLINE);
                             'Z','z'       : BEGIN
                                               ED_SEQUENT(8,MAXTLINE);
                                             END;
                            END;{case}
                         END;

                'I','i' : ED_INDIVIDUAL;

              END;{case}

      END;{else}
   UNTIL CH IN ['Q','q']
END;{edit}
```

Listing 9: *The FIT segment procedure CALCULATE. This procedure calculates Schedule B, then Schedule A, and finally form 1040. Procedure TAXCALC selects the tax table, and procedure GETTAX searches the table for the correct bracket and calculates the tax.*

```
SEGMENT PROCEDURE CALCULATE;

  VAR           LN : TLINE_NUM;


    PROCEDURE AD(FIRST,SECOND,SUM:TLINE_NUM);
    {add two lines}
      VAR           LN : TLINE_NUM;
      BEGIN
        TLINES[SUM].HUS := TLINES[FIRST].HUS + TLINES[SECOND].HUS;
        TLINES[SUM].WIF := TLINES[FIRST].WIF + TLINES[SECOND].WIF;
        TLINES[SUM].TOT := TLINES[FIRST].TOT + TLINES[SECOND].TOT;
      END;

    PROCEDURE ADD(START,FINISH,SUM:TLINE_NUM);
    {add several sequential lines}
      VAR           LN : TLINE_NUM;
      BEGIN
        FOR LN := START TO FINISH DO
          BEGIN
           TLINES[SUM].HUS := TLINES[SUM].HUS + TLINES[LN].HUS;
           TLINES[SUM].WIF := TLINES[SUM].WIF + TLINES[LN].WIF;
           TLINES[SUM].TOT := TLINES[SUM].TOT + TLINES[LN].TOT;
          END;
      END;

    PROCEDURE SUB(FIRST,SECOND,DIF:TLINE_NUM);
    {subtract two lines}
       VAR           LN : TLINE_NUM;
       BEGIN
         TLINES[DIF].HUS := TLINES[FIRST].HUS - TLINES[SECOND].HUS;
         TLINES[DIF].WIF := TLINES[FIRST].WIF - TLINES[SECOND].WIF;
         TLINES[DIF].TOT := TLINES[FIRST].TOT - TLINES[SECOND].TOT;
       END;


  PROCEDURE TAXCALC;
    {the tax calculation is done here}
    VAR
          CH : CHAR;
          HTAXABLE,WTAXABLE,TTAXABLE : LONGINT;
          XFS : FILING_STATUS;
          I : 1..16;
          WHICH : LONGINT;

    PROCEDURE GETTAX(TT : TAX_TABLE;
                  TAX_ABLE : LONGINT ;VAR TAX : LONGINT;W : OWNER);
    {set the factors from the taxtable and do calculate the tax}
     BEGIN
       FOR I := 1 TO 16 DO      {search the array for the correct tax bracket}
         IF(TAX_ABLE > TAXRAY[TT,I,LOWER]) AND (TAX_ABLE <= TAXRAY[TT,I,UPPER])
             THEN BEGIN {bracket found now calculate tax}
                    TAX := TAXRAY[TT,I,BASE] + (TAXRAY[TT,I,PERCENT])*
                                          ((TAX_ABLE-TAXRAY[TT,I,LOWER]) DIV 100);
                    MAX_TAX[W] := TAXRAY[TT,I,PERCENT];
                    EXIT(GETTAX)
                  END;
      END;{gettax}

    BEGIN
```

```
  FSTAT := TLINES[7].FS;     {set filing status}
  IF FSTAT IN [2,3]
    THEN BEGIN       {setexemptions for married}
            HTAXABLE := TLINES[34].HUS - 100000;
            WTAXABLE := TLINES[34].WIF - 100000;
            TTAXABLE := TLINES[34].TOT - 100000 * (TLINES[7].EXEM);
            {calculate total as  joint return use tax table Y}
            GETTAX(Y,TTAXABLE,TLINES[35].TOT,T_OWN);
            REPEAT
              CLEAR;
              WRITELN('SHOULD THE INDIVIDUAL TAXES BE CALCULATED ');
              WRITE('          AS M)MARRIED FILING SEPARATELY  U)UNMARRIED ');
              READ(CH)
            UNTIL CH IN ['M','m','U','u'];
            IF CH IN ['U','u']
              THEN BEGIN
                     {calculate taxes for husband and wife as if they
                                                could file as individuals}
                     GETTAX(X,HTAXABLE,TLINES[35].HUS,H_OWN);
                     GETTAX(X,WTAXABLE,TLINES[35].WIF,W_OWN);
                   END
              ELSE BEGIN
                    {calculate taxes for husband and wife as filing separate}
                     GETTAX(YS,HTAXABLE,TLINES[35].HUS,H_OWN);
                     GETTAX(YS,WTAXABLE,TLINES[35].WIF,W_OWN);
                   END;
           END{if married}
     ELSE BEGIN      {set exemptions for unmarried}
            TTAXABLE := TLINES[34].TOT - 100000 * (TLINES[7].EXEM);
            CASE FSTAT OF
                   1 : GETTAX(X,TTAXABLE,TLINES[35].TOT,T_OWN);
                   4 : GETTAX(Z,TTAXABLE,TLINES[35].TOT,T_OWN);
                   5 : GETTAX(Y,TTAXABLE,TLINES[35].TOT,T_OWN);
             END;{case}
           END;
 END;{calctax}

PROCEDURE LINEA40;
{compensate for zero base }
  BEGIN
    IF TLINES[7].FS IN [2,3]
      THEN BEGIN
             TLINES[106].HUS := 170000;
             TLINES[106].WIF := 170000;
             TLINES[106].TOT := 340000;
           END
      ELSE CASE TLINES[7].FS OF

                1,4    : TLINES[106].TOT := 230000;
                5      : TLINES[106].TOT := 340000;
             END;{case}
  END;{linea40}

PROCEDURE CALSCH_A;
{do the calculations required by schedule A}
BEGIN
  TLINES[69].HUS := TLINES[31].HUS DIV 100; {line A 3}
  TLINES[69].WIF := TLINES[31].WIF DIV 100; {line A 3}
  TLINES[69].TOT := TLINES[31].TOT DIV 100; {line A 3}
  SUB(68,69,70);                            {line A 4}
```

Listing 9 continued on page 392

Listing 9 continued:

```
      WITH TLINES[70] DO
        BEGIN
          IF HUS < 0 THEN HUS := 0;                    {line A 4}
          IF WIF < 0 THEN WIF := 0;                    {line A 4}
          IF TOT < 0 THEN TOT := 0;                    {line A 4}
        END;
      ADD(70,72,73);                                   {line A 7}
      TLINES[74].HUS := 3*TLINES[69].HUS;              {line A 8}
      TLINES[74].WIF := 3*TLINES[69].WIF;              {line A 8}
      TLINES[74].TOT := 3*TLINES[69].TOT;              {line A 8}
      SUB(73,74,75);                                   {line A 9}
      WITH TLINES[75] DO
        BEGIN
          IF HUS < 0 THEN HUS := 0;                    {line A 9}
          IF WIF < 0 THEN WIF := 0;                    {line A 9}
          IF TOT < 0 THEN TOT := 0;                    {line A 9}
        END;
      AD(67,75,76);                                    {line A 10}
      TLINES[99] := TLINES[76];                        {line A 33}
      ADD(77,81,82);                                   {line A 16}
      TLINES[100] := TLINES[82];                       {line A 34}
      ADD(83,85,86);                                   {line A 20}
      TLINES[101] := TLINES[86];                       {line A 35}
      ADD(87,89,90);                                   {line A 24}
      TLINES[102] := TLINES[90];                       {line A 36}
      SUB(91,92,93);                                   {line A 27}
      IF TLINES[93].HUS < 10000 THEN TLINES[94].HUS := TLINES[93].HUS
                                ELSE TLINES[94].HUS := 10000;
      IF TLINES[93].WIF < 10000 THEN TLINES[94].WIF := TLINES[93].WIF
                                ELSE TLINES[94].WIF := 10000;
      IF TLINES[93].TOT < 10000 THEN TLINES[94].TOT := TLINES[93].TOT
                                ELSE TLINES[94].TOT := 10000;
      SUB(93,94,95);                                   {line A 29}
      TLINES[103] := TLINES[95];                       {line A 37}
      ADD(96,97,98);                                   {line A 32}
      TLINES[104] := TLINES[98];                       {line A 38}
      ADD(99,104,105);                                 {line A 39}
      LINEA40;
      SUB(105,106,107);                                {line A 41}
      TLINES[33] := TLINES[107];
     END;{calsch_a}

   PROCEDURE CALSCH_B;
     BEGIN
       TLINES[MINBLINE + 1] := TLINES[MINBLINE];              {line B 1}
       TLINES[9] := TLINES[MINBLINE + 1];
       TLINES[MINBLINE + 3] := TLINES[MINBLINE + 2];          {line B 3}
       ADD(MINBLINE+4,MINBLINE+5,MINBLINE+6);                 {line B 6}
       SUB(MINBLINE+3,MINBLINE+6,MINBLINE+7);                 {line B 7}
       TLINES[10] := TLINES[MINBLINE+7];
     END;

BEGIN{calculate}
  FOR LN := 8 TO MAXLINE DO IF LN IN CALCSET THEN BEGIN
                                                   TLINES[LN].HUS := 0;
                                                   TLINES[LN].WIF := 0;
                                                   TLINES[LN].TOT := 0;
                                                 END;
  CALSCH_B;
  WITH TLINES[10] DO

  BEGIN                        {dividend exclusion}
    HUS := HUS - 10000;
```

Listing 9 continued:

```
      IF HUS < 0 THEN HUS := 0;
      WIF := WIF - 10000;
      IF WIF < 0 THEN WIF := 0;
      TOT := HUS + WIF;
    END;
  ADD(8,21,22);                    {total income}
  ADD(23,29,30);                   {total adjustments}
  SUB(22,30,31);                   {adjusted gross}
  TLINES[32] := TLINES[31];        {transfer 31 to 32}
  CALSCH_A;
  SUB(32,33,34);                   {income for start of tax calculation}
  TAXCALC;
  ADD(35,36,37);                   {total taxes}
  ADD(38,45,46);                   {total credits}
  SUB(37,46,47);                   {balance}
  ADD(47,53,54);                   {balance}
  ADD(55,61,62);                   {total tax payments}
  SUB(54,62,63);                   {taxes-tax payments}
  IF TLINES[63].HUS < 0
     THEN TLINES[63].HUS := -1 * TLINES[63].HUS          {overpayment}
     ELSE BEGIN
            TLINES[66].HUS := TLINES[63].HUS;            {balance due}
            TLINES[63].HUS := 0;
          END;
  IF TLINES[63].WIF < 0
     THEN TLINES[63].WIF := -1 * TLINES[63].WIF
     ELSE BEGIN
            TLINES[66].WIF := TLINES[63].WIF;
            TLINES[63].WIF := 0;
          END;
  IF TLINES[63].TOT < 0
     THEN TLINES[63].TOT := -1 * TLINES[63].TOT
     ELSE BEGIN
            TLINES[66].TOT := TLINES[63].TOT;
            TLINES[63].TOT := 0;
          END;

  FOR LN := 8 TO MAXLINE DO IF LN IN CALCSET THEN TLINES[LN].IPTR := NIL
END;{calculate}
```

Text continued from page 162:
four tax tables (X, Y, YS, and Z), I made the complete set of tables the array TAXRAY, which has four tables × the previously defined two-dimensional array FACTORARRAY.

Program Structure

I organized FIT in a main body, 11 support procedures and one support function, five *segment* procedures (defined later), and two separate programs. I'll begin by describing the general relationships among all these elements of FIT, then give more detail about each. Listing 6 contains the main body and the support procedures. The main body, at the end of listing 6, calls the five segment procedures START (listing 7), EDIT (listing 8), CALCULATE (listing 9), PRINTER (listing 10), and RW (listing 11). The segment procedures and the main program use the support procedures to perform basic tasks. To reduce FIT's memory requirements, I used the separate programs TAXNAMES (listing 12) and TAXTABLE (listing 13) to create the arrays TITLES and TAXRAY respectively, and to write these arrays to disk files (LINENAMS.FTAX for TITLES and FACTORS.FTAX for TAXRAY).

The Main Body and the Support Procedures

At the beginning of listing 6 are all the declarations, most of which have already been described. I declared all the support procedures with the FORWARD statement so that each support procedure can be called by other procedures before it is formally defined. Otherwise, the compiler would reject each such call as use of an undeclared identifier. The support procedures and one support function and their tasks are as follows:

- PROCEDURE MEM displays on the console the current amount of memory available.
- PROCEDURES CLEAR, ELINE, EEOL, and EEOS perform screen manipulations.
- PROCEDURE WAIT halts the program to allow inspection of output.
- PROCEDURE PDOL converts a long integer into a printable string with two decimal places.
- PROCEDURE CENTER centers output on the screen.
- PROCEDURE READDOL prompts for input of dollars and cents, checks for errors, and converts input to a long integer.
- PROCEDURE NAMER prompts for entry of a string from the keyboard, reads the input, and checks the input for errors.
- PROCEDURE LINE prints on the screen a line of one repeated character.
- FUNCTION READINT prompts for entry of an integer, reads the input, and checks it for errors.

When you execute FIT, the main program (found at the end of listing 6) calls the segment procedure START (listing 7), which sets up the program's variables, and reads LINENAMS.FTAX and FACTORS.FTAX. Then, the main program sets up FIT's now familiar main prompt line:

```
FIT COMMAND--> P)rint E)dit C)alculate R)ead
                     W)rite Q)uit
```

If you input P, the program goes to segment procedure PRINTER; E takes you to segment procedure EDIT; C, to segment procedure CALCULATE; R, to segment procedure RW (to read in a data file); W, to segment procedure RW (to write a file).

The Segment Procedures

A segment procedure is an overlay; that is, each segment procedure occupies memory space previously used by a different part of the program. As soon as the segment procedure finishes running, the space it occupied is released; most of the time, the segment procedure resides on the disk. At any time during the execution of a program that uses segment procedures, the memory required is only enough space for the code of the main body, the global variables, and the segment (if any) currently in use. The time required to fetch a segment from disk into memory is insignificant; you only know it's happening because you hear the disk access.

The structure of FIT lends itself to the use of segment procedures because there is little movement between segments. Segmenting saves about 10K bytes of RAM during execution. As a result of my efforts to conserve memory, FIT should work with a 48K-byte system. I have a 56K-byte system and have always had at least 8.5K bytes free while running FIT.

If you know chaining in BASIC, you will see that these segment procedures give a similar result. However, segment procedures are much faster than chaining.

I also took advantage of segmenting to make my editing of FIT easier by dividing its source code into several files. At the end of the declarations in listing 6, I set up a text file for the source code for each segmented procedure. At compile time, I used the include directive to the compiler; this directive caused the compiler to read all the indicated source files and produce a single file of compiled code, FIT.CODE.

I have already described the segment procedure START. Now I'll give some details about the other segment procedures.

Segment Procedure EDIT

The most complex segment procedure is EDIT (listing 8). The main body of EDIT begins by calling EDIT-CHAR, which is a function that returns a character designating which tax form you want to edit. EDIT then asks you to choose either individual or sequential line editing. A CASE statement uses the selected character to call either ED-INDIVIDUAL or ED-SEQUENT. If ED-SEQUENT is called, the main body of EDIT passes the range of line numbers to be edited to the procedure ED-SEQUENT. Both of the ED- procedures call the procedure EDIT-TLINE to do the real editing. ED-SEQUENT steps from the lowest line number to the highest, checks to see if the line number is in CALCSET (the set of calculated lines, which can't be edited), and, if not, calls EDIT-TLINE.

ED-INDIVIDUAL gets the desired line number from operator input or, if you ask, provides help by displaying a list of line numbers and line names. ED-INDIVIDUAL converts the input line number to the correct array index, then calls EDIT-TLINE.

EDIT-TLINE, the workhorse of the Edit function, operates on the tax line whose number is passed to it. EDIT-TLINE's first step is to see if the pointer in TLINES[LN], the record for the given line number, points to anything. If not, there are no previous entries for this line number. If the pointer does point to something, the function VIEWITEM displays the ITEM on the screen and allows editing or deletion of the ITEM. VIEWITEM also returns to EDIT-TLINE the pointer to the next ITEM.

Providing the ability to delete an ITEM complicates the code. In order to delete a record from a linked list, you assign the pointer in the record to the pointer in the parent of the record. As a result, the deleted record is bypassed. Since, in this case, the first pointer is in a TLINES record and all other pointers are in ITEM records, we have to keep track of which record is the parent and which record type the parent belongs to. I used two variables for this purpose. The Boolean variable

TL is true if the parent is a TLINES record; the pointer LASTPTR points to the parent if the parent is an ITEM record. The procedure VIEWITEM performs the deletion following an IF statement conditioned on the variable TL.

When all the existing ITEMs have been presented to you, EDIT-TLINE offers the option to add new ITEMs. A Repeat loop provides for continuing entry of new ITEMs. When they all have been entered, EDIT-TLINE calls the procedure SUMS to add the amounts of all the ITEMs and put the sums in TLINE[LN]. Then EDIT-TLINE calls VIEW to display the data contained in TLINE[LN]. Finally, EDIT-TLINE exits to either ED-INDIVIDUAL or ED-SEQUENT.

Segment Procedure CALCULATE

This segment procedure, shown in listing 9, is straightforward. For any calculation for a given line, if the filing status is married, three calculations are needed—one each for HUS, WIF, and TOT. To simplify additions and subtractions, I wrote three procedures: AD, ADD, and SUM. These procedures are passed the line number to act upon and then do the three calculations (on HUS, WIF, and TOT).

The calculations are done in the following order. First, Schedule B is calculated and its results placed in lines 10 and 11 of form 1040. The dividend exclusion is then applied to line 10. Form 1040 is then calculated to line 32 and CALSCH-A is called to calculate Schedule A and place the results in line 33 of form 1040. Line 34 is calculated and PROCEDURE TAXCALC is called.

PROCEDURE TAXCALC adjusts the taxable income for the number of dependents, selects the correct tax table based on the filing status, and calls PROCEDURE GETTAX.

PROCEDURE GETTAX searches the tax table for the correct bracket, calculates the tax, and inserts it in line 35.

Lines 37-63 of form 1040 are next calculated. Based on the value of line 63, either an overpayment or an underpayment exists. The balance of the lines is adjusted accordingly.

Segment Procedure PRINTER

The main body of PRINTER, shown in listing 10, begins by initializing three sets of TLINE-NUMs. These three sets contain the TLINE-NUMs that:

- have a separator line printed after them (SLINESET)
- have a summation line printed after them (DLINESET)
- are the last line written to a screen (SPAGESET)

The main body of PRINTER also contains the Boolean variable SCREEN, which determines whether the output goes to the screen or the printer. The Boolean variable DETAIL determines if all the ITEMs are to be printed for each line, or just the totals.

Segment Procedure RW

The segment procedure RW, shown in listing 11, contains the code that reads and writes disk files. The data are stored on disk in two files. One file contains the TLINE records; the other contains the ITEM records. The two files have the same file identified with ".LINE" or ".ITEM" appended to the end of the name.

The procedure to write the data to file is WRITER, which prompts for the name of the file name to be written, adds ".LINE", and calls WRITE-TLINES. WRITE-TLINES calls LOOKUP, which checks to see if a file with the same name is already on the disk. If the file name already exists, you are asked if the file should be rewritten.

After WRITE-TLINES returns control to WRITER,

Text continued on page 400

Listing 10: *The FIT segment procedure PRINTER. This procedure prints FIT's output. The procedure DETAIL_PRINT prints all the entries for each line, as well as the totals. The procedure PRINT prints just the total for each line.*

```
SEGMENT PROCEDURE PRINTER;
  VAR
               DETAIL : BOOLEAN;
               LINES : INTEGER;
               PRINT_WHAT,CH1 : CHAR;

 PROCEDURE PRINT_DATE;
  VAR          CMONTH : STRING[3];
  BEGIN
    CASE MONTH OF
        1: CMONTH := 'Jan';
        2: CMONTH := 'Feb';
        3: CMONTH := 'Mar';
        4: CMONTH := 'Apr';
        5: CMONTH := 'May';
        6: CMONTH := 'June';
        7: CMONTH := 'July';
        8: CMONTH := 'Aug';
        9: CMONTH := 'Sept';
        10: CMONTH := 'Oct';
        11: CMONTH := 'Nov';
        12: CMONTH := 'Dec'
      END;
     WRITELN(P, DAY: 2, ' ', CMONTH,' ', '19', YEAR: 2);
   END;


  PROCEDURE HEADING(TITLE : FILENAME);
  {prints heading}
    BEGIN
      LINE('*',79);       {print a line of 79 '*'s}
      WRITELN(P);         {goto next line}
      WRITE(P,TLINES[6].NAME);
      WRITE(P,'TAX YEAR ':(44-LENGTH(TLINES[6].NAME)));
      WRITELN(P,TLINES[7].TAXYEAR:4,TITLE :29);
      WRITE(P,'FILING STATUS ');
      CASE TLINES[7].FS OF
        1 : WRITE(P,'1');
        2 : WRITE(P,'2');
        3 : WRITE(P,'3');
        4 : WRITE(P,'4');
        5 : WRITE(P,'5');
       END;
      WRITE(P,'                  EXEMPTIONS ');
      WRITE(P,TLINES[7].EXEM,' ':27);
      PRINT_DATE;
      LINE('*',79);WRITELN(P);
      IF FSTAT IN [2,3]
        THEN WRITELN(P,' ':40,' HUSBAND ':12,'   WIFE    ':12,'   TOTAL    ':12)
        ELSE WRITELN(P);
      LINES := 4;
    END;{heading}

PROCEDURE DETAIL_PRINT(FIRST,LAST : TLINE_NUM; TITLE : FILENAME);
  {prints items by tax line}
  VAR
        LN : TLINE_NUM;
```

Listing 10 continued on page 398

Listing 10 continued:

```
      OBJ,HDOL,WDOL,TDOL:STRING[10];
      NEXTPTR : POINTER;
BEGIN
  IF SCREEN THEN CLEAR;
  HEADING(TITLE);
  FOR LN := FIRST TO LAST DO
    IF TLINES[LN].IPTR <> NIL {do not bother unless line has an ITEM}
      THEN BEGIN
             CASE PRINT_WHAT OF                   {print form line number}
                 'A','a'      : WRITE(P,(LN-MINALINE+1):2);
                 'B','b'      : WRITE(P,(LN-MINBLINE+1):2);
                 'Z','z'      : WRITE(P,(LN):2);
             END;{case}
             WRITELN(P,' ',TITLES[LN]);           {print name of line}
             LINES := LINES + 1;                  {increment the line counter}
             NEXTPTR := TLINES[LN].IPTR;          {first pointer}
             WHILE NEXTPTR <> NIL DO              {until the last ITEM}
               BEGIN
                 WITH NEXTPTR^ DO
                   BEGIN
                     WRITE(P,NAME);
                     PDOL(AMT,OBJ);               {convert longint to string}
                     CASE WHOSE OF
                       H_OWN   : BEGIN
                                   WRITE(P,'HUS':(25-LENGTH(NAME)));
                                   WRITELN(P,OBJ:25)
                                 END;
                       W_OWN   : BEGIN
                                   WRITE(P,'WIF':(25-LENGTH(NAME)));
                                   WRITELN(P,OBJ:38)
                                 END;
                       T_OWN   : BEGIN
                                   WRITE(P,'TOT':(25-LENGTH(NAME)));
                                   WRITELN(P,OBJ:51)
                                 END;
                      END;{case}
                    LINES := LINES + 1;
                    NEXTPTR := NPTR;
                 END;{with}
             END;{while}
    WITH TLINES[LN] DO                            {now summarize the line}
      BEGIN
        PDOL(HUS,HDOL);                           {convert longint to string}
        PDOL(WIF,WDOL);                           {convert longint to string}
        PDOL(TOT,TDOL);                           {convert longint to string}
        IF FSTAT IN [2,3]
          THEN WRITELN(P,'TOTAL',HDOL:45,WDOL:13,TDOL:13)
          ELSE WRITELN(P,'TOTAL',' ':58,TDOL:13);
        WRITELN(P);
        LINES := LINES + 1;                       {increment the line counter}
      END;{with tlines}
 IF SCREEN
   THEN IF (16 - LINES) < 0                       {test line counter}
      THEN BEGIN
             WAIT;
             CLEAR;
             LINES := 0;
           END
    ELSE IF (54 - LINES) < 0                      {test line counter}
      THEN BEGIN
             WRITE(P,CHR(12));
             HEADING(TITLE)
           END;
```

```
    END;{for}
 IF SCREEN THEN WAIT;
 WRITE(P,CHR(12));
END;{detail_print}

PROCEDURE PRINT(FIRST,LAST : TLINE_NUM; TITLE : FILENAME);
  CONST
          S1='  ----------   ----------   ----------    ';
  VAR
        LN : TLINE_NUM;
        HDOL,WDOL,TDOL:STRING[10];

  BEGIN
    IF SCREEN THEN CLEAR;
    HEADING(TITLE);
    FOR LN := FIRST TO LAST DO
      WITH TLINES[LN] DO
       BEGIN
         PDOL(HUS,HDOL);
         PDOL(WIF,WDOL);
         PDOL(TOT,TDOL);
         CASE PRINT_WHAT OF
           'A','a'      : WRITE(P,(LN-MINALINE+1):2);
           'B','b'      : WRITE(P,(LN-MINBLINE+1):2);
           'Z','z'      : WRITE(P,(LN):2);
           END;
         WRITELN(P,'  ',TITLES[LN],' ':5,HDOL:12,WDOL:12,TDOL:12);
         IF (LN IN DLINESET) THEN WRITELN(P,S1:79);     {print dashed line}
         IF (LN IN SLINESET)                            {print separator}
              THEN BEGIN
                     LINE('=',79);
                     WRITELN(P);
                   END;
         IF ((SCREEN) AND (LN IN SPAGESET))    {do not overfill the screen}
           THEN BEGIN
                  WAIT;
                  CLEAR;
                END;
         IF (NOT SCREEN) AND (LN=37)           {do not overfill the page}
           THEN BEGIN
                  WRITE(P,CHR(12));
                  HEADING(TITLE);
                END;
       END;{with}
  IF PRINT_WHAT IN ['Z','z']
       THEN BEGIN
              WRITE(P,'  MAXIMUM TAX BRACKET',' ':20);
              WRITELN(P,MAX_TAX[H_OWN]:12,MAX_TAX[W_OWN]:12,MAX_TAX[T_OWN]:12)
            END;
  IF SCREEN THEN WAIT;
  WRITE(P,CHR(12))
END;{print}

BEGIN{printer}
    {a separator line is printed after a line in SLINESET}
    SLINESET := [22,30,37,47,54,62,66,76,82,86,90,95,98,107,109,111];
    {a dashed line is printed after a line in SLINESET}
    DLINESET := [21,29,33,36,45,46,53,61,69,72,75,81,85,89,92,94,97,106,113];
    {last lines on a SCREEN page are in SPAGESET}
```

Listing 10 continued on page 400

Listing 10 continued:

```
 SPAGESET := [22,37,54,76,90,98];
 CLEAR;
 mem;
 REPEAT
  DETAIL := FALSE;                   {control to print detail}
  CLEAR;
  WRITE ('PRINTER COMMAND --> A)sched A  B)sched B  Z)form 1040 ');
  WRITE(' #)for detail   Q)uit');
  REPEAT
    READ(PRINT_WHAT);
    IF PRINT_WHAT = '#' THEN DETAIL := TRUE
  UNTIL ( PRINT_WHAT IN ['A','a','B','b','Z','z','Q','q']);
  IF NOT ( PRINT_WHAT IN ['Q','q'])
   THEN BEGIN
     WRITELN;
     WRITE('DO YOU WANT TO OUTPUT TO --> P)rinter S)creen  ');
     REPEAT
       READ(CH1)
     UNTIL CH1 IN ['P','p','S','s'];
     IF CH1 IN ['S','s']
       THEN BEGIN
              SCREEN := TRUE;
              REWRITE(P,'CONSOLE:')
           END
       ELSE BEGIN
              SCREEN := FALSE;
              REWRITE(P,'PRINTER:')
           END;
     IF DETAIL
       THEN CASE PRINT_WHAT OF
                'A','a'   : DETAIL_PRINT(67,107,'SCHEDULE A');
                'B','b'   : DETAIL_PRINT(108,115,'SCHEDULE B');
                'Z','z'   : DETAIL_PRINT(8,66,'FORM 1040');
               END

       ELSE CASE PRINT_WHAT OF
                'A','a'   : PRINT(67,107,'SCHEDULE A');
                'B','b'   : PRINT(108,115,'SCHEDULE B');
                'Z','z'   : PRINT(8,66,'FORM 1040');
               END;
     END{if};
 CLOSE(P);
 UNTIL PRINT_WHAT IN ['Q','q'];
END;{printer}
```

Text continued from page 396:

WRITE-ITEMS is called. This procedure scans the TLINEs for the existence of ITEMs and writes them to "FILENAME.ITEM" when found.

READER reads the ".LINE" and ".ITEM" files into the array and linked lists, respectively. The array read is straightforward. When the ITEMs are read in, they must be linked to the proper list, which begins with the TLINE[LN]. Since each ITEM contains the number of the TLINE[LN] to which it belongs, the correct starting point can be found. The list is then traversed to the end and the ITEM inserted. Since these lists are short, the whole operation goes quickly. If a long list were involved, an array could be created to hold the pointer to the last ITEM in each list; that would allow direct insertion without traversing the list.

Closing Comments

I think you will find FIT a useful program and the basis for other useful programs. Its framework will permit you to add other tax forms with relative ease. If another federal form interests you, try adding it to FIT. It won't take long.

You may also be able to adapt FIT to do your state taxes. I live in Delaware, which has a tax form similar to the federal form. I had no difficulty using FIT as the basis for developing a similar program for the state form.

Without modification, FIT should help you adjust your federal withholding tax, compile thorough and convenient tax records, and examine the tax consequences of different investment strategies. I hope you find FIT helpful in all these ways.■

Listings 11, 12, and 13 follow on pages 401-412

Listing 11: *The FIT segment procedure RW. This procedure reads and writes disk files of tax data.*

```
SEGMENT PROCEDURE RW(CH : CHAR);{reads or writes Files of TLINES and ITEMS }
VAR
        FL  : FILE OF TLS;
        FI  : FILE OF ITEM;

  FUNCTION LOOKUP(FN:STRING):BOOLEAN;
  {checks to see if file is on disk}
    VAR
            IOR:0..15;
    BEGIN
      {$I-}
      RESET(F,FN);
      IOR:=IORESULT;
      CLOSE(F);
      {$I+}
      IF (IOR=0)
       THEN LOOKUP:=TRUE
       ELSE BEGIN
              LOOKUP:=FALSE;
              IF (IOR<>10) THEN WRITELN('IORESULT FOR FILE ',FN,' IS ',IOR);
            END;{else}
    END;{lookup}


  PROCEDURE READER;                {reads files of TLINES and ITEMS}
    CONST            FN1='.LINE';    FN2='.ITEM';
    VAR              ST : STRING;
                     FN : FILENAME;

    PROCEDURE READ_TLINES(FN : FILENAME);
      VAR
            I : TLINE_NUM;
      BEGIN
        IF NOT LOOKUP(FN)
          THEN BEGIN
                 CLEAR;
                 GOTOXY(12,20);
                 WRITELN('FILE ',FN,' NOT FOUND');
                 WAIT;
                 EXIT(READ_TLINES)
               END;
        RESET(FL,FN);
        TLINES := FL^;
        CLOSE(FL);
        FOR I := 8 TO MAXLINE DO TLINES[I].IPTR := NIL;
        WRITELN('FILE ',FN,' READ ');
      END;

    PROCEDURE READ_ITEMS(FN : FILENAME);
      VAR
            CH : CHAR;
            PT,NEWPT : POINTER;
```

Listing 11 continued on page 402

```
      BEGIN
        IF NOT LOOKUP(FN)
          THEN BEGIN
                 CLEAR;GOTOXY(10,10);
                 WRITE('FILE ',FN,' NOT FOUND ');
                 WAIT;
                 EXIT(READ_ITEMS)
           END;
    RESET(FI,FN);
    WRITE('READING FILE ',FN);
    WHILE NOT EOF(FI) DO
      BEGIN
        NEW(NEWPT);
        NEWPT^ := FI^;
        NEWPT^.NPTR := NIL;
        IF (TLINES[NEWPT^.TLNUM].IPTR = NIL)
          THEN TLINES[NEWPT^.TLNUM].IPTR := NEWPT
          ELSE BEGIN
                 PT := TLINES[NEWPT^.TLNUM].IPTR;
                 WHILE (PT^.NPTR <> NIL) DO PT := PT^.NPTR;
                 PT^.NPTR := NEWPT;
               END;
         GET(FI);
         WRITE('.');
       END;{WHILE}
     CLOSE(FI);
   END;{read_items}

   BEGIN{reader}
     NAMER('FILE TO BE READ ',ST,8);
     FN := CONCAT(ST,FN1);
     READ_TLINE(FN);
     FN := CONCAT(ST,FN2);
     READ_ITEMS(FN);
     WAIT;
   END;{reader}

PROCEDURE WRITER;      {writes file of TLINES and ITEMs}
   CONST          FN1='.LINE';    FN2='.ITEM';
   VAR            ST : STRING;
                  FN : FILENAME;

   PROCEDURE WRITE_TLINES(FN : FILENAME);
     VAR            CH :CHAR;
                    LN : TLINE_NUM;
     BEGIN
       IF LOOKUP(FN)
         THEN BEGIN
                CLEAR;
                GOTOXY(0,20);
                WRITELN('FILE ',FN,' ALREADY EXISTS ');
                WRITE('DO YOU WANT TO REMOVE THE OLD FILE Y/N');
                REPEAT
                  READ(CH)
                UNTIL (CH IN ['Y','y','N','n']);
                IF ( CH IN ['N','n']) THEN EXIT(WRITER);
              END;
       REWRITE(FL,FN);
       FL^ := TLINES;
       PUT(FL);
       CLOSE(FL,LOCK)
     END;{write_tlines}
```

Listing 11 continued:

```
PROCEDURE WRITE_ITEMS (FN : FILENAME);
  VAR             CH :CHAR;
                  PT : POINTER;

                  LN : TLINE_NUM;
  BEGIN
     REWRITE(FI,FN);
     FOR LN := 8 TO MAXLINE DO
       IF  NOT (LN IN CALCSET)
         THEN BEGIN
                  IF TLINES[LN].IPTR <> NIL
                    THEN BEGIN
                          PT := TLINES[LN].IPTR;
                          WHILE (PT <> NIL) DO
                            BEGIN
                              FI^ := PT^;
                              PUT(FI);
                              PT := PT^.NPTR
                            END;{while}
                         END;{if}
                END;{if}
      CLOSE(FI,LOCK);
    END;{write_items}

BEGIN{writer}
  NAMER('FILE TO BE WRITTEN ',ST,8);
  FN := CONCAT(ST,FN1);
  WRITE_TLINE(FN);
  FN := CONCAT(ST,FN2);
```

Listing 11 continued on page 404

Listing 11 continued:

```
    WRITE_ITEMS(FN);
  END;{writer}

BEGIN
  CASE CH OF
    'R' : READER;
    'W' : WRITER;
  END;
END;{rw}
```

Listing 12: *The program TAXNAMES. Separate from FIT, this program creates the one-dimensional array TITLES and writes the array to the disk file LINENAMS.FTAX. FIT uses the array TITLES to store the names of the lines on form 1040, Schedule A, and Schedule B.*

```
 {$L TNAME.PRN.TEXT}

PROGRAM TAXNAMES;        {program to create file of names of tax lines}
CONST
        MAXTLINE = 115;
TYPE
                T=ARRAY [1..MAXTLINE] OF STRING[30];
VAR
        TITLES : T;
        TFILE  : FILE OF T;


PROCEDURE WAIT;
  VAR
      CH : CHAR;
  BEGIN
    GOTOXY(10,23);
    WRITE('ENTER <ESC> TO CONTINUE');
    REPEAT
      READ(CH)
    UNTIL CH=CHR(27);
  END;

PROCEDURE WRITEFILE;
  BEGIN
    REWRITE(TFILE,'LINENAMS.FTAX');
    TFILE^ := TITLES;
    PUT(TFILE);
    CLOSE(TFILE,LOCK);
  END;


PROCEDURE READFILE;
  VAR
        I:1..MAXTLINE;
  BEGIN
    RESET(TFILE,'LINENAMS.FTAX');
    TITLES := TFILE^;
    FOR I := 1 TO MAXTLINE DO
      BEGIN
        WRITELN(TITLES[I]);
        IF (I MOD 16) = 0
         THEN BEGIN
               WAIT;
               WRITE(CHR(12));
             END;
      END;
  END;
```

Listing 12 continued:

```
PROCEDURE INIT1;
  BEGIN
    TITLES[1] := 'FILING STATUS                  ';
    TITLES[2] := 'FILING STATUS                  ';
    TITLES[3] := 'FILING STATUS                  ';
    TITLES[4] := 'FILING STATUS                  ';
    TITLES[5] := 'FILING STATUS                  ';
    TITLES[6] := 'EXEMPTIONS                     ';
    TITLES[7] := 'EXEMPTIONS                     ';
    TITLES[8] := 'WAGES,SALARIES,ETC             ';
    TITLES[9] := 'INTEREST INCOME                ';

   TITLES[10] := 'DIVIDENDS                      ';
   TITLES[11] := 'INCOME TAX REFUNDS             ';
   TITLES[12] := 'ALIMONY RECEIVED               ';
   TITLES[13] := 'BUSINESS INCOME                ';
   TITLES[14] := 'CAPITAL GAIN                   ';
   TITLES[15] := 'CAPITAL GAIN DIST              ';
   TITLES[16] := 'SUPPLEMENTAL GAINS             ';
   TITLES[17] := 'TAXABLE PENSIONS & ANNUITIES   ';
   TITLES[18] := 'PENSIONS,RENTS,ROYS,PARTNER    ';
   TITLES[19] := 'FARM INCOME                    ';
   TITLES[20] := 'UNEMPLOYMENT                   ';
   TITLES[21] := 'OTHER INCOME                   ';
   TITLES[22] := 'TOTAL INCOME                   ';
   TITLES[23] := 'MOVING EXPENSE                 ';
   TITLES[24] := 'EMP BUSINESS EXPENSE           ';
   TITLES[25] := 'PAYMENTS TO IRA                ';
   TITLES[26] := 'PAYMENTS TO KEOGH              ';
END;{init1}

PROCEDURE INIT2;
 BEGIN
    TITLES[27] := 'INTEREST PENALTY               ';
    TITLES[28] := 'ALIMONY PAID                   ';
    TITLES[29] := 'DISABILITY INCOME              ';
    TITLES[30] := 'TOTAL ADJUSTMENTS              ';
    TITLES[31] := 'ADJUSTED GROSS INCOME          ';
    TITLES[32] := 'ADJUSTED GROSS INCOME          ';
    TITLES[33] := 'DEDUCTIONS                     ';
    TITLES[34] := '32-33                          ';
    TITLES[35] := 'TAX                            ';
    TITLES[36] := 'ADDITIONAL TAXES               ';
    TITLES[37] := 'TOTAL TAXES                    ';
    TITLES[38] := 'POLITICAL CONTRIBUTIONS        ';
    TITLES[39] := 'CREDIT FOR ELDERLY             ';
    TITLES[40] := 'CHILD AND DEPENDENT            ';
    TITLES[41] := 'INVESTMENT CREDIT              ';
    TITLES[42] := 'FOREIGN TAX CREDIT             ';
    TITLES[43] := 'WORK INCENTIVE                 ';
    TITLES[44] := 'JOBS CREDIT                    ';
    TITLES[45] := 'ENERGY CREDITS                 ';
    TITLES[46] := 'TOTAL CREDITS (lines 38 to 45)';
    TITLES[47] := 'BALANCE (line 37 - line 46)    ';
    TITLES[48] := 'SELF EMPLOYMENT TAX            ';
    TITLES[49] := 'MINIMUM TAX                    ';
END;{init2}

PROCEDURE INIT3;
BEGIN
    TITLES[50] := 'TAX FROM PRIOR YEAR INV-CREDIT';
    TITLES[51] := 'FICA AND RRTA TAXES            ';
    TITLES[52] := 'TAX ON IRA                     ';
```

Listing 12 continued on page 406

Listing 12 continued:

```
      TITLES[53] := 'ADVANCE EIC PAYMTS RECEIVED     ';
      TITLES[54] := 'BALANCE (lines 47 to 53)        ';
      TITLES[55] := 'TOTAL FICA WITHHELD             ';
      TITLES[56] := '1980 ESTIMATED TAX PAYMENTS     ';
      TITLES[57] := 'EARNED INCOME CREDIT            ';
      TITLES[58] := 'AMOUNT PAID WITH FORM 4868      ';
      TITLES[59] := 'EXCESS FICA AND RRTA TAX PAID   ';
      TITLES[60] := 'CREDIT FOR FED TAX ON SP FUEL   ';
      TITLES[61] := 'REGULATED INVESTMENT CO CREDIT';
      TITLES[62] := 'TOTAL (line 55 to 61)           ';
      TITLES[63] := 'OVERPAID                        ';
      TITLES[64] := 'TO BE REFUNDED TO YOU           ';
      TITLES[65] := 'APPLIED TO EST 1981 TAX         ';
      TITLES[66] := 'BALANCE DUE                     ';
END;{init3}

PROCEDURE INIT4;
   BEGIN
      TITLES[67] := '50 % OF MEDICAL INS PREMS       ';
      TITLES[68] := 'MEDICINE AND DRUGS              ';
      TITLES[69] := '1% OF LINE 31 FORM 1040         ';
      TITLES[70] := 'SUB TOTAL line 3-line 2         ';
      TITLES[71] := 'BALANCE OF INS PREMS            ';
      TITLES[72] := 'OTHER MEDICAL AND DENTAL        ';
      TITLES[73] := 'TOTAL (lines 4 to 6)            ';
      TITLES[74] := '3% OF LINE 31 FORM 1040         ';
      TITLES[75] := 'LINE 7 - LINE 8                 ';
      TITLES[76] := 'TOTAL MED & DENTAL              ';
      TITLES[77] := 'STATE & LOCAL INCOME TAX        ';
      TITLES[78] := 'REAL ESTATE TAXES               ';
      TITLES[79] := 'GENERAL SALES TAXES             ';
      TITLES[80] := 'PERSONAL PROPERTY TAXES         ';
      TITLES[81] := 'OTHER TAXES                     ';
      TITLES[82] := 'TOTAL TAXES lines 11 to 15      ';
      TITLES[83] := 'HOME MORTGAGE INTEREST          ';
      TITLES[84] := 'CREDIT & CHARGE CARDS           ';
      TITLES[85] := 'OTHER INTEREST                  ';
      TITLES[86] := 'TOTAL INT (lines 17 to 19)      ';
END;

PROCEDURE INIT5;
   BEGIN
      TITLES[87] := 'CASH CONTRIBUTIONS              ';
      TITLES[88] := 'OTHER CASH CONTRIBUTIONS        ';
      TITLES[89] := 'CARRYOVER                       ';
      TITLES[90] := 'TOTAL CONTRIBUTIONS             ';
      TITLES[91] := 'LOSS BEFORE INSURANCE           ';
      TITLES[92] := 'INSURANCE REIMBURSEMENT         ';
      TITLES[93] := 'LINE 25 - LINE 26               ';
      TITLES[94] := '$100 OR LINE 27                 ';
      TITLES[95] := 'TOTAL  CASUALTY OR THEFT        ';
      TITLES[96] := 'UNION DUES                      ';
      TITLES[97] := 'OTHER MISC DEDUCTIONS           ';
      TITLES[98] := 'TOTAL MISCELLANEOUS             ';
      TITLES[99] := 'TOTAL MEDICAL & DENTAL          ';
      TITLES[100] := 'TOTAL TAXES                     ';
      TITLES[101] := 'TOTAL INTEREST                  ';
      TITLES[102] := 'TOTAL CONTRIBUTIONS             ';
      TITLES[103] := 'TOTAL CASUALTY OR THEFT         ';
      TITLES[104] := 'TOTAL MISCELLANEOUS             ';
      TITLES[105] := 'SUM (lines 33 to 38)            ';
      TITLES[106] := 'ADJUSTMENT                      ';
END;
```

Listing 12 continued:

```
PROCEDURE INIT6;
  BEGIN
    TITLES[107] := 'LINE 39 - LINE 40                  ';
    TITLES[108] := 'INTEREST INCOME                    ';
    TITLES[109] := 'TOTAL INTEREST INCOME              ';
    TITLES[110] := 'DIVIDEND INCOME                    ';
    TITLES[111] := 'TOTAL DIVIDEND INCOME              ';
    TITLES[112] := 'CAPITAL GAIN DISTRIBUTION          ';
    TITLES[113] := 'NONTAXABLE DISTRIBUTIONS           ';
    TITLES[114] := 'TOTAL (lines 5 & 6)                ';
    TITLES[115] := 'DIVIDENDS BEFORE EXCLUSIONS        ';

END;


BEGIN
  INIT1;
  INIT2;
  INIT3;
  INIT4;
  INIT5;
  INIT6;
  WRITEFILE;
  WAIT;
  READFILE;
END.
```

Listing 13: *The program TAXTABLE. Like TAXNAMES, this program is separate from FIT. TAXTABLE creates the array TAXRAY and writes the array to the disk file FACTORS.FTAX. TAXRAY is a three-dimensional array that holds the four factors needed to calculate a tax: the lower limit of a bracket, the upper limit, the minimum tax for the bracket, and the tax rate.*

```
{$L TTABLE.FRN.TEXT}

  PROGRAM TAXTABLE;        {creates a file of tax factors for use by FIT}

  TYPE
          TFACTORS=(LOWER,UPPER,BASE,PER);
          FACTORRAY=ARRAY [1..16,TFACTORS] OF INTEGER[9];
          T=ARRAY [1..4] OF FACTORRAY;

  VAR
          TY : T;
          TFILE  : FILE OF T;

  PROCEDURE WRITEFILE;
    BEGIN
      REWRITE(TFILE,'FACTORS.FTAX');
      TFILE^ := TY;
      PUT(TFILE);
      CLOSE(TFILE,LOCK);
    END;


    PROCEDURE INIT1A;
    {schedule X single tax payers lower bracket limit}
      BEGIN
        TY[1,1,LOWER]    := 230000;
        TY[1,2,LOWER]    := 340000;
        TY[1,3,LOWER]    := 440000;
        TY[1,4,LOWER]    := 650000;
        TY[1,5,LOWER]    := 850000;
        TY[1,6,LOWER]    := 1080000;
        TY[1,7,LOWER]    := 1290000;
        TY[1,8,LOWER]    := 1500000;
        TY[1,9,LOWER]    := 1820000;
        TY[1,10,LOWER]    := 2350000;
        TY[1,11,LOWER]    := 2880000;
        TY[1,12,LOWER]    := 3410000;
        TY[1,13,LOWER]    := 4150000;
        TY[1,14,LOWER]    := 5530000;
        TY[1,15,LOWER]    := 8180000;
        TY[1,16,LOWER]    := 1083000;
        END;

    PROCEDURE INIT1B;
    {schedule X single tax payers upper bracket limit}
      BEGIN
        TY[1,1,UPPER]    := 340000;
        TY[1,2,UPPER]    := 440000;
        TY[1,3,UPPER]    := 650000;
        TY[1,4,UPPER]    := 850000;
        TY[1,5,UPPER]    := 1080000;
        TY[1,6,UPPER]    := 1290000;
        TY[1,7,UPPER]    := 1500000;
        TY[1,8,UPPER]    := 1820000;
        TY[1,9,UPPER]    := 2350000;
        TY[1,10,UPPER]    := 2880000;
        TY[1,11,UPPER]    := 3410000;
        TY[1,12,UPPER]    := 4150000;
        TY[1,13,UPPER]    := 5530000;
        TY[1,14,UPPER]    := 8180000;
```

Listing 13 continued:

```
    TY[1,15,UPPER]    := 10830000;
    TY[1,16,UPPER]    := 99999999;
    END;

PROCEDURE INIT1C;
{schedule X single tax payers base tax}
  BEGIN
    TY[1,1,BASE ]    := 00;
    TY[1,2,BASE ]    := 15400;
    TY[1,3,BASE ]    := 31400;
    TY[1,4,BASE ]    := 62900;
    TY[1,5,BASE ]    := 107200;
    TY[1,6,BASE ]    := 155500;
    TY[1,7,BASE ]    := 205900;
    TY[1,8,BASE ]    := 260500;
    TY[1,9,BASE ]    := 356500;
    TY[1,10,BASE ]    := 536700;
    TY[1,11,BASE ]    := 743400;
    TY[1,12,BASE ]    := 976600;
    TY[1,13,BASE ]    := 1339200;
    TY[1,14,BASE ]    := 2098200;
    TY[1,15,BASE ]    := 3767700;
    TY[1,16,BASE ]    := 5569700;
    END;
PROCEDURE INIT1D;
{schedule X single tax payers
tax rate}
  BEGIN
    TY[1,1,PER] := 14;
    TY[1,2,PER] := 16;
    TY[1,3,PER] := 18;
    TY[1,4,PER] := 19;
    TY[1,5,PER] := 21;
    TY[1,6,PER] := 24;
    TY[1,7,PER] := 26;
    TY[1,8,PER] := 30;
    TY[1,9,PER] := 34;
    TY[1,10,PER] := 39;
    TY[1,11,PER] := 44;
    TY[1,12,PER] := 49;
    TY[1,13,PER] := 55;
    TY[1,14,PER] := 63;
    TY[1,15,PER] := 68;
    TY[1,16,PER] := 70;
  END;

PROCEDURE INIT2A;
{schedule Y married tax payers lower
bracket limit}
   BEGIN
     TY[2,1,LOWER]    := 340000;
     TY[2,2,LOWER]    := 550000;
     TY[2,3,LOWER]    := 760000;
     TY[2,4,LOWER]    := 119000;
     TY[2,5,LOWER]    := 160000;
     TY[2,6,LOWER]    := 2020000;
     TY[2,7,LOWER]    := 2460000;
     TY[2,8,LOWER]    := 2990000;
     TY[2,9,LOWER]    := 3520000;
     TY[2,10,LOWER]    := 4580000;
     TY[2,11,LOWER]    := 6000000;
     TY[2,12,LOWER]    := 8560000;
     TY[2,13,LOWER]    := 10940000;
     TY[2,14,LOWER]    := 16240000;
```

Listing 13 continued on page 410

Listing 13 continued:

```
    TY[2,15,LOWER]    := 21540000;
    TY[2,16,LOWER]    := 99999999;
  END;

 PROCEDURE INIT2B;
  BEGIN
    TY[2,1,UPPER]    := 550000;
    TY[2,2,UPPER]    := 760000;
    TY[2,3,UPPER]    := 119000;
    TY[2,4,UPPER]    := 160000;
    TY[2,5,UPPER]    := 2020000;
    TY[2,6,UPPER]    := 2460000;
    TY[2,7,UPPER]    := 2990000;
    TY[2,8,UPPER]    := 3520000;
    TY[2,9,UPPER]    := 4580000;
    TY[2,10,UPPER]    := 6000000;
    TY[2,11,UPPER]    := 8560000;
    TY[2,12,UPPER]    := 10940000;
    TY[2,13,UPPER]    := 16240000;
    TY[2,14,UPPER]    := 21540000;
    TY[2,15,UPPER]    := 99999999;
    TY[2,16,UPPER]    := 99999999;
  END;

 PROCEDURE INIT2C;
  BEGIN
    TY[2,1,BASE ]    := 00;
    TY[2,2,BASE ]    := 29400;
    TY[2,3,BASE ]    := 63000;
    TY[2,4,BASE ]    := 14040;
    TY[2,5,BASE ]    := 226500;
    TY[2,6,BASE ]    := 327300;
    TY[2,7,BASE ]    := 450500;
    TY[2,8,BASE ]    := 620100;
    TY[2,9,BASE ]    := 816200;
    TY[2,10,BASE ]    := 1272000;
    TY[2,11,BASE ]    := 1967800;
    TY[2,12,BASE ]    := 3350200;
    TY[2,13,BASE ]    := 4754400;
    TY[2,14,BASE ]    := 8146400;
    TY[2,15,BASE ]    := 11750400;
    TY[2,16,BASE ]    := 11750400;
  END;

 PROCEDURE INIT2D;
  BEGIN
    TY[2,1,PER] := 14;
    TY[2,2,PER] := 16;
    TY[2,3,PER] := 18;
    TY[2,4,PER] := 21;
    TY[2,5,PER] := 24;
    TY[2,6,PER] := 28;
    TY[2,7,PER] := 32;
    TY[2,8,PER] := 37;
    TY[2,9,PER] := 43;
    TY[2,10,PER] := 49;
    TY[2,11,PER] := 54;
    TY[2,12,PER] := 59;
    TY[2,13,PER] := 64;
    TY[2,14,PER] := 68;
    TY[2,15,PER] := 70;
    TY[2,16,PER] := 70;
  END;
```

Listing 13 continued:

```
PROCEDURE INIT3A;
{schedule YS married tax payers filing separately
 lower bracket limit}

  BEGIN
    TY[3,1,LOWER]    := 170000;
    TY[3,2,LOWER]    := 275000;
    TY[3,3,LOWER]    := 380000;
    TY[3,4,LOWER]    := 595000;
    TY[3,5,LOWER]    := 800000;
    TY[3,6,LOWER]    := 1010000;
    TY[3,7,LOWER]    := 1230000;
    TY[3,8,LOWER]    := 1495000;
    TY[3,9,LOWER]    := 1760000;
    TY[3,10,LOWER]    := 2290000;
    TY[3,11,LOWER]    := 3000000;
    TY[3,12,LOWER]    := 4280000;
    TY[3,13,LOWER]    := 5470000;
    TY[3,14,LOWER]    := 8120000;
    TY[3,15,LOWER]    := 10770000;
    TY[3,16,LOWER]    := 99999999;
  END;

PROCEDURE INIT3B;
  BEGIN
    TY[3,1,UPPER]    := 275000;
    TY[3,2,UPPER]    := 380000;
    TY[3,3,UPPER]    := 595000;
    TY[3,4,UPPER]    := 800000;
    TY[3,5,UPPER]    := 1010000;
    TY[3,6,UPPER]    := 1230000;
    TY[3,7,UPPER]    := 1495000;
    TY[3,8,UPPER]    := 1760000;
    TY[3,9,UPPER]    := 2290000;
    TY[3,10,UPPER]    := 3000000;
    TY[3,11,UPPER]    := 4280000;
    TY[3,12,UPPER]    := 5470000;
    TY[3,13,UPPER]    := 8120000;
    TY[3,14,UPPER]    := 1077000;
    TY[3,15,UPPER]    := 99999999;
    TY[3,16,UPPER]    := 99999999;
  END;

PROCEDURE INIT3C;
  BEGIN
    TY[3,1,BASE ]    := 00;
    TY[3,2,BASE ]    := 14700;
    TY[3,3,BASE ]    := 31500;
    TY[3,4,BASE ]    := 70200;
    TY[3,5,BASE ]    := 113250;
    TY[3,6,BASE ]    := 163650;
    TY[3,7,BASE ]    := 225250;
    TY[3,8,BASE ]    := 310050;
    TY[3,9,BASE ]    := 408100;
    TY[3,10,BASE ]    := 636000;
    TY[3,11,BASE ]    := 983900;
    TY[3,12,BASE ]    := 1675100;
    TY[3,13,BASE ]    := 2377200;
    TY[3,14,BASE ]    := 4073200;
    TY[3,15,BASE ]    := 5875200;
    TY[3,16,BASE ]    := 5875200;
  END;
```

Listing 13 continued on page 412

Listing 13 continued:

```
PROCEDURE INIT3D;
  BEGIN
    TY[3,1,PER] := 14;
    TY[3,2,PER] := 16;
    TY[3,3,PER] := 18;
    TY[3,4,PER] := 21;
    TY[3,5,PER] := 24;
    TY[3,6,PER] := 28;
    TY[3,7,PER] := 32;
    TY[3,8,PER] := 37;
    TY[3,9,PER] := 43;
    TY[3,10,PER] := 49;
    TY[3,11,PER] := 54;
    TY[3,12,PER] := 59;
    TY[3,13,PER] := 64;
    TY[3,14,PER] := 68;
    TY[3,15,PER] := 70;
    TY[3,16,PER] := 70;
  END;

PROCEDURE INIT4A;
{schedule Z head of household
lower bracket limit}

  BEGIN
    TY[4,1,LOWER]   := 230000;
    TY[4,2,LOWER]   := 440000;
    TY[4,3,LOWER]   := 650000;
    TY[4,4,LOWER]   := 870000;
    TY[4,5,LOWER]   := 1180000;
    TY[4,6,LOWER]   := 1500000;
    TY[4,7,LOWER]   := 1820000;
    TY[4,8,LOWER]   := 2350000;
    TY[4,9,LOWER]   := 2880000;
    TY[4,10,LOWER]   := 3410000;
    TY[4,11,LOWER]   := 4470000;
    TY[4,12,LOWER]   := 6060000;
    TY[4,13,LOWER]   := 8180000;
    TY[4,14,LOWER]   := 10800000;
    TY[4,15,LOWER]   := 16130000;
    TY[4,16,LOWER]   := 99999999;
  END;

PROCEDURE INIT4B;
  BEGIN
    TY[4,1,UPPER]   := 440000;
    TY[4,2,UPPER]   := 650000;
    TY[4,3,UPPER]   := 870000;
    TY[4,4,UPPER]   := 1180000;
    TY[4,5,UPPER]   := 1500000;
    TY[4,6,UPPER]   := 1820000;
    TY[4,7,UPPER]   := 2350000;
    TY[4,8,UPPER]   := 2880000;
    TY[4,9,UPPER]   := 3410000;
    TY[4,10,UPPER]   := 4470000;
    TY[4,11,UPPER]   := 6060000;
    TY[4,12,UPPER]   := 8180000;
    TY[4,13,UPPER]   := 10830000;
    TY[4,14,UPPER]   := 16130000;
    TY[4,15,UPPER]   := 99999999;
    TY[4,16,UPPER]   := 99999999;
  END;

PROCEDURE INIT4C;
  BEGIN
    TY[4,1,BASE ]   := 00;
    TY[4,2,BASE ]   := 29400;
    TY[4,3,BASE ]   := 63000;
    TY[4,4,BASE ]   := 102600;
    TY[4,5,BASE ]   := 170800;
    TY[4,6,BASE ]   := 247600;
    TY[4,7,BASE ]   := 330800;
    TY[4,8,BASE ]   := 495100;
    TY[4,9,BASE ]   := 685900;
    TY[4,10,BASE ]   := 908500;
    TY[4,11,BASE ]   := 1396100;
    TY[4,12,BASE ]   := 2254700;
    TY[4,13,BASE ]   := 3505500;
    TY[4,14,BASE ]   := 5175000;
    TY[4,15,BASE ]   := 8779000;
    TY[4,16,BASE ]   := 9999999;
  END;

PROCEDURE INIT4D;
  BEGIN
    TY[4,1,PER] := 14;
    TY[4,2,PER] := 16;
    TY[4,3,PER] := 18;
    TY[4,4,PER] := 22;
    TY[4,5,PER] := 24;
    TY[4,6,PER] := 26;
    TY[4,7,PER] := 31;
    TY[4,8,PER] := 36;
    TY[4,9,PER] := 42;
    TY[4,10,PER] := 46;
    TY[4,11,PER] := 54;
    TY[4,12,PER] := 59;
    TY[4,13,PER] := 63;
    TY[4,14,PER] := 68;
    TY[4,15,PER] := 70;
    TY[4,16,PER] := 70;
  END;

BEGIN
  INIT1A;INIT1B;INIT1C;INIT1D;
  INIT2A;INIT2B;INIT2C;INIT2D;
  INIT3A;INIT3B;INIT3C;INIT3D;
  INIT4A;INIT4B;INIT4C;INIT4D;
  WRITEFILE;
END.
```

Double-Width Silentype Graphics for Your Apple

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Now your Apple II computer can print double-sized graphics on your Silentype thermal printer. Using the method presented here, each pixel on the Apple's high-resolution (hi-res) screen is represented by a two-by-two array of dots on the printer.

To generate double-sized graphics, first load a picture into either of the Apple's hi-res screens. Then load the program given in listing 1 or 2 starting at hexadecimal location 800 (2048 decimal). Set the parameters according to table 1 and begin execution at 800 hexadecimal (using either 800G in the monitor or CALL 2048 from BASIC). The printer will dump the chosen hi-res page in either normal or inverse video mode.

How It Works

The Silentype printer is connected to the Apple with a small serial interface card that plugs into one of the peripheral slots inside the computer. This card provides two-way serial communications between the computer and the printer. If the card is plugged into peripheral slot 0, the output to the printer is addressed at hexadecimal memory location C081, and the input is at C084 (−16255 and −16252 in decimal). To determine the new port addresses if the card is plugged into a different slot, multiply the slot number by hexadecimal 10 (or 16 if working in decimal) and add the result to the above memory locations.

The high-order bit (7) of bytes read from the printer (location C084 hexadecimal) is set (1xxxxxxx) when the printhead is fully returned to the left margin and is reset (0xxxxxxx) if the printhead is anywhere else.

The Silentype expects data to be transmitted to it in 16-bit words, one for each movement of the printhead or paper roller. Since writing a byte of data to the output port at location C081 results in the low-order bit (0) being transmitted (only bit 0 of the

Text continued on page 423

Parameter Location Table

Parameter	Location	Setting
NORMAL / INVERT	\$803 (2051)	NORMAL = \$FF(255), INVERT = \$00 (0)
SLOT NUMBER	\$804 (2052)	SLOT 1 = \$10 (16), SLOT 2 = \$20 (32) ETC
HI-RES PAGE	\$805 (2053)	PAGE 1 = \$20 (32), PAGE 2 = \$40 (64)
PAGE LENGTH	\$806 (2054)	159 LINES = \$9F, 192 LINES = \$C0

Table 1: *Parameters which must be set before running the Silentype thermal-printer double-width graphics program. The desired parameter values are stored in the memory locations shown.*

Listing 1: *A 6502 assembly-language program that will provide hard copy of Apple graphics displays by dumping the contents of the Apple high-resolution graphics screen to the Silentype thermal printer. This screen print uses a two-by-two array of dots on the paper for each pixel on the screen. The program is loaded and executed at memory location 800 hexadecimal (2048 decimal).*

```
ASM

0800- 4C 7F 09 1000 GRAPH  JMP PICTUR   GET RIGHT TO IT
               1010 *
               1020 *
               1030 *---------------------------------*
               1040 *
               1050 *
               1060 * INPUT AND OUTPUT ADDRESSES
               1070 *
               1080 *
               1090 *
C081-          1100 STROBE .EQ $C081    PRINTER STROBE
C084-          1110 RETURN .EQ $C084    PRINTER CARRIAGE RETURNED
               1120 *
               1130 *
               1140 *---------------------------------*
               1150 *
               1160 *
               1170 *  CONSTANTS AND VARIABLES
               1180 *
               1190 *
               1200 *
0803- FF       1210 NEG    .DA #$FF     POS/NEG PICTURE (POS = $FF , NEG = $00)
0804- 10       1220 SLOT   .DA #$10     SLOT NUMBER ( SLOT ONE )
0805- 20       1230 PAGE   .DA #$20     HI RES PAGE (PAGE 1 = 20 , PAGE 2 = 40)
0806- C0       1240 LEN    .DA #$C0     HI RES PAGE LENGTH ($9F=157 , $C0=192)
0807- 00       1250 DOTS   .DA #*-*     DOTS DATA
0808- 00       1260 WINDS  .DA #*-*     WINDING DATA
0809- 00       1270 STEPX  .DA #*-*     OLD X STEP
080A- 00       1280 STEPY  .DA #*-*     OLD Y STEP
080B- 00       1290 DIRX   .DA #*-*     X DIRECTION
080C- 00       1300 DIRY   .DA #*-*     Y DIRECTION
080D- 00       1310 SUML   .DA #*-*     SUM - LOW BYTE
080E- 00       1320 SUMH   .DA #*-*     SUM - HIGH BYTE
080F- 03       1330 WIND   .DA #$03     STEPPER WINDING TABLE
0810- 02       1340        .DA #$02
0811- 06       1350        .DA #$06
0812- 04       1360        .DA #$04
0813- 0C       1370        .DA #$0C
0814- 08       1380        .DA #$08
0815- 09       1390        .DA #$09
0816- 01       1400        .DA #$01
0817- 00       1410 XL     .DA #*-*     PIXEL X COORDINATE - LOW BYTE
0818- 00       1420 XH     .DA #*-*     PIXEL X COORDINATE - HIGH BYTE
0819- 00       1430 Y      .DA #*-*     PIXEL Y COORDINATE
0060-          1440 ADRESL .EQ $60      Y ADDRESS - LOW BYTE
0061-          1450 ADRESH .EQ $61      Y ADDRESS - HIGH BYTE
081A- 00       1460 XMOD7  .DA #*-*     TEMP FOR REMAINDER
081B- 00       1470 ADRESX .DA #*-*     X ADDRESS - USED AS INDEX
081C- 00       1480 XMASK  .DA #*-*     MASK FOR PIXEL
081D- 00       1490 PRINT  .DA #*-*     PRINT LINE FOR TRANSLATION
               1500 *
```

Listing 1 continued:

```
                  1510 *
                  1520 *--------------------------------*
                  1530 *
                  1540 *
                  1550 * ROUTINE TO CLOCK DATA TO PRINTER INTERFACE
                  1560 *
                  1570 * X REGISTER CONTAINS SLOT NUMBER TIMES SIXTEEN
                  1580 * DOTS AND WINDS ARE CHANGED UPON EXIT
                  1590 *
                  1600 *
081E- AE 04 08 1610 CLOCK  LDX SLOT      GET SLOT NUMBER
0821- A0 10    1620        LDY #$10      SET INDEX
0823- AD 07 08 1630 CLK1   LDA DOTS      GET BOTTOM WORD
0826- 29 01    1640        AND #$01      MASK IT
0828- 09 0E    1650        ORA #$0E      MAKE E OR F
082A- 9D 81 C0 1660        STA STROBE,X CLOCK IT IN
082D- 6E 08 08 1670        ROR WINDS     SHIFT TOP WORD
0830- 6E 07 08 1680        ROR DOTS      CARRY INTO BOTTOM
0833- 88       1690        DEY           DEC LOOP
0834- D0 ED    1700        BNE CLK1      DONE 16 TIMES ?
0836- A9 1C    1710        LDA #$1C      *
0838- 9D 81 C0 1720        STA STROBE,X *
083B- A9 18    1730        LDA #$18      *
083D- 9D 81 C0 1740        STA STROBE,X CLOCK IN
0840- A9 1C    1750        LDA #$1C      THE FOUR STOP CODES
0842- 9D 81 C0 1760        STA STROBE,X *
0845- A9 0C    1770        LDA #$0C      *
0847- 9D 81 C0 1780        STA STROBE,X *
084A- 60       1790        RTS
               1800 *
               1810 *
               1820 *---------------------------------*
               1830 *
               1840 *
               1850 *  ROUTINE TO PRINT DOTS
               1860 *
               1870 *
084B- A9 00    1880 PRINTS LDA #$00
084D- 8D 08 08 1890        STA WINDS     NO MOVEMENT
0850- 20 1E 08 1900        JSR CLOCK     SEND IT
0853- A0 02    1910        LDY #$02      DELAY LOOP
0855- A2 FF    1920        LDX #$FF      FOR DARKER PRINT - LENGTHEN THIS DELAY
0857- CA       1930 PRIN1  DEX
0858- D0 FD    1940        BNE PRIN1     ENOUGH X ?
085A- 88       1950        DEY
085B- D0 FA    1960        BNE PRIN1     ENOUGH Y ?
085D- 60       1970        RTS
               1980 *
               1990 *
               2000 *--------------------------------*
               2010 *
               2020 *
               2030 * ROUTINE TO INCREMENT OR DECREMENT
               2040 * POINTER TO WINDING TABLE AND KEEP
               2050 * IT IN THE RANGE 0 TO 7
```

Listing 1 continued on page 416

Listing 1 continued:

```
              *
              *
085E- 10 07   STEPER BPL STEP1     POSITIVE STEP
0860- CA             DEX           DEC STEP
0861- 10 0C          BPL STEP2     WRAPAROUND?
0863- A2 07          LDX #$07      START AT TOP
0865- 10 08          BPL STEP2     ALWAYS JUMP
0867- E8      STEP1  INX           INC STEP
0868- 8A             TXA
0869- C9 08          CMP #$08      WRAPAROUND?
086B- 90 02          BCC STEP2     NO
086D- A2 00          LDX #$00      START AT BOTTOM
086F- 60      STEP2  RTS
              *
              *
              *-------------------------------*
              *
              *
              * ROUTINE TO MOVE ALONG Y AXIS (CARRIAGE)
              *
              *
0870- AE 0A 08 MOVEY LDX STEPY     GET OLD Y STEP
0873- AD 0C 08       LDA DIRY      GET Y DIRECTION
0876- F0 1E          BEQ MOVEY2    NO MOVEMENT ?
0878- 20 5E 08       JSR STEPER    INC OR DEC
087B- 8E 0A 08       STX STEPY     SAVE NEW POSITION
087E- BD 0F 08       LDA WIND,X    GET Y WINDINGS
0881- 8D 08 08       STA WINDS     PASS IT
0884- A9 00          LDA #$00
0886- 8D 07 08       STA DOTS      NO DOTS
0889- 20 1E 08       JSR CLOCK     CLOCK THE DATA
088C- A0 11          LDY #$11      DELAY LOOP
088E- A2 FF          LDX #$FF
0890- CA      MOVEY1 DEX
0891- D0 FD          BNE MOVEY1    ENOUGH X ?
0893- 88             DEY
0894- D0 FA          BNE MOVEY1    ENOUGH Y ?
0896- 60      MOVEY2 RTS
              *
              *
              *-------------------------------*
              *
              *
              * ROUTINE TO MOVE ALONG X AXIS (PRINTHEAD)
              *
              *
0897- AE 09 08 MOVEX LDX STEPX     GET OLD X STEP
089A- AD 0B 08       LDA DIRX      GET X DIRECTION
089D- F0 22          BEQ MOVEX2    NO MOVEMENT ?
089F- 20 5E 08       JSR STEPER    INC OR DEC
08A2- 8E 09 08       STX STEPX     SAVE NEW POSITION
08A5- BD 0F 08       LDA WIND,X   GET Y WINDINGS
08A8- 0A             ASL
08A9- 0A             ASL
08AA- 0A             ASL
08AB- 0A             ASL           NOW X WINDINGS
```

Listing 1 continued:

```
08AC- 8D 08 08          STA WINDS
08AF- A9 00             LDA #$00
08B1- 8D 07 08          STA DOTS      NO DOTS
08B4- 20 1E 08          JSR CLOCK     CLOCK THE DATA
08B7- A0 02             LDY #$02      DELAY LOOP
08B9- A2 40             LDX #$40
08BB- CA         MOVEX1 DEX
08BC- D0 FD             BNE MOVEX1    ENOUGH X ?
08BE- 88                DEY
08BF- D0 FA             BNE MOVEX1    ENOUGH Y ?
08C1- 60         MOVEX2 RTS
                 *
                 *
                 *----------------------------------
                 *
                 *
                 * ROUTINE TO CALCULATE ADDRESS OF
                 * PIXEL AT XH,XL  AND Y AND RETURN
                 * ACC POSITIVE IF ITS ON
                 *
                 *
08C2- AD 19 08   PIXEL  LDA Y         GET Y
08C5- 29 07             AND #$07      GET Y2 - Y0
08C7- 18                CLC
08C8- 2A                ROL
08C9- 2A                ROL           MOVE INTO POSITION
08CA- 85 61             STA ADRESH
08CC- AD 19 08          LDA Y         GET Y AGAIN
08CF- 29 30             AND #$30      MASK INTO Y5 - Y4
08D1- 4A                LSR
08D2- 4A                LSR
08D3- 4A                LSR
08D4- 4A                LSR           MOVE INTO BOTTOM TWO BITS
08D5- 05 61             ORA ADRESH    ADD TO EXISTING
08D7- 0D 05 08          ORA PAGE      HI RES PAGE
08DA- 85 61             STA ADRESH    FINISHED WITH ADRESH
08DC- AD 19 08          LDA Y
08DF- 29 08             AND #$08      GET Y3 ONLY
08E1- 18                CLC
08E2- 2A                ROL
08E3- 2A                ROL
08E4- 2A                ROL
08E5- 2A                ROL           MOVE INTO ADRESL BIT 7
08E6- 85 60             STA ADRESL
08E8- AD 19 08          LDA Y
08EB- 29 40             AND #$40      CHECK Y6
08ED- F0 06             BEQ ADD1      ZERO ?
08EF- A5 60             LDA ADRESL
08F1- 69 28             ADC #$28      ONE LINE OF PIXELS ( 40 DEC )
08F3- 85 60             STA ADRESL
08F5- AD 19 08   ADD1   LDA Y
08F8- 29 80             AND #$80      CHECK Y7
08FA- F0 06             BEQ ADD2      ZERO ?
08FC- A5 60             LDA ADRESL
08FE- 69 50             ADC #$50      TWO LINES OF PIXELS ( 80 DEC )
```

Listing 1 continued on page 418

Listing 1 continued:

```
0900- 85 60     3170        STA ADRESL
0902- 38        3180 ADD2   SEC
0903- A2 00     3190        LDX #$00       INITIALIZE COUNT
0905- AD 17 08  3200        LDA XL
0908- 8D 0D 08  3210        STA SUML       USE AS TEMP
090B- AD 18 08  3220        LDA XH
090E- 8D 0E 08  3230        STA SUMH       USE AS TEMP
0911- AD 0D 08  3240 ADD3   LDA SUML       BEGIN DIVIDE
0914- E9 07     3250        SBC #$07       BY SEVEN
0916- 8D 0D 08  3260        STA SUML
0919- AD 0E 08  3270        LDA SUMH
091C- E9 00     3280        SBC #$00
091E- 8D 0E 08  3290        STA SUMH
0921- 30 04     3300        BMI ADD4       BELOW ZERO ?
0923- E8        3310        INX            ADD TO COUNT OF SUBTRACTIONS
0924- 4C 11 09  3320        JMP ADD3       REPEAT
0927- AD 0D 08  3330 ADD4   LDA SUML       GET SUML AGAIN
092A- 69 07     3340        ADC #$07       RESTORE TO > ZERO
092C- 8D 1A 08  3350        STA XMOD7      REMAINDER
092F- 8E 1B 08  3360        STX ADRESX     LATER INDEX
0932- 18        3370        CLC
0933- A9 01     3380        LDA #$01       BUILD MASK
0935- AE 1A 08  3390        LDX XMOD7
0938- CA        3400 ADD5   DEX
0939- 30 04     3410        BMI ADD6       SHIFT IF POSITIVE
093B- 2A        3420        ROL            SHIFT MASK
093C- 4C 38 09  3430        JMP ADD5       REPEAT
093F- 8D 1C 08  3440 ADD6   STA XMASK      NOW WILL MASK CORRECT BIT
0942- AC 1B 08  3450        LDY ADRESX     USE FOR INDEX
0945- B1 60     3460        LDA (ADRESL),Y
0947- 4D 03 08  3470        EOR NEG        SHOULD WE INVERT
094A- 2D 1C 08  3480        AND XMASK      EXTRACT PIXEL
094D- 60        3490        RTS            PIXEL ON IF ACC = 1 (POSITIVE CASE)
                3500 *
                3510 *
                3520 *---------------------------------*
                3530 *
                3540 *
                3550 * ROUTINE TO RETURN PRINTHEAD AND
                3560 * SPACE CARRIAGE DOWN SIX DOTS
                3570 *
                3580 *
094E- A9 FF     3590 CARRET LDA #$FF       SOMETHING NEGATIVE
0950- 8D 0B 08  3600        STA DIRX       RETURN PRINTHEAD
0953- 20 97 08  3610 CAR1   JSR MOVEX      NUDGE IT
0956- AE 04 08  3620        LDX SLOT       GET SLOT NUMBER
0959- BD 84 C0  3630        LDA RETURN,X CHECK MICROSWITCH
095C- 10 F5     3640        BPL CAR1       KEEP NUDGING
095E- A9 01     3650        LDA #$01       SOMETHING POSITIVE
0960- 8D 0B 08  3660        STA DIRX       NOW BACK A LITTLE
0963- AE 04 08  3670 CAR2   LDX SLOT       GET SLOT NUMBER
0966- BD 84 C0  3680        LDA RETURN,X GET STATUS
0969- 10 06     3690        BPL CAR3       ENOUGH ?
096B- 20 97 08  3700        JSR MOVEX      NO, NOT QUITE
096E- 4C 63 09  3710        JMP CAR2       KEEP GOING
0971- A9 06     3720 CAR3   LDA #$06       SIX DOTS TOTAL
```

Listing 1 continued:

```
0973- 8D 0C 08 3730        STA DIRY
0976- 20 70 08 3740 CAR4   JSR MOVEY    MOVE DOWN ONE STEP
0979- CE 0C 08 3750        DEC DIRY     DIRY = DIRY - 1
097C- D0 F8    3760        BNE CAR4     AGAIN ?
097E- 60       3770        RTS
               3780 *
               3790 *
               3800 *--------------------------------*
               3810 *
               3820 *
               3830 *  ROUTINE TO TRANSFER HI RES SCREEN TO SILENTYPE
               3840 *
               3850 *
097F- 20 4E 09 3860 PICTUR JSR CARRET   START AT RIGHT PLACE
0982- A9 00    3870        LDA #$00     INITIALIZE
0984- 8D 19 08 3880        STA Y        Y = 0
0987- A9 0C    3890 PICT1  LDA #$0C     XL = LEFT EDGE (CLIPPED)
0989- 8D 17 08 3900        STA XL
098C- A9 00    3910        LDA #$00     XH = 0
098E- 8D 18 08 3920        STA XH
0991- A9 00    3930 PICT2  LDA #$00
0993- 8D 1D 08 3940        STA PRINT    PRINTLINE = 0
0996- 20 C2 08 3950        JSR PIXEL    CHECK FIRST DOT
0999- F0 08    3960        BEQ PICT3    PIXEL ON ?
099B- A9 03    3970        LDA #$03     TOP TWO DOTS
099D- 6D 1D 08 3980        ADC PRINT
09A0- 8D 1D 08 3990        STA PRINT    ADD TO PRINTLINE
09A3- EE 19 08 4000 PICT3  INC Y        NEXT PIXEL
09A6- 20 C2 08 4010        JSR PIXEL    CHECK SECOND PIXEL
09A9- F0 08    4020        BEQ PICT4    PIXEL ON ?
09AB- A9 0C    4030        LDA #$0C     MIDDLE TWO DOTS
09AD- 6D 1D 08 4040        ADC PRINT
09B0- 8D 1D 08 4050        STA PRINT    ADD TO PRINTLINE
09B3- EE 19 08 4060 PICT4  INC Y        NEXT PIXEL
09B6- 20 C2 08 4070        JSR PIXEL    CHECK THIRD PIXEL
09B9- F0 08    4080        BEQ PICT5    PIXEL ON ?
09BB- A9 30    4090        LDA #$30     BOTTOM TWO DOTS
09BD- 6D 1D 08 4100        ADC PRINT
09C0- 8D 1D 08 4110        STA PRINT    ADD TO PRINTLINE
09C3- AD 1D 08 4120 PICT5  LDA PRINT    PUT IT DOTS
09C6- 8D 07 08 4130        STA DOTS
09C9- 20 4B 08 4140        JSR PRINTS   PLOT THREE PIXELS
09CC- A9 01    4150        LDA #$01     MOVE RIGHT ONE DOT
09CE- 8D 0B 08 4160        STA DIRX
09D1- 20 97 08 4170        JSR MOVEX
09D4- 20 97 08 4180        JSR MOVEX
09D7- AD 1D 08 4190        LDA PRINT
09DA- 8D 07 08 4200        STA DOTS
09DD- 20 4B 08 4210        JSR PRINTS   DO IT AGAIN
09E0- A9 01    4220        LDA #$01
09E2- 8D 0B 08 4230        STA DIRX
09E5- 20 97 08 4240        JSR MOVEX    MOVE RIGHT ONE DOT
09E8- 20 97 08 4250        JSR MOVEX
09EB- EE 17 08 4260        INC XL       X = X + 1
09EE- D0 03    4270        BNE PICT6    CARRY TO XH ?
```

Listing 1 continued on page 420

Listing 1 continued:

```
09F0- EE 18 08              INC XH
09F3- CE 19 08       PICT6  DEC Y
09F6- CE 19 08              DEC Y         Y = Y - 2
09F9- A9 0C                 LDA #$0C      XL = 0C ? (XL,XH = 268 , CLIPPED)
09FB- CD 17 08              CMP XL
09FE- D0 91                 BNE PICT2     NOT AT END YET
0A00- A9 01                 LDA #$01      XH = 1 ?
0A02- CD 18 08              CMP XH
0A05- D0 8A                 BNE PICT2     NOT AT END YET
0A07- EE 19 08       PICT7  INC Y
0A0A- EE 19 08              INC Y
0A0D- EE 19 08              INC Y         Y = Y + 3
0A10- AD 19 08              LDA Y
0A13- CD 06 08              CMP LEN       HI RES PAGE END
0A16- B0 06                 BCS PICT8     WE'RE DONE
0A18- 20 4E 09              JSR CARRET    START NEW PRINT LINE
0A1B- 4C 87 09              JMP PICT1
0A1E- AE 04 08       PICT8  LDX SLOT      GET SLOT NUMBER
0A21- A9 00                 LDA #$00      GET ZERO
0A23- 9D 81 C0              STA STROBE,X  MAKE SURE PRINTER WINDINGS ARE OFF
0A26- 60                    RTS
```

SYMBOL TABLE

	0823- CLK1	0987- PICT1	0867- STEP1
08F5- ADD1	081E- CLOCK	0991- PICT2	086F- STEP2
0902- ADD2	080B- DIRX	09A3- PICT3	085E- STEPER
0911- ADD3	080C- DIRY	09B3- PICT4	0809- STEPX
0927- ADD4	0807- DOTS	09C3- PICT5	080A- STEPY
0938- ADD5	0800- GRAPH	09F3- PICT6	C081- STROBE
093F- ADD6	0806- LEN	0A07- PICT7	080E- SUMH
0061- ADRESH	0897- MOVEX	0A1E- PICT8	080D- SUML
0060- ADRESL	08BB- MOVEX1	097F- PICTUR	080F- WIND
081B- ADRESX	08C1- MOVEX2	08C2- PIXEL	0808- WINDS
0953- CAR1	0870- MOVEY	0857- PRIN1	0818- XH
0963- CAR2	0890- MOVEY1	081D- PRINT	0817- XL
0971- CAR3	0896- MOVEY2	084B- PRINTS	081C- XMASK
0976- CAR4	0803- NEG	C084- RETURN	081A- XMOD7
094E- CARRET	0805- PAGE	0804- SLOT	0819- Y

Listing 2: *If you do not have a 6502 assembler for your Apple, you can enter this previously assembled version of the graphics-print program directly into the Apple's memory using the machine-language monitor.*

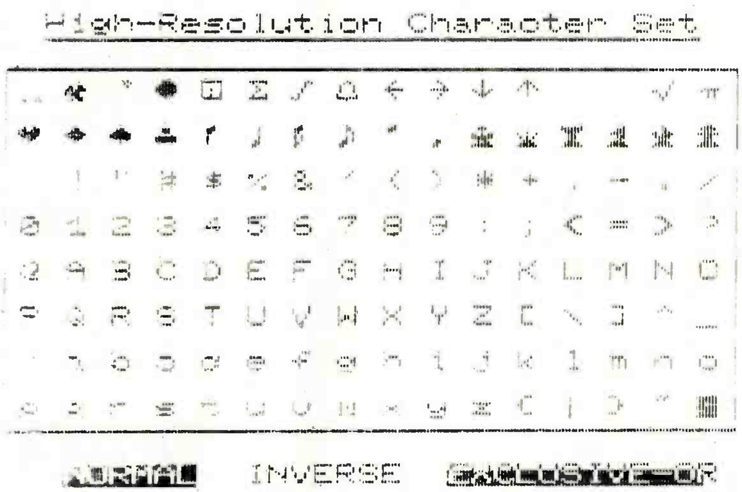
```
:$800.A26

0800- 4C 7F 09 FF 10 20 C0 00
0808- 00 00 00 00 00 00 00 03
0810- 02 06 04 0C 08 09 01 00
0818- 00 00 00 00 00 00 AE 04
0820- 08 A0 10 AD 07 08 29 01
0828- 09 0E 9D 81 C0 6E 08 08
0830- 6E 07 08 88 D0 ED A9 1C
0838- 9D 81 C0 A9 18 9D 81 C0
0840- A9 1C 9D 81 C0 A9 0C 9D
0848- 81 C0 60 A9 00 8D 08 08
0850- 20 1E 08 A0 02 A2 FF CA
0858- D0 FD 88 D0 FA 60 10 07
0860- CA 10 0C A2 07 10 08 E8
0868- 8A C9 08 90 02 A2 00 60
0870- AE 0A 08 AD 0C 08 F0 1E
0878- 20 5E 08 8E 0A 08 BD 0F
0880- 08 8D 08 08 A9 00 8D 07
0888- 08 20 1E 08 A0 11 A2 FF
0890- CA D0 FD 88 D0 FA 60 AE
0898- 09 08 AD 0B 08 F0 22 20
08A0- 5E 08 8E 09 08 BD 0F 08
08A8- 0A 0A 0A 0A 8D 08 08 A9
08B0- 00 8D 07 08 20 1E 08 A0
08B8- 02 A2 40 CA D0 FD 88 D0
08C0- FA 60 AD 19 08 29 07 18
08C8- 2A 2A 85 61 AD 19 08 29
08D0- 30 4A 4A 4A 4A 05 61 0D
08D8- 05 08 85 61 AD 19 08 29
08E0- 08 18 2A 2A 2A 2A 85 60
08E8- AD 19 08 29 40 F0 06 A5
08F0- 60 69 28 85 60 AD 19 08
08F8- 29 80 F0 06 A5 60 69 50
0900- 85 60 38 A2 00 AD 17 08
0908- 8D 0D 08 AD 18 08 8D 0E
0910- 08 AD 0D 08 E9 07 8D 0D
0918- 08 AD 0E 08 E9 00 8D 0E
0920- 08 30 04 E8 4C 11 09 AD
0928- 0D 08 69 07 8D 1A 08 8E
0930- 1B 08 18 A9 01 AE 1A 08
0938- CA 30 04 2A 4C 38 09 8D
0940- 1C 08 AC 1B 08 B1 60 4D
0948- 03 08 2D 1C 08 60 A9 FF
0950- 8D 0B 08 20 97 08 AE 04
0958- 08 BD 84 C0 10 F5 A9 01
0960- 8D 0B 08 AE 04 08 BD 84
0968- C0 10 06 20 97 08 4C 63
0970- 09 A9 06 8D 0C 08 20 70
0978- 08 CE 0C 08 D0 F8 60 20
0980- 4E 09 A9 00 8D 19 08 A9
0988- 0C 8D 17 08 A9 00 8D 18
0990- 08 A9 00 8D 1D 08 20 C2
0998- 08 F0 08 A9 03 6D 1D 08
09A0- 8D 1D 08 EE 19 08 20 C2
09A8- 08 F0 08 A9 0C 6D 1D 08
```

Listing 2 continued:

```
09B0- 8D 1D 08 EE 19 08 20 C2
09B8- 08 F0 08 A9 30 6D 1D 08
09C0- 8D 1D 08 AD 1D 08 8D 07
09C8- 08 20 4B 08 A9 01 8D 0B
09D0- 08 20 97 08 20 97 08 AD
09D8- 1D 08 8D 07 08 20 4B 08
09E0- A9 01 8D 0B 08 20 97 08
09E8- 20 97 08 EE 17 08 D0 03
09F0- EE 18 08 CE 19 08 CE 19
09F8- 08 A9 0C CD 17 08 D0 91
0A00- A9 01 CD 18 08 D0 8A EE
0A08- 19 08 EE 19 08 EE 19 08
0A10- AD 19 08 CD 06 08 B0 06
0A18- 20 4E 09 4C 87 09 AE 04
0A20- 08 A9 00 9D 81 C0 60
```

Listing 3: *Several examples of Apple high-resolution pictures printed on a Silentype using the author's double-width graphics-print routine.*



Text continued from page 413:
output port is connected to the serial data line), 16 bytes of data must be written to the port for each command sent to the printer. Bits 1, 2, and 3 of each byte have been set as guard bits to prevent confusion over the value of bit 0. Once the 16 data bytes have been stored to the output location, 4 stop bits must be transmitted to inform the printer that we have reached the end of a command word. An example of a typical transmission is given in table 2.

The first 7 bits of the 2 transmission bytes control the thermal printhead. The thermal printhead consists of seven resistors (transistors are also used) deposited on a ceramic base. When these elements are heated, a dot will appear on the paper if the printhead is allowed to dwell at that position. The darkness of the dot will depend on the dwell time. (Darkness may also be controlled by multiple firings of the thermal elements.)

The stepper-motor windings are controlled by the last 8 data bits. (Bit 8 is not used as far as I can determine.) In the Silentype, there are separate stepper motors to move the drive roller and the thermal printhead. Both motors are identical four-winding stepper motors with 48 steps per revolution. To step either motor, you must know the last step made and energize the windings for the next step. In the full-step sequence (used by the Silentype routines) there are four steps. I use an 8-step sequence (called electronic half-stepping) for slightly smoother operation. Table 3 shows the two stepping sequences for the printhead motor. The carriage motor is similar, but the upper 4 bits are used. Either motor can be stepped clockwise or counterclockwise by exercising the stepping sequence in reverse order.

Fine Tuning

The dot density can be adjusted by changing the delays in the PRINT DOTS routine. The 2-byte value is at locations 854 and 856 hexadecimal (2132 and 2134 decimal). The current delay value is 02FF (767). The movement of the printhead can be speeded up or slowed down by the delay values in locations 8B8 and 8BA hexadecimal (2232 and 2234 decimal). The delay I found to give the fastest movement without any skipping was 0240 (576). Likewise, the movements of the carriage can be speeded up or slowed down by the delay values at locations 88D and 88F hexadecimal (2189 and 2191 decimal). The carriage has considerably more inertia so this delay value is currently 11FF hexadecimal (4607 decimal). The PICTUR routine can print the lines of pixels only in multiples of three (printhead dot 7 is not used) so the page length parameter in location 806 hexadecimal (2054 decimal) prints 159 lines (9F in hexadecimal) instead of 160.

One likely reason that Apple did not develop the double-sized graphics is that some pixels have to be clipped from the left and right edges because of paper size. I clip twelve vertical rows from each side of the screen. In most cases, this still gives a good picture, but these limits can be changed if necessary. The left edge is checked at location 987, and the right edge is checked at 9F9.

With the basics of the Silentype printer in mind, the operation of the assembly-language routines should be fairly clear. Now—double your fun with Silentype.■

Transmission Details

$1E or $1F	Data bit 1 =	Printhead dot 1 (top dot)
$1E or $1F	Data bit 2 =	Printhead dot 2
$1E or $1F	Data bit 3 =	Printhead dot 3
$1E or $1F	Data bit 4 =	Printhead dot 4
$1E or $1F	Data bit 5 =	Printhead dot 5
$1E or $1F	Data bit 6 =	Printhead dot 6
$1E or $1F	Data bit 7 =	Printhead dot 7 (bottom dot)
$1E or $1F	Data bit 8 =	Not Used (?)
$1E or $1F	Data bit 9 =	Drive roller stepper winding 1
$1E or $1F	Data bit 10 =	Drive roller stepper winding 2
$1E or $1F	Data bit 11 =	Drive roller stepper winding 3
$1E or $1F	Data bit 12 =	Drive roller stepper winding 4
$1E or $1F	Data bit 13 =	Printhead stepper winding 1
$1E or $1F	Data bit 14 =	Printhead stepper winding 2
$1E or $1F	Data bit 15 =	Printhead stepper winding 3
$1E or $1F	Data bit 16 =	Printhead stepper winding 4
$1C	Stop bit	
$18	Stop bit	
$1C	Stop bit	
$0C	Stop bit	

Table 2: *Details of the 20-bit command word which controls the Silentype printer. Each of the first 7 bits corresponds to a thermal element in the printhead or one dot on the paper. Bits 9 through 12 control the stepping of the paper roller motor, while bits 13 through 16 control the motor, which positions the printhead. The 4 stop bits inform the printer that the current command word has ended.*

Full Step Sequence

Step	Winding W4	W3	W2	W1	Hex
1	0	0	1	1	$03
2	0	1	1	0	$06
3	1	1	0	0	$0C
4	1	0	0	1	$09

Half Step Sequence

Step	Winding W1	W2	W3	W4	Hex
1	0	0	1	1	$03
2	0	0	1	0	$02
3	0	1	1	0	$06
4	0	1	0	0	$04
5	1	1	0	0	$0C
6	1	0	0	0	$08
7	1	0	0	1	$09
8	0	0	0	1	$01

Table 3: *To control the two stepper motors in the Silentype printer, these 4-bit codes are inserted into the command word described in table 2. Each motor-control sequence must be transmitted sequentially, as shown; skipping a code will result in improper operation. Transmitting the sequence in reverse order will step the motors in the opposite direction. The author uses the half-step sequence for smoother operation.*

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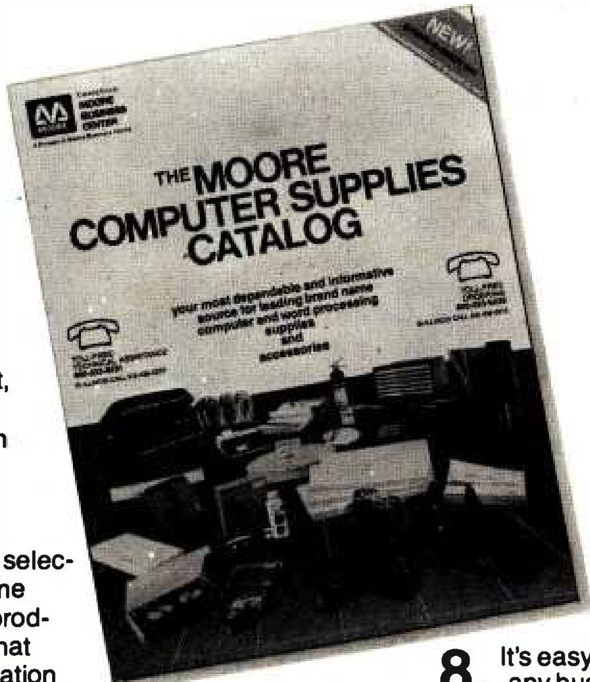

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SYSTEMS

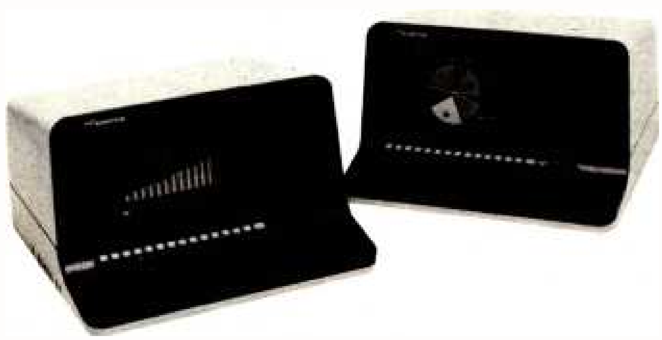
Single-Board for Multiusers

The single-board Net/82 gives S-100-bus-system users complete networking capabilities, including bank-switched memory and parity checking for detection of memory malfunctions. The Net/82 features a Z80A processor, two serial ports, optional floating-point processor, interrupt controller, shadow EPROM (erasable programmable read-only memory), a real-time clock, and an S-100 parallel port for communication with the master processor.

The Net/82 is compatible with the MuDOS, CP/M, MP/M, and CP/Net operating systems. The 128K-byte bank-switched memory option allows the program to select from 48 to 63K bytes of user-programmable memory, controlled through an I/O (input/output) port. Each serial port can be customized for a variety of applications, such as an interface with a serial printer. The interrupt controller provides standard interrupt configurations by means of jumper plugs, but wire-wrap connections can be made to achieve special interrupt configurations. The real-time clock provides a 60-Hz interrupt source, which is derived from the data-rate clock. In a networking configuration, the Net/82 performs as a slave processor. Each slave operates independently, except for resource queuing in the master, which makes the entire system appear to be dedicated to each user. The master processor has complete control over each slave and can reset or interrupt a slave at any time.

The Net/82 costs $1395 or, with 128K bytes and the floating-point processor, $1995. Contact MuSYS Corp., Suite 11, 1451 Irvine Blvd., Tustin, CA 92680, (714) 750-5693.

Circle 426 on inquiry card.



North Star Takes Advantage

North Star Computers' new Advantage stand-alone desktop microcomputer system has full graphics capabilities. The fully integrated system is capable of producing bar and pie charts, plotted graphics, and three-dimensional visual displays. The Advantage features two integrated double-sided double-density floppy-disk drives, an 87-key typewriter-style keyboard with 15 programmable function keys, a 12-inch video-display screen, business-graphics software, self-diagnostic capabilities, and compatibility with Horizon series software.

The Advantage is compatible with all the North Star-developed software for the Horizon series. Optional software packages that support the CP/M operating system and North Star's application-support packages for word and data processing are available. In the future, North Star's Advantage and Horizon series computers will be enhanced to attach directly to local networks. This allows business users to decide now in favor of single- or multiuser systems without fear of short-term obsolescence.

The Advantage costs $3999. Contact North Star Computers Inc., 14440 Catalina St., San Leandro, CA 94577, (415) 357-8500.

Circle 427 on inquiry card.

Multiuser Development System

Ithaca Intersystems' DPS-8000 is a 16-bit, Z8000-based, multiuser system. It features a 20-slot S-100 mainframe, advanced memory management with up to 128K bytes of protected memory per user, 2.5 megabytes of parity memory in 256K-byte increments, serial and parallel I/O (input/output), and DMA (direct memory access) hard-disk controller with 32-bit error checking and control.

The DPS-8000 has an advanced multiuser and multitasking Unix-compatible operating system called Coherent. Coherent has a full range of utilities and compilers, file and device handling capabilities, and real-time responsiveness. Also included is Interpak 8000—a special set of utilities designed to aid programmers in the rapid editing, correcting, and documentation of software. For details, contact Ithaca Intersystems, Inc., 1650 Hanshaw Rd., POB 91, Ithaca, NY 14850, (800) 847-2088; in New York (607) 257-0190.

Circle 428 on inquiry card.

Flexible Business Computer

Data Technology Industries' System 10 is a Z80-based single-user business computer that runs CP/M software. The System 10 has 65K bytes of read and write user-programmable memory and 2K bytes of PROM (programmable read-only memory). By using double-sided, double-density 5¼-inch disk drives and 5¼-inch Winchester hard disks, the System 10 provides from 700K bytes to 5 megabytes of disk storage. Onscreen data are easily managed because a separate microprocessor handles the keyboard and video display. A clear-to-end-of-line function and an addressable cursor are coupled with a transfer rate for responsive video displays. Other features include power-down disk protection, switching power supply, and the capability of supporting multiple users by linking several System 10s or by having one System 10 act as the master. Contact Data Technology Industries, 700 Whitney St., San Leandro, CA 94577, (415) 638-1206.

Circle 429 on inquiry card.

Fortune Shines on the 68000

The Fortune 32:16 desktop microcomputer is based on the Motorola 68000 microprocessor. It features the Unix operating system and a full range of business applications software packages. The basic Fortune 32:16 includes a 32-bit microprocessor with a 16-bit data path, expandable memory from 128K bytes to 1 megabyte, a 1-megabyte 5¼-inch floppy-disk drive, a keyboard, and a 12-inch video-display screen. For applications requiring greater storage capacities, a 5¼-inch Winchester disk drive with 5, 10, or 20 megabytes of storage is available.

The single-user Fortune 32:16 is readily expandable to a multiuser, multiapplication system. It can be upgraded in the field to a multiuser, timeshared system that can be employed in a Xerox Ethernet network.

The Fortune 32:16 supports most widely used languages, including BASIC, COBOL, FORTRAN, Pascal, and C. Its 99-key keyboard is removable. The keyboard has a 15-key numeric keypad with nine cursor-control keys and 16 programmable-function keys.

The basic Fortune 32:16 system costs $4995. Contact Fortune Systems Corp., 1501 Industrial Rd., San Carlos, CA 94070, (415) 595-8444.

Circle 430 on inquiry card.

Gateway for Designers

Forward Technology has unveiled the third member of its Gateway Series of Multibus-compatible single-board computers: the FT-68M. Based on the 16-bit Motorola 68000, the FT-68M has 256K bytes of user-programmable memory, including error detection, two-level, multiprocess memory management and protection, serial and parallel communication facilities, and five counter/timers. The FT-68M is designed to assist system designers who need the power and flexibility of the 68000 combined with 256K bytes on a single Multibus-compatible board.

The FT-68M has two user-programmable RS-232C interfaces, and its serial interfaces will operate in either synchronous or asynchronous modes. Among its other features are Xenix operating system compatibility, no wait states with local RAM (random-access memory), up to 32K bytes of PROM (programmable read-only memory), dual serial-communication channels, single 16-bit input port, 8-megabyte addressability, 8 MHz clock rate, and IEEE (Institute of Electrical and Electronics Enginneers) P-796 Bus (Multibus) with Multimaster capabilities. The FT-68M costs $3495. Contact Forward Technology Inc., 2595 Martin Ave., Santa Clara, CA 95050, (408) 988-2378.

Circle 431 on inquiry card.

Single-Board Computer

RCP Systems' IEEE (Institute of Electrical and Electronics Engineers) S-100 interface board is a single-board computer for the hobbyist or small-systems manufacturer. The board has a 4-MHz Z80 microprocessor, a 2716 EPROM (erasable programmable read-only memory), a four-channel timer, two parallel ports, two serial ports with onboard drivers and receivers with data rates ranging from 75 to 38,400 bits per second, and 16K bytes of dynamic user-programmable memory expandable to 128K bytes with software bank-select of the upper and lower banks. Other features include an S-100 slave address of 1 to 64, an interrupt-driven system, and five onboard regulators.

The board costs $1395, assembled and tested. Contact RCP Systems Inc., 1020 East 18th Ave., North Kansas City, MO 64116, (816) 221-0816.

Circle 432 on inquiry card.

Let the Professor Show You

Looking for an inexpensive way to learn how to design a program? Let the Micro-Professor show you. The Micro-Professor is a book-shaped Z80-based microcomputer learning tool. It has a 2K-byte ROM (read-only memory) monitor program with system initialization, keyboard and display scan, and tape write and read. Micro-Professor features 2K bytes of user-programmable memory, 24 parallel I/O (input/output) lines, audiotape interface, system clock, and a single power supply. As your knowledge of microcomputing grows, you can expand the Micro-Professor to Z80-CTC and Z80-PIO and add an EPROM (erasable programmable read-only memory) and a prototyping board.

Documentation includes a user's manual and a book of 18 sample programs and experiments that range from simple software programming to complex electronic-control systems. The manual includes the source listings for the 2K-byte monitor program, schematic diagrams, and operating instructions. It also describes the hardware and software specifications. The Micro-Professor costs $99; dealer inquiries are welcomed. Contact Multitech Industrial Corp., 977-1 Min Shen E. Rd., Taipei 105, Taiwan, Republic of China, Telex: 23756 Multiic.

Circle 433 on inquiry card.

6-MHz Card for S-100 Systems

The CP 600 Central Processor Card can increase your S-100 system's throughput by as much as 50%. The CP 600 is a 6-MHz, 8-bit Z80 card that conforms to the IEEE (Institute of Electrical and Electronics Engineers) 696 (i.e., S-100) standard. Two onboard ports extend memory addressing to 24 bits and I/O (input/output) addressing to 16 bits, which allows up to 16 megabytes of system memory and 64K bytes of system I/O. The system memory refresh is performed as a standard S-100 memory-read cycle, minimizing the need for special logic on memory cards. To accommodate 64K-byte dynamic-memory devices, the 8 lower address bits are used for refreshing.

The CP 600 has a crystal-controlled master clock, jumper-selectable onboard-generated memory and I/O wait states, and onboard EPROM (erasable programmable read-only memory). The CP 600 is available from Echo Communications Corp., 1708 Stierlin Rd., Mountain View, CA 94043, (415) 969-6086.

Circle 434 on inquiry card.

Single-Chip Microcomputer

General Instrument has introduced a new 8-bit single-chip microcomputer called the PIC16C55. The PIC16C55 is a low-power consumption, 28-pin device with wide power-supply tolerances. Although nominally a 5-V device, the chip will accept voltages ranging between 2.5 and 6 V. The device is a CMOS (complementary metal-oxide semiconductor) circuit array that contains user-programmable memory, eight user-defined I/O (input/output) lines, a central processing unit, and ROM (read-only memory). The device can perform logical processing, basic code conversions and formatting, and can generate timing and control signals for I/O devices.

Internally, the device consists of three functional elements connected by a single bidirectional bus: the register file, consisting of 32 addressable 8-bit registers, an arithmetic logic unit, and a program ROM of 512 program words, each 12 bits wide. The device features an intelligent controller for stand-alone operations, 32 by 8-bit programmable memory, a real-time clock counter, onboard or crystal-controlled oscillator, single-word instructions, single-supply operation, and software compatibility with other members of General Instrument's PIC family. The eight I/O registers provide latched lines for interfacing to a wide variety of applications, such as scan keyboards, drive displays, electronic-game control, and vending machines.

Software support is available, and sample programs can be used to develop programs that can be assembled into machine language using PICAL, which was specially designed for the PIC series. PICAL is available in a FORTRAN IV version. Contact General Instrument, 600 West John St., Hicksville, NY 11802, (516) 733-3107.

Circle 436 on inquiry card.

Link Sorcerers to S-100 Bus

Exidy Systems' Display/S-100 unit links the Sorcerer computer to any S-100-bus product. The Display/S-100 combines the expansion capability of S-100 products within an enclosure that houses a 12-inch green-phosphor video display for the Sorcerer. The unit is mounted on a swivel-base stand, and the video screen sports a 20-MHz bandwidth for high resolution. The unit's S-100 bus is a self-contained motherboard with power supply and translation logic for the Sorcerer computer.

The Display/S-100 includes cables and documentation. The suggested retail price is $699. Contact Exidy Systems, Inc., 1234 Elko Dr., Sunnyvale, CA 94086, (408) 734-9831.

Circle 435 on inquiry card.

Programming and Design System

The IDC-8 is a programming and design subsystem based on the Intel 8088 microprocessor. Software developed on the IDC-8 is compatible with other 8088-based computers, including the IBM Personal Computer. The device features an 18-square-inch wire-wrap area for special design applications, card expansions, and additional peripheral-support circuitry and processors. The IDC-8 includes a 5-MHz 8088 microprocessor, monitor software in an 8755 I/O (input/output) ROM (read-only memory), 1K bytes of static RAM (random-access memory), 256 bytes of I/O memory, and an 8251-based video-display interface. The I/O ROM and the I/O RAM have a total of 38 parallel I/O lines. The device requires 5 volts at 1 amp, and it communicates by means of an RS-232C terminal.

The IDC-8 is fully assembled and tested and is shipped with complete documentation for hardware and software applications. It costs $399; kit versions are available. For details, contact Intelligent Devices Corp., One Cameron Pl., Wellesley, MA 02181, (617) 237-7327.

Circle 467 on inquiry card.

Symbol-Processing System

The Symbolics 3600 is a dedicated computer system that's designed for high-productivity software development and support of large symbolic systems. Typical applications include CAD (computer-aided design), artificial intelligence, and expert systems. The primary language of the 3600 is Symbolics' ZetaLisp, an expressive, efficient, and extensible langauge. Fully integrated into the ZetaLisp language is a unique approach to object-oriented programming called the Flavor System. In addition to ZetaLisp, FORTRAN-77 and Pascal can be run on the 3600.

The basic Symbolics 3600 hardware consists of a high-performance microcoded central processing unit with 36-bit tagged architecture and 32-bit data paths, special features for symbolic computing, 1.125 megabytes of main memory, a fast-access 67-megabyte Winchester hard-disk drive, 10-megabit-per-second Ethernet II network interface, two serial lines, and a graphics console with 100-key keyboard with N-key rollover, a landscape-format 1000-line black-and-white bit-mapped display, a mouse, and audio output. The 3600's virtual memory consists of more than one million pages of 256 words of 36 bits each.

The 3600 has a Motorola MC68000-based front-end processor that serves two functions: during normal operation it controls low- and medium-speed I/O (input/output) devices and performs error logging and recovery; when the 3600 is not running, it is used for debugging. Contact Symbolics Inc., 21150 Califa St., Woodland Hills, CA 91367, (213) 347-9224.

Circle 437 on inquiry card.

Little Big Computer

The Findex computer is a complete microcomputer system that weighs only 31 pounds and is no larger than the average electric typewriter. The Findex has a keyboard, memory capacity of up to 2 million characters on floppy-disk drives, a display, and a printer. Serial, parallel, and S-100 bus interfaces are standard, and Bell 103 and CCITT acoustic couplers are available as options. Many high-level languages are supported, including Business BASIC, COBOL, Pascal, FORTRAN, APL, and PL/I. Applications software is also available.

The Findex computer will operate on 110 V (volts), 220 V, or 12 V, and its battery backup will let the machine operate for 30 minutes. Depending on the peripherals and software selected, the Findex computer costs between $6980 and $20,000. Contact Findex, 20775 South Western Ave., Torrance, CA 90501, (213) 533-6842.

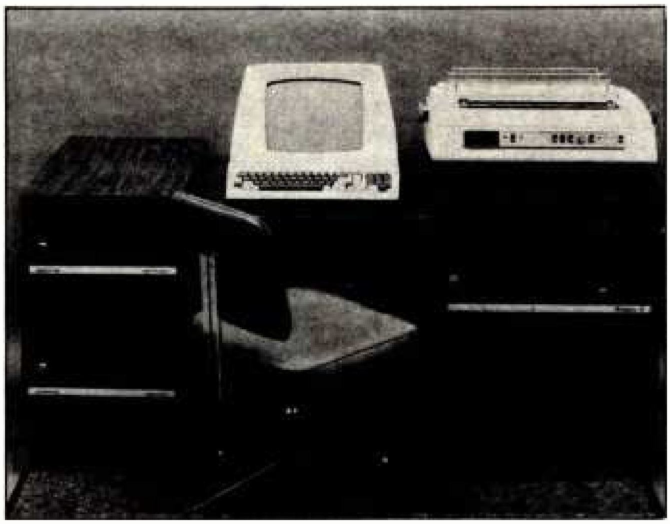
Circle 438 on inquiry card.

Versatile Business Computers

The System 12B is the heart of a new line of business computers from Midwest Scientific Instruments. The 12B supports four users simultaneously, contains 328K bytes of memory, and employs a 10-megabyte partially fixed and partially removable hard-disk drive that is capable of supporting several hundred megabytes of online disk storage.

The 12B uses the SDOS operating system and runs a complete library of business-software modules, including inventory control, bills of material, sales order entry, accounts receivable and payable, and payroll. The system starts at $2495 for a 64K-byte model. For details, contact Midwest Scientific Instruments, 220 West Cedar, Olathe, KS 66061, (913) 764-3273.

Circle 439 on inquiry card.



Have Angels In Your Office

The Angel-I is an S-100-based word- and data-processing system featuring a Z80 central-processing unit, 64K bytes of programmable memory, two large-capacity 8-inch floppy-disk drives, an 80-character by 24-line video-display screen, and a daisy-wheel printer. The new multiterminal Angel-I small-business system can support up to sixteen terminals and from four to six users concurrently writing and testing programs. Programs can be developed for 16-bit target computers, such as the 8086 microprocessor. Three versions are offered: a low-cost model for order desks and doctors' offices, a medium-priced model for word and data processing, and a multiterminal system that features off-line processing.

Angel-I system terminals feature Z80 processors, from 48,000 to 68,000 characters of memory, and serial I/O (input/output). In the top-of-the-line multiterminal Angel-I system, each terminal has a separate mainframe, 64,000 characters of memory, a single large-capacity 8-inch floppy-disk drive, and a serial I/O channel for communication with the central processor. The Angel-I costs $7995; add-on terminals range from $1500 to $3500, depending upon model selected. Contact E & U Engel Consulting, 1719 South Carmelina Ave., Los Angeles, CA 90025, (213) 820-4231.

Circle 440 on inquiry card.

System Has Robotics Potential

The VIμP (Versatile Industrial Microprocessor) 7000 is a small, 18- by 27-cm (6½- by 10¾-inch), microcomputer system designed for OEM (original equipment manufacturer) and small-user applications in industrial control, machine automation, and robotics. Among the VIμP's features are stepper-motor drivers, A/D (analog-to-digital) and D/A (digital-to-analog) converters, a real-time calendar clock, and optically isolated I/O (input/output).

The VIμP uses a 6502 microprocessor, and its bus is KIM-compatible. The bus uses two 44-pin edge card connectors per slot, one for the central bus and the other for additional applications.

The VIμP 7000 costs between $500 and $2000, depending on configuration. Contact Systems Innovations Inc., POB 2066, Lowell, MA 01851, (617) 459-4449.

Circle 441 on inquiry card.

Electronic Mail Data Sheet

The CDI/Comet Portable Electronic Mail System is a business-communications software package that uses Computer Devices' Miniterm computer as an electronic mailbox. The CDI/Comet features guaranteed message distribution, 24-hour-a-day accessibility, English-language commands, and word-processing and editing functions. A data sheet describing the CDI/Comet is available from the company. It explains how the CDI/Comet, when used with Miniterm computer terminals, provides efficient, cost-effective, and instantaneous access to field personnel and how it ensures accurate, complete, and guaranteed message delivery. The CDI/Comet data sheet can be obtained from Computer Devices Inc., 25 North Ave., Burlington, MA 01803, (800) 225-1230; in Massachusetts (617) 273-1550.

Circle 442 on inquiry card.

PERIPHERALS

High-Resolution Alphanumerics Display

The GT-1 Z80-based Multibus-compatible video-display board features a high-resolution (640 by 500 pixel) monochrome graphics display with onboard vector, arc, circle, and text generation. Two user-programmable and several built-in patterns are available for different line and area fill styles, as well as eight text sizes. The GT-1 includes a separately addressable scrolling alphanumerics display that features 80 by 25 characters, four individually programmable attributes, and a fully addressable cursor. The 96-character ASCII (American Standard Code for Information Interchange) set is standard. The ASCII code is enhanced with 32 special characters, with the option of a second user-specified set.

The GT-1 uses 5 volts at 1.5 amperes from the Multibus. Communication with the host computer is accomplished by a separate 25-pin EIA (Electronics Industry Association) connector. The GT-1's RS-232C interface supports full-duplex serial communication with 16 switch-selectable data rates to 38.4 kbps (thousand bits per second). Up to 256 characters can be buffered in both directions. A connector is provided for attaching an 8-bit parallel keyboard, and composite and XYZ video connections are standard. The GT-1 uses XOFF/XON protocols.

In single quantities, the GT-1 costs $1995. Contact Micrographics Research, 28 Pioneer Dr., Nashua, NH 03062, (603) 888-6790.

Circle 443 on inquiry card.

Macrosystem-88

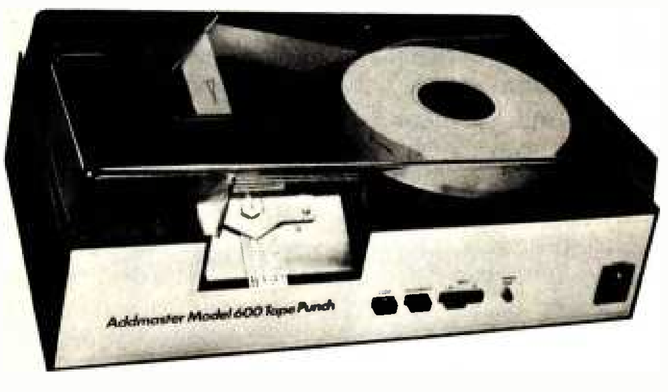
The Macrosystem-88 adds 16-bit processing power and up to 128K bytes of additional RAM (random-access memory) to the Apple II. The Macrosystem-88 is a full microcomputer system based on the 5-MHz Intel 8088 8/16-bit microprocessor. It has 64K bytes of programmable memory, expandable to 128K bytes, and 4K bytes of PROM (programmable read-only memory) on a single self-contained board with power supply. The Macrosystem-88 features front-panel power and reset switches and indicators for run, pause, and select.

The Macrosystem-88's DMA (direct memory access) control card, which can be installed in any Apple slot except 0, handles communications between the Macrosystem-88 and the Apple. On this basis, the Macrosystem-88 has complete access to the Apple's memory and peripherals. The Apple's 6502 microprocessor handles I/O (input/output) processing.

Macrosystem-88 can run Digital Research's CP/M-86 and Softech Microsystems' UCSD Pascal p-System 4.0 with UCSD Pascal along with FORTRAN-77 and a BASIC compiler. Switching between Apple DOS (disk operating system) and CP/M-86 is as simple as booting with the appropriate disk.

The Macrosystem-88 has a suggested retail price of $995. Contact Cal-Tech Computer Services Inc., 4112 Napier St., San Diego, CA 92110, (714) 275-4350.

Circle 445 on inquiry card.



Paper Tape for Apples

Your Apple II can have complete paper-tape capability for less than $1800 with Addmaster's parallel interface board and data-handling program. The cable, which connects the Model 600-1 punch and the Model 605 reader to your Apple, costs $75. The Data Handling Program costs $100, the Model 600-1 is $1099, and the Model 605 is $495. Applications include numerical control and secure communications systems. Contact Addmaster Corp., 416 Junipero Serra Dr., San Gabriel, CA 91776, (213) 285-1121.

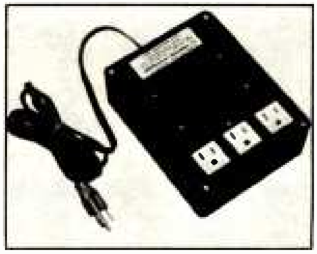
Circle 444 on inquiry card.

IBM-Compatible Equipment

Tecmar's new line of hardware products are compatible with the IBM Personal Computer. In the vanguard is the Tecmate Expansion Chassis, a seven-slot expansion cabinet for IBM-compatible boards. It features heavy-duty power supplies and provision for a 5¼-inch Winchester hard-disk drive.

Some of Tecmar's other products include a time-of-day clock, a BSR X-10 device-control module, a Winchester disk and controller, a 256K-byte programmable memory board, a serial and parallel port I/O (input/output) board, D/A (digital-to-analog) and A/D (analog-to-digital) converters, a video digitizer, and a stepper motor controller. Contact Tecmar, 23600 Mercantile Rd., Cleveland, OH 44122, (216) 464-7410.

Circle 446 on inquiry card.



Super Isolator

Electronic Specialists' Super Isolator is designed to control electrical pollution that can damage your hardware. The Super Isolator features three individually dual-pi-filtered AC sockets and heavy-duty spike and surge suppression. Equipment interactions are eliminated and disruptive or damaging power-line pollution, such as spikes from lightning or heavy machinery, is controlled. The Super Isolater can control pollution for a 1875-watt load; each socket can handle a 1000-watt load. The Model ISO-3 Super Isolator costs $94.95 and is available from Electronic Specialists Inc., 171 South Main St., Natick, MA 01760, (617) 655-1532.

Circle 447 on inquiry card.

Modular Color Printer

The Prism printer is a modular 80- or 132-column dot-matrix printer that allows add-on modules for expanded graphics, resolution, speed, type style, single-sheet feeding, and color abilities. The basic Prism printer is a correspondence-quality device capable of printing at up to 150 cps (characters per second) in a 24 by 9 dot matrix, expandable to a high-speed data mode of 200 cps and a character resolution of 24 by 18.

The Prism printer is based on the Motorola 6803 microprocessor and features bidirectional printing, logic-seeking abilities, and high-speed slew for increased throughput.

Optional equipment for the Prism printer includes a graphics module and a color module with a choice of three four-zone color ribbons and software for text or data modes. Up to eight colors can be produced using a four-color ribbon. Paper feed is semiautomatic cut-sheet, where the operator inserts an 8½- by 11-inch sheet and the printer automatically positions it. The basic 80-column Prism printer costs $899. Contact Integral Data Systems Inc., Milford, NH 03055, (800) 258-1386; in New Hampshire (603) 673-9100.

Circle 448 on inquiry card.

DMM Connects to Microprocessors

Sabtronics' Model 2020 Digital Multimeter (DMM) has microprocessor interfaces so that it can adapt to any personal computer. The DMM has a 3½-digit LED (light-emitting diode) display and 0.1% basic DC accuracy. It is capable of directly measuring AC and DC voltages of up to 1000 volts, resistances up to 20 megohms, and AC and DC currents up to 10 amperes. Optical coupling between the DMM and the computer protects the computer from damage and serves to isolate ground noises that can affect sensitive measurements.

The Model 2020 DMM is supplied with cables and I/O (input/output) support needed for connection with TRS-80, Apple, PET, or Atari microcomputers. The DMM costs $299, including interface and some software support. Contact Sabtronics International Inc., 5709 North 50th St., Tampa, FL 33610, (813) 623-2631..

Circle 449 on inquiry card.

Timer/Counter Board

The STD-V108 I/O timer/counter board is handy for process control, production testing, or data logging. It features eight programmable I/O (input/output) ports and 64 individually programmable I/O lines. The STD-V108 has 16 programmable handshake lines that permit high-speed data transfers to peripherals and four 16-bit timers that allow a wide range of timing (2 microseconds to many hours), automatic pulse output to an I/O line, and interrupt-on-timeout capabilities. Incoming I/O signals can be monitored without the intervention of the central processor by means of four 16-bit event counters. Four programmable shift registers permit serial data to be sent and received. Fully programmable interrupts on all functions avoid the overhead of software polling. Connection to I/O devices is accomplished by standard 50-pin headers and switch-selectable addressing facilitates system configuration.

The STD-V108 costs $199, including a one-year warranty and documentation. It's available from Forethought Products, 87070 Dukhobar Rd., Eugene, OR 97402, (503) 485-8575.

Circle 450 on inquiry card.

Winchester and Floppy Disk System

The Model SCS-10/F Winchester hard-disk and 8-inch floppy-disk drive subsystem can interface with most popular microcomputers, including the Apple II, the TRS-80 I, II, and III, and S-100 microcomputers. The SCS-10 permits the use of most disk operating systems, which allows standard 8-inch CP/M floppy disks to operate with Apple II machines and 3.3 Apple DOS with 1.1 Pascal. Its storage capacities start at 10-megabyte configurations and range as high as 120 megabytes. For higher storage levels, daisy-chaining is permitted. The SCS-10 supports Supercalc, DB Master, and medical, legal, accounting, stock, and educational applications software packages.

The SCS-10 is shipped complete with controller, host adapter, operating software, power supply, cables, cabinet, and user manuals. For details, contact Santa Clara Systems, Inc., 560 Division St., Campbell, CA 95008, (408) 997-2010.

Circle 451 on inquiry card.

PUBLICATIONS

Short Form Catalog

Micro Power Systems has an updated edition of its short form catalog that lists all of its current products. Micro Power Systems markets digital-to-analog (D/A) and analog-to-digital (A/D) converters, precision voltage references, analog multiplexers, analog switches, op amps, and dual transistors. Included in the updated catalog is a comparison of standard MOS (metal-oxide semiconductor) devices to Micro Power Systems' custom high-density CMOS (complementary metal-oxide semiconductor) devices. Micro Power Systems custom designs LSI (large-scale integration) circuits for such applications as pacemakers and digital meters.

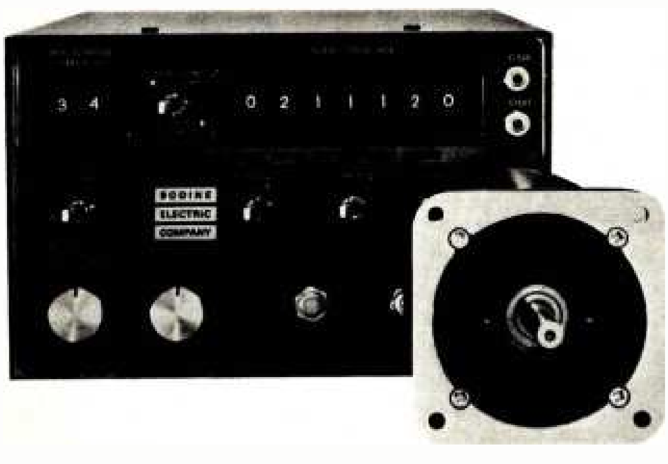
The short form catalog is available from Micro Powers Systems Inc., 3100 Alfred St., Santa Clara, CA 95050, (408) 247-5350.

Circle 452 on inquiry card.

Telecommunications Policy

Each issue of Telecommunications Policy includes articles on assessment, control, and management of developments in telecommunications and information systems. A one-year subscription to this quarterly journal costs $124.80. Contact IPC Science and Technology Press, Ltd., 205 East 42nd St., New York, NY 10017, (212) 867-2080. In England, contact IPC Science and Technology Press, Ltd., POB 63, Westbury House, Bury St., Guildford, Surrey, GU2 5BH, England.

Circle 453 on inquiry card.



Stepper Motor Catalog

Stepper motors and controls are described in Catalog ST-1 from the Bodine Electric Company. The catalog includes test data, application guides, check lists, and thermal-characteristics information showing motor temperatures. For your free catalog, write to Bodine Electric Co., 2500 West Bradley Place, Chicago, IL 60618.

Circle 454 on inquiry card.

New Books from Arcsoft

Books on the TRS-80 Color Computer and Pocket Computer are described in a free 16-page catalog from Arcsoft Publishers. The books include tips, tricks, secrets, and programming shortcuts as well as many new programs. Among Arcsoft's titles are BASIC Made Easy, 50 Color Computer Programs in BASIC for the Home, School, & Office, and 101 Pocket Computer Programming Tips & Tricks. The books range in price from $6.95 to $9.95. For your free catalog, contact Arcsoft Publishers, POB 132BY, Woodsboro, MD 21798, (301) 845-8856.

Circle 455 on inquiry card.

Experiments in Artificial Intelligence

John Krutch's Experiments in Artificial Intelligence for Small Computers begins with an explanation of artificial intelligence illustrated by a short Microsoft Level II BASIC program. Problem-solving, natural-language processing, and other aspects of artificial intelligence are covered in the same easily understood manner.

Experiments in Artificial Intelligence for Small Computers is available in softcover for $8.95. Contact Howard W. Sams & Co., 4300 West 62nd St., Indianapolis, IN 46268, (800) 428-3696; in Indiana, (317) 298-5400.

Circle 456 on inquiry card.

SOFTWARE

Engineering Software

Micro-Tech Associates has structural and foundation engineering software programs for the Apple II Plus microcomputer that provide an alternative to high-cost service bureaus. The disk-based Pascal and FORTRAN programs are designed for interactive use and include SBEAM, GRID, and TRUSS2D. The programs are easy to use and do not require programming knowledge. Contact Micro-Tech Associates, 2305 Appleby Court, Wheaton, IL 60187.

Circle 457 on inquiry card.

Multiplan—Electronic Spreadsheet

Multiplan, a new electronic spreadsheet, is now available from Microsoft. The spreadsheet is 63 columns wide, 255 rows deep, and several pages thick. You enter the numbers, titles, or formulas, and all computations are performed automatically. You can assign a name to any given cell or area and then access that name in future planning activities.

Multiplan offers extensive screen messages, a menu of commands, and a Help file that's always available. Multiplan gives you a number of features: easy editing, relative references, cell formatting, and a copy command. Column widths can be reduced from the standard 10-character column with the Format command and you can watch up to eight different areas through Multiplan's windows as you work.

Multiplan is available to run on CP/M systems and the Apple II. For details, contact Microsoft, 10700 Northup Way, Bellevue, WA 98004, (206) 828-8080.

Circle 458 on inquiry card.

Pascal Sourcebooks

The Pascal Sourcebooks are a complete library of well-structured Pascal software written in a self-documenting style. Among the Pascal Sourcebooks being offered are File System, Incremental Backup System, Report Generator, Graphic Applications-I, and Typewriter Simulators. File System lets you interrogate directories from applications program. Incremental Backup System will save recently used files so that loss of disk data is prevented. Using the UCSD Pascal system's screen editor, Report Generator lets you create word-processing-quality documentation. Examples of Pascal programs driving applications-oriented graphics are provided in Graphics Applications-I, and Typewriter Simulators turns a printer and a terminal into an electric typewriter with automatic address accumulation, envelope addressing, and line-by-line correction.

With an Apple Pascal disk, the Pascal Sourcebooks range in price from $49.95 to $109.95. Contact North American Technology, Suite 23, Strand Building, 174 Concord St., Peterborough, NH 03458, (800) 854-0561, operator 860; in California (800) 432-7257, operator 860; in New Hampshire (603) 924-6048.

Circle 459 on inquiry card.

You've Earned an MBA

Context Management Systems' MBA software package blends database, electronic spreadsheet, word-processing, graphics, and communications capabilities into a single system. Once information has been added to MBA's database, it can be used without further typing or keystrokes. Specific figures can be called up and inserted into a report automatically. You can communicate numbers in rows or columns, let MBA format figures into charts or graphs, or you can return to your figures and run experimental simulations. As an electronic spreadsheet, you can change a number, and MBA will recalculate affected items.

MBA's word processor lets you prepare concise, accurate reports. The reports can use data stored in other MBA modules, so you can have MBA fill in appropriate figures as you write the report.

MBA requires an IBM Personal Computer with 192K bytes of random-access memory, dual disk drives, and a video monitor or an Apple III with 256K bytes of memory, dual disk drives, and a video monitor. A modem and a printer are recommended. Contact Context Management Systems Inc., Suite 101, 23864 Hawthorne Blvd., Torrance, CA 90505, (213) 378-8277.

Circle 460 on inquiry card.

Report Manager

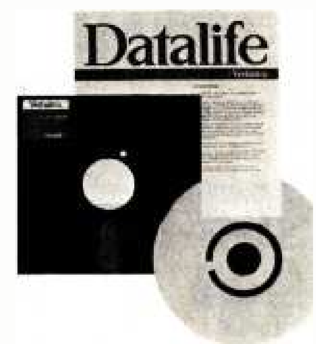
The Report Manager creates and instantly updates a variety of reports for financial, accounting, engineering, and scientific applications. The CP/M-based Report Manager can generate income statements, balance sheets, sales forecasts, and other business reports. The reports can be created from any plane in the X, Y, and Z axis "data cube" generated by the program. This "third dimension" calculating ability allows for the existence of thousands of individual cells, each of which can contain a number, a label, or a formula. Report Manager has editing commands for changing or adding to a cell's contents. Reports can be up to 255 cells wide, long, and deep, and multiple report pages with controls to scan data on any page or all the pages on one column are provided.

The Report Manager has the ability to copy portions of rows or columns, entire portions of pages, or full sections from sets of pages. It lets you view four independent sections on-screen and define headings that are longer than nominal cell widths. Calculations on calendar and time entries for determining the duration of flowcharts and work in progress can be performed.

The Report Manager is a standard feature with NEC's PC-8000 series microcomputer. Contact NEC Home Electronics USA, 1401 Estes Ave., Elk Grove Village, IL 60007, (312) 228-5900.

Circle 461 on inquiry card.

MISCELLANEOUS



Head-Cleaning Kits

The Verbatim Datalife head-cleaning kit consists of a reusable Lexan jacket, which is impervious to head-cleaning solvents, and presaturated, disposable cleaning disks. The kits are available in 5¼- and 8-inch sizes and can be used on both single- and dual-head drives. Operation is easy: the disk is removed from its protective foil and polyethylene pouch, inserted in the Lexan jacket, and the whole assembly is placed in the drive for 60 seconds.

The Verbatim Datalife head-cleaning kit is not recommended for use on Vydec 8-inch-drive word processors. The kit has a

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FLOPPY DISK DRIVES

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6-9	$485
10	$475

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TM100-2 . . . . 48 TPI (500 KBYTES) $325
Compatible with Northstar, Cromemco, TRS-80

TM100-4 . . . . 96 TPI (1000 KBYTES) $425
Compatible with Zenith, Heath, etc.

TANDON 5¼" HARD DISKS

TM 602 (5MB) $1195
TM 603 (10MB) $1295

CPU

CCS 2810	$ 275
Godbout Z-80A	$ 275
Godbout 8085A	$ 295

MEMORY

CCS 2065 64K dynamic	$ 595
CCS 2116 32K static	$ 625
Godbout RAM 17 64K	$ 675

I/O

CCS 2710 4 SIO	$ 325
Godbout Interfacer 1	$ 225
Godbout Interfacer 2	$ 225

CONTROLLERS

Tarbell single density kit	$195
Tarbell single density A & T	$310
Tarbell double density A & T	$425
CCS 2422 w/CPM 2.2	$350
Godbout Disk 1	$450
MDA MXV-21 LSI-11 controller (RX-01, RX-02 compatible)	$1050

MISCELLANEOUS

2 Disk drive enclosure . . . . . $ 95
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(powers two floppies)

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2 drives $120

Cable Kits 2 drives . . . . . . $ 35
3 drives . . . . . . $ 40
4 drives . . . . . . $ 45
Diskettes ss $39/10 — ds $59/10

NEW !!!!
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DAISY WHEEL PRINTER . . $2395
45 CPS, RO. Available in KSR version.
Call for further particulars.
Ribbons: $125/case
Bidirectional tractor feed $225

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ABM 85 Video Terminal . . $ 895
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SBC 80/30	$450
SBC 204	$450
SBC 534	$500
SBC 556	$200
SBC 711	$500
SBC 614	$100

DATACUBE RM-119 64K Dynamic RAM, with memory refresh + more. . . . . $595.

CENTRAL DATA 128K Dynamic RAM, featuring 8/16 bit addressing, more . . . . . $1399.

NEW YEAR'S SPECIALS

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2) 80/30, 204, 556 . . . . . $995
3) 80/30, 204, Datacube RM-119 . . . . . $1400
4) 80/30, 204, Central Data 128K $1999
5) Create your own combo. Call & we will be happy to price it for you. Many more multibus boards in stock to choose from. (This offer good only while supply lasts, so hurry, folks)

DEVELOPMENT SYSTEM CORNER

MDS 230, Complete, factory fresh $9999
Note: We usually have other development systems in stock, like MDS 800, 235, etc., so give a jingle to see what Oracle's elves have cooking.

ENDS & ODDS

Miscellaneous goodies have been accumulating at Oracle. Here's a chance to pick up some terrific buys. Please act quickly, as many of these won't last long.

Memorex 660 50 Mby hard disk drive . . . . . $1000.
Versatec 110 Electrostatic printer . . . . . $6999.
General Automation 16/440 with a multitude of peripherals. . $14,000.
PDP 11/34A with 32K memory, operator's console, and much much more. A veritable steal at . . . . . $7500.

Terms of sale: MC/VISA O.K. COD shipments with 25% deposit. Purchase orders accepted from qualified firms and institutions. All goods subject to prior sale, and prices subject to change without notice. Shipping/handling extra. CA residents add sales tax.

IC RAMAGANZA PARTSALANCHE

RAM	1-49	50-99	100+up
2104	$1.00	$ .75	$ .65
4116	2.25	2.15	2.00
4164	17.00	15.00	13.00
2114 (450)	2.25	2.25	2.00
2114 (300)	2.50	2.25	2.00
4044-25NL	3.25	3.00	2.75
6104-3	2.00	1.75	1.50
5101L	3.00	2.85	2.75
2147	3.50	3.25	3.15

CPU	1-49	50-99	100+up
Z80	$8.95	$8.75	$8.50
Z80A	9.95	9.75	9.50
6502	6.95	6.85	6.75
8085A	10.00	9.00	8.75
9900	25.00	23.00	20.00

EPROM	1-49	50-99	100+up
5203Q	$7.50	$6.50	$5.50
5204Q	7.50	6.50	5.50
2708	3.25	2.75	2.50
2716	5.00	4.50	4.00
2732	12.00	11.00	9.00
68764	30.00	25.00	20.00

MISC	1-49	50-99	100+up
3242	$9.00	$8.00	$7.00
8202A	45.00	43.00	40.00
8255A	5.75	5.65	5.50
MM5303/TR1602B	4.00	3.85	3.75
9901	4.00	3.75	3.65

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Circle 258 on inquiry card.

suggested price of $12.50; a 10-pack of replacement disks costs $20. Contact Verbatim Corp., 323 Soquel Way, Sunnyvale, CA 94086, (408) 245-4400.

Circle 462 on inquiry card.

Programmable CMOS Interrupt Controller

The CDP1877 CMOS (complementary metal-oxide semiconductor) IC (integrated-circuit) programmable interrupt controller is designed to minimize software and real-time overhead for multilevel priority interrupts in CDP1800-based microprocessor systems. The device features eight levels of prioritized interrupts and software-programmable vectoring to interrupt routines. The CDP1877 is a memory-mapped device with latched interrupt requests and hard-wired interrupt priorities. Interrupts can be expanded in increments of eight. The CDP1877 can be cascaded into a large number of interrupts, limited only by the amount of memory space available and the extent of address coding in the microprocessor. Its multiple chip-select inputs minimize the amount of address space required for operation. Selectable 2-, 4-, 8-, and 16-byte intervals provide flexibility for interrupt-routine memory allocations.

The CDP1877 operates from a single supply voltage of 4 to 10.5 V (volts). The CDP1877C is identical to the the CDP1877 except for the operating voltage range, which is 4 to 6.5 V. Both are supplied in 28-lead plastic or hermetically-sealed ceramic DIPs (dual inline packages). The CDP1877 and the CDP1877C are priced at $11.96 and $8.16, respectively. Contact RCA Solid State Div., POB 3200, Somerville, NJ 08876

Circle 463 on inquiry card.

Low-Cost Oscilloscopes

The low-cost Models 2213 and 2215 are members of Tektronix's 2200 series of dual-trace, delayed-sweep oscilloscopes. Both models achieve a 60-MHz bandwidth at 20 mV to 10 V and 50 MHz at 2, 5, and 10 mV settings. The maximum sweep speed is 5 nanoseconds per division. The lightweight oscilloscopes incorporate advanced systems for easy triggering and provide Z-axis input, front-panel trace rotation, and beam-finder controls. Fewer operator adjustments are required because both units have automatic intensity and focus.

The Model 2213, with a single time base, has a screen-calibrated delayed sweep with 3% accuracy and an intensified sweep. The Model 2215 has a dual time base with 1.5% delay time accuracy and features alternate sweep switching, A/B sweep separation control, and B triggering after delay for jitter-free delayed time measurements.

The Tektronix Models 2213 and 2215 cost $1100 and $1400, respectively. For further details, contact Tektronix, Inc., Marketing Communications Dept., POB 1700, Beaverton, OR 97077, (800) 547-1845; in Oregon (800) 452-6773.

Circle 464 on inquiry card.

Timeshared Typesetting Service

Type Share Inc. is a timeshared typesetting service that can accept sequential ASCII (American Standard Code for Information Interchange) files from any computer and return typeset copy according to user coding and specifications. A computer user can input and format material for typesetting on his or her computer, send it to a Type Share center over a telephone, and receive typeset copy that's ready for paste-up and printing.

To use the Type Share system a user must have a computer/modem combination that can transmit ASCII sequential files over telephone lines. Contact Type Share Inc., 8315 Firestone Blvd., Downey, CA 90241, (213) 923-9361.

Circle 465 on inquiry card.

Add-On Memory Cards for the IBM Personal Computer

A.S.T. Research has introduced a series of ultra high-density add-on memory cards for the IBM Personal Computer that feature storage capacities ranging from 64K to 256K bytes of random-access memory. The Personal Computer-compatible cards include parity checking to ensure data integrity. Each card is thoroughly tested.

In addition to the memory cards, A.S.T. has introduced a communications option card that has two RS-232C ports and a wire-wrap extender card set. The add-on memory cards range in price from $495 to $1595, which includes a one-year warranty. The RS-232C port communications card costs $240, and the wire-wrap extender is available for $95. Contact A.S.T. Research Inc., 17925 B Skypark Circle, Irvine, CA 92714, (714) 540-1333.

Circle 466 on inquiry card.

Where Do New Products Items Come From?

The information printed in the new products pages of BYTE is obtained from "new product" or "press release" copy sent by the promoters of new products. If in our judgment the information might be of interest to the personal computing experimenters and homebrewers who read BYTE, we print it in some form. We openly solicit releases and photos from manufacturers and suppliers to this marketplace. The information is printed more or less as a first-in first-out queue, subject to occasional priority modifications. While we would not knowingly print untrue or inaccurate data, or data from unreliable companies, our capacity to evaluate the products and companies appearing in the "What's New?" feature is necessarily limited. We therefore cannot be responsible for product quality or company performance.

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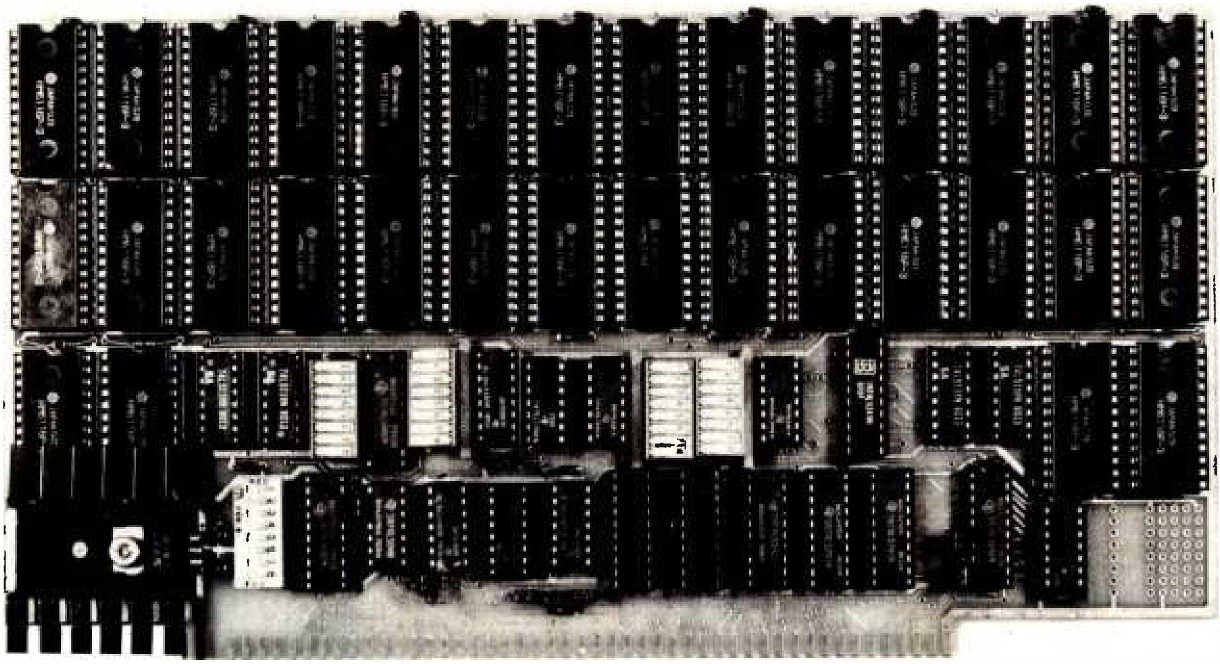

FEATURES

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- 8 or 16 bit data transfers.
- 24 bit addressing.
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- Power consumption is typically 600 ma.
- Banks on or off on power up.
- Bank addressable to any of 256 possible ports.
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- Available partially loaded as a 32K board.
- Multiple bank residence.

Manufacturer	Ext. Addr.	Bank Select	2716 Pin Out	Current	16 Bit	Speed	Phantom	Price
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Memory Mer.	✓	✓	✓	350mil.	No	10meg.	✓	$795
Digital Design	✓	✓	No	990mil.	✓	12meg.	✓	$995
Static Mem. Systems	✓	No	✓	550mil.	No	6meg.	✓	$679
Seattle Comp. Products	✓	✓	No	2.5amps	✓	8meg.	✓	$995
California Digital	✓	✓	No	.9amps	✓	8meg.	✓	$850
Godbout	✓	No	✓	250mil.	✓	8meg.	✓	$850
Digital Res. Computers	✓	No	✓	500mil.	No	?	✓	$539
Omniram 64	✓	✓	✓	**600mil.**	✓	**8meg.**	✓	**$470**

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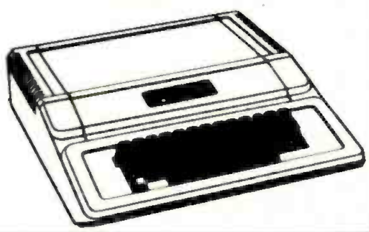

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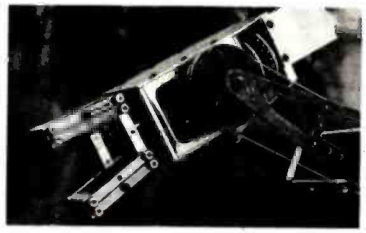

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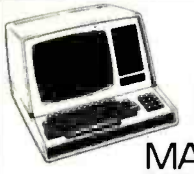

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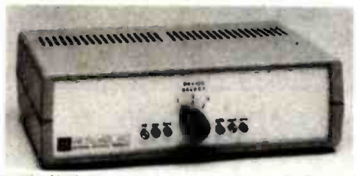

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2.5000 A	5.587 B	8.579 B	12.958 B	26.875 B	38.084 B	42.815 B
2.6850 A	5.7143 B	8.605 B	13.1072 B	27.000 B	38.444 B	42.851 B
2.6670 A	5.780 B	8.990 B	13.478 B	28.357 B	38.825 B	42.878 B
3.000 A	5.882 B	9.544 B	13.5168 B	28.400 B	38.876 B	42.928 B
3.087 A	5.9904 B	9.830 B	14.3182 B	28.827 B	38.925 B	42.963 B
3.2768 A	6.000 B	9.8304 B	14.381 B	29.837 B	38.937 B	43.000 B
3.330 A	6.144 B	9.833 B	15.000 B	30.084 B	39.503 B	43.037 B
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4.000 B	6.2977 B	10.000 B	16.000 B	32.937 B	39.963 B	43.146 B
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4.3425 B	6.400 B	10.496 B	17.508 B	33.878 B	40.444 B	43.259 B
4.434 B	6.5536 B	10.499 B	17.825 B	34.375 B	40.592 B	43.296 B
4.440 B	6.667 B	10.664 B	18.000 B	34.437 B	40.777 B	43.333 B
4.550 B	6.7584 B	10.8250 B	18.1958 B	34.555 B	40.8125 B	43.370 B
4.736 B	6.912 B	10.838 B	18.432 B	34.877 B	40.833 B	43.407 B
4.750 B	7.0018 B	10.850 B	18.750 B	35.788 B	40.875 B	43.444 B
4.9152 B	7.15909 B	11.000 B	20.000 B	35.873 B	40.888 B	43.518 B
4.9582 B	7.183 B	11.136 B	20.480 B	35.875 B	40.926 B	43.550 B
5.000 B	7.825 B	11.218 B	20.890 B	35.925 B	41.000 B	43.592 B
5.0178 B	8.000 B	11.280 B	21.400 B	35.937 B	41.160 B	43.830 B
5.0688 B	8.055 B	11.858 B	22.1184 B	36.000 B	41.377 B	48.000 B
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- Uses +5V & ±12V Power Supplies
- Does not have graphic capabilities.

Documentation includes program listing and composite video circuit.

Bare Board only (with doc)	$39.95
2716 Char. Gen. A7	$19.95
2716 Program A12	$19.95

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 <100 μsec. 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
81-132K Kit	$69.95
81-132B 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.

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80-244K Kit	$39.95
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6502 MPU	$9.95
6522 VIA	$9.95
Z-80 MPU	$9.95
Z-80 PIO	$9.95
TWO 2114 RAM	$9.95
2716	$14.95
50 pin conn.	$5.95
Dip Jumper 2 ft.	$4.95

6522 APPLE II INTERFACE

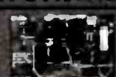
The JBE 6522 Parallel Interface for the Apple II Computer, plugs directly into any slot 1 through 7 in the Apple. This card has 2 6522 VIA's that provide:

- 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	$69.95	Assembled
79-295K	$59.95	Kit
79-295B	$19.95	Bareboard

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 many user programs.

81-088 Apple II Speech Synthesizer	$139.95
81-120 Parallel Input Speech Synthesizer	$149.95

Prices include the SC-01 Chip
SC-01 sold separately for $ 75.95

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
81-085K Kit	$49.95
81-085B Bare Board	$39.95

81-260 "SLIM"

Single board large scale Integration Microcomputer. This 4.5 x 6.5 board uses the 6502 Microprocessor, two 6522 VIA's, four 2114 RAM's, 2516, 2716 or 2532 EPROM. The fully buffered 22/44 pin bus is similar to the KIM®, SYM®, and AIM® expansion connector. The four 8 bit I/O ports connect through 16 pin dip sockets. This board was designed for control and is ideal for Personal and OEM use.

- 6502 MPU
- Two 6522 VIA's
- Four 2114 RAM's (2K bytes)
- One EPROM 2516 or 2532
- Crystal clock 1 Mhz
- Requires 5V 1AMP Power
- 4.5 x 6.5 card
- Power on reset
- Fully buffered-expandable
- Solder mask-both sides

Use your Apple II Computer, JBE 6522 Parallel Interface card and EPROM Programmer as a development system for SLIM.

Prices:

81-260A	$199.95	Assembled
81-260K	$149.95	Kit
81-260B	$ 39.95	Bare Board

6502 MICROCOMPUTER

6502 MPU, 6522 VIA, 2716 EPROM, 2114 RAM single board computer. Single 5 volt power supply at 400 Ma. Two independent 8 bit I/O ports with handshake lines. RC controlled 1 Mhz clock.

Complete documentation. I/O lines use 50 pin edge connector. Data and address lines are not accessible. Mod. for 2532 is included. EPROM is not included. 1K RAM, 2K EPROM, 2 I/O ports.

80-153 Assm.	$110.95
80-153 Kit	$ 89.95
80-153 Bare Board	$ 19.95

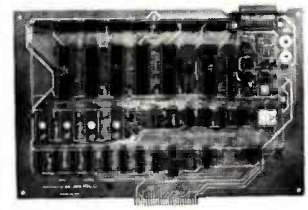
Z-80 MICROCOMUTER

Z-80 MPU, Z-80 PIO, 2716 EPROM, 2114 RAM single board computer. Single 5 volt power supply at 300 Ma. Two independent 8 bit I/O ports with handshake lines. RC controlled 2Mhz clock.

Complete documentation. I/O lines use 50 pin edge connector. Data and address lines are not accessible. Mod. for 2532 is included. EPROM is not included. 1K RAM, 2K EPROM, 2 I/O ports.

80-280 Assm.	$129.95
80-280 Kit	$119.95
80-280 Bare Board	$ 19.95

JBE I MICROCOMPUTER



JBE's 7.75 x 11.75 6502 base Microcomputer has the capacity for 16K of EPROM, 4K of RAM, 8 Parallel Ports and 1 Serial Port. Monitor and Tiny Basic are also available. The fully populated version includes:

- 1 6502 CPU
- 4 6522 VIA (8 Parallel I/O Ports)
- 1 AY5-1013 (Serial I/O Ports)
- 8 2114 RAM (4K)
- 2 2716 EPROM (Monitor & Tiny Basic)

The partially populated version includes:

- 1 6502 CPU
- 1 6522 VIA (2 Parallel I/O Ports)
- 1 AY5-1013 (Serial I/O Port)
- 2 2114 RAM (1K)
- 1 2716 EPROM (with Monitor)

Both versions include sockets for 2716s or 2532s, 8 16 pin sockets for I/O interfacing and a DB25 connector for RS232.

All address and data lines are brought off the board to the 50 pin edge connector. (similar to the Apple II bus)

This board also features power on reset and cassette interface.

81-030 C Fully Populated	$349.95
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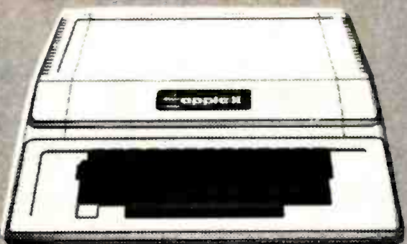

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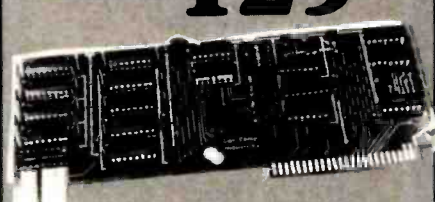

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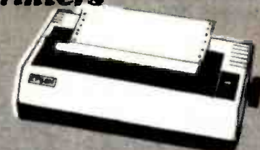

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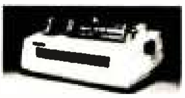

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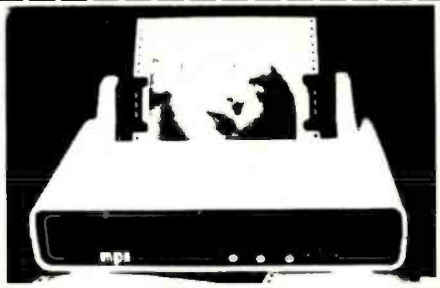

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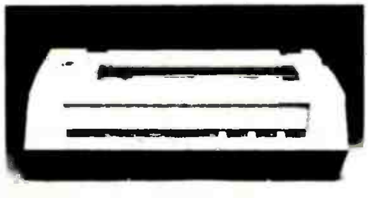

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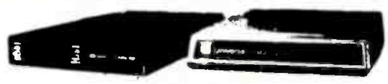

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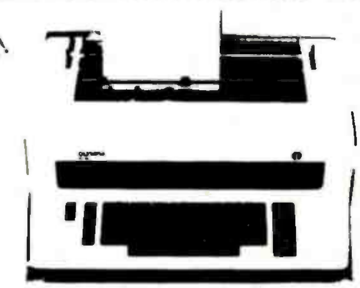

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AY5-3600	17.95
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HD0165-5	7.95

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DL747/750	CA/CC	.600	1.49
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FND500/507	CC/CA	.500	.99
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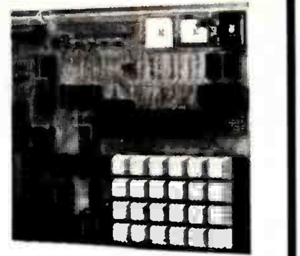

RCA Cosmac 1802 Super Elf Computer $106.95

The Super Elf is a small single board computer that does many big things. It's an excellent computer for training and for learning programming with its machine language and yet it's easily **expanded with additional memory, Full Basic, ASCII Keyboards, video character generation, etc.**

ROM monitor; State and Mode displays; Single step; Optional address displays; Power Supply; Audio Amplifier and Speaker; Fully socketed for all IC's; Full documentation.

The **Super Elf** includes a **ROM** monitor for program loading, editing and execution with **SINGLE STEP for program debugging** which is not included in others at the same price. With **SINGLE STEP** you can see the microprocessor chip operating with the **unique Quest** address and data bus displays **before, during** and **after** executing instructions. Also, CPU mode and instruction cycle are decoded and displayed on 8 LED indicators.

An RCA 1861 **video graphics** chip allows you to connect to your own TV with an inexpensive video modulator to do graphics and games. There is a **speaker system** included for writing your own music or using many music programs already written. The speaker amplifier may also be used to drive relays for control purposes.

A 24 key **HEX keyboard** includes 16 HEX keys plus **load, reset, run, wait, input, memory protect, monitor select** and **single step**. Large, on board displays provide output and optional **high and low address**. There is a 44 pin standard connector slot for PC cards and a 50 pin connector slot for the Quest Super Expansion Board. Power supply and sockets for **all** IC's are included plus a detailed 127 pg. instruction manual which now includes over 40 pgs. of software info. including a series of lessons to help get you started and a music program and graphics target game. Many schools and universities are using the Super Elf as a course of study. OEM's use it for training and R&D.

Remember, other computers only offer Super Elf features at additional cost or not at all. **Compare before you buy. Super Elf Kit $106.95, High address option $8.95, Low address option $9.95. Custom Cabinet** with drilled and labelled plexiglass front panel **$24.95.** All metal Expansion Cabinet, painted and silk screened, with room for 5S-100 boards and power supply **$57.00. NiCad Battery Memory Saver Kit $6.95.** All kits and options also completely assembled and tested.

Questdata, a software publication for 1802 computer users is available by subscription for $12.00 per 12 issues. Single issues $1.50. Issues 1-12 bound $16.50.

Moews Video Graphics **$3.50**, Games and Music **$3.00**, Chip 8 Interpreter **$5.50**, Starship 4K cassette **$14.95**.

Quest Super Basic V5.0

A new enhanced version of **Super Basic** now available. Quest was the first company worldwide to ship a full size Basic for 1802 Systems. A complete function **Super Basic** by **Ron Cenker** including floating point capability with scientific notation (number range $\pm .17E^{38}$), 32 bit integer ± 2 billion; multi dim arrays, string arrays; string manipulation; cassette I/O; save and load, basic, data and machine language programs; and over 75 statements, functions and operations.

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A 1K Super ROM Monitor $19.95 is available as an on board option in 2708 EPROM which has been preprogrammed with a program loader/editor and error checking multi file cassette read/write software, (relocatable cassette file) another exclusive from Quest. It includes register save and readout, block move capability and video graphics driver with blinking cursor. Break points can be used with the register save feature to isolate program bugs quickly, then follow with single step. If you have the **Super Expansion Board** and **Super Monitor** the monitor is up and running at the push of a button.

Other on board options include **Parallel Input and Output Ports** with **full handshake**. They allow easy connection of an ASCII keyboard to the input port. **RS 232 and 20 ma Current Loop** for teletype or other device are on board and if you need more memory there are two **S-100** slots for static RAM or video boards. Also a 1K Super Monitor version 2 with video driver for full capability display with Tiny Basic and a video interface board. **Parallel I/O Ports $9.85, RS 232 $4.50, TTY 20 ma I/F $1.95, S-100 $4.50. A 50 pin connector set** with ribbon cable is available at **$18.95** for easy connection between the **Super Elf** and the **Super Expansion Board.**

Power Supply Kit for the complete system (see Multi-volt Power Supply below).

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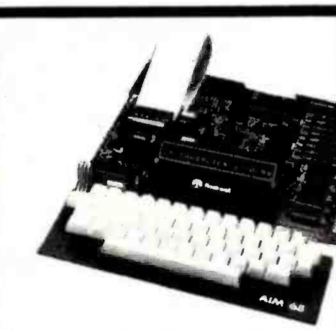

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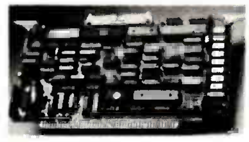

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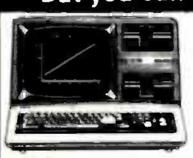

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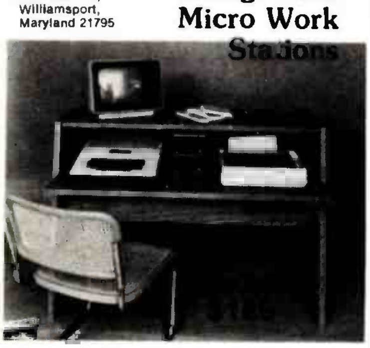

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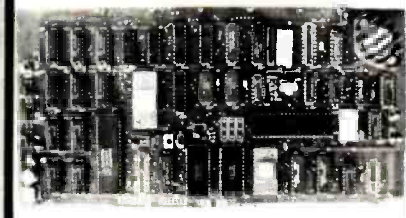

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This card can function as a stand alone single board computer or a S 100 intelligent video interface card.

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256K RAM $879.95

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SBC-200, 64K ExpandoRAM II, Versafloppy II, CP/M 2.2

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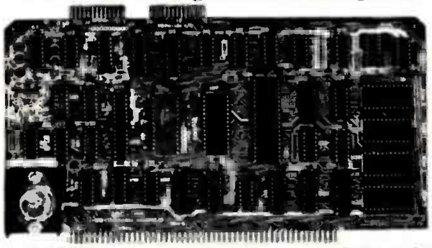
4 MHz Z-80A CPU, 64K RAM, serial I/O port, parallel I/O port, double-density disk controller, CP/M 2.2 disk and manuals, system monitor, control and diagnostic software.

Add $100.00 for upgrade to ExpandoRAM III 64K (expandable to 256K)

-All boards are assembled and tested-

SBC-200

2 or 4 MHz single board computer



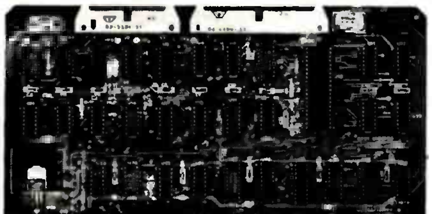
• S-100 bus compatible • Powerful 4MHz Z-80A CPU • Synchronous/asynchronous serial I/O port with RS-232 interface and software programmable baud rates up to 9600 baud • Parallel input and parallel output port • Four channel counter/timer • Four maskable, vectored interrupt inputs and a non-maskable interrupt • 1K of on-board RAM • Up to 32K of on-board ROM • System monitor PROM included

The SBC-200 is an excellent CPU board to base a microcomputer system around. With on-board RAM, ROM, and I/O, the SBC-200 allows you to build a powerful three-board system that has the same features found in most five-board microcomputers. The SBC-200 is compatible with both single-user and multi-user systems.

CPU-30200A *A & T with monitor* **$299.95**

Versafloppy II

Double density controller with CP/M 2.2



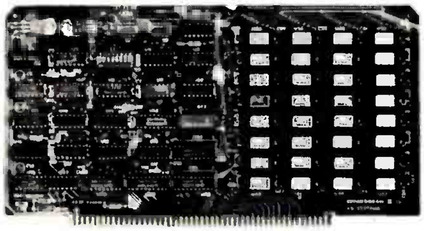
• S-100 bus compatible • IBM 3740 compatible soft sectored format • Controls single and double-sided drives, single or double density, 5¼" and 8" drives in any combination of four simultaneously • Drive select and side select circuitry • Analog phase-locked loop data seperator • Vectored interrupt operation optional • CP/M 2.2 disk and manual set included • Control/diagnostic software PROM included

The Versafloppy II is faster, more stable and more tolerant of bit shift and "jitter" than most controllers. CP/M 2.2 and all necessary control and diagnostic software are included.

IOD-1160A *A & T with CP/M 2.2* .. **$370.00**

ExpandoRAM III

64K to 256K expandable RAM board



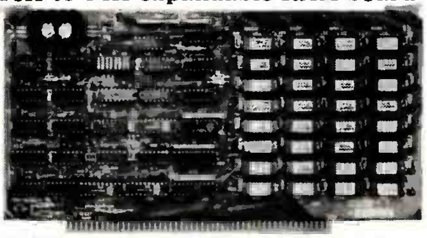
SD Systems has duplicated the famous reliability of their ExpandoRAM I and II boards in the new ExpandoRAM III, a board capable of containing 256K of high speed RAM. Utilizing the new 64K x 1 dymanic RAM chips, you can configure a memory of 64K, 128K, 192K, or 256K, all on one S-100 board. Memory address decoding is done by a programmed bipolar ROM so that the memory map may be dip-switch configured to work with either COSMOS/MPM-type systems or with OASIS-type systems.

Extensive application notes concerning how to operate the ExpandoRAM III with Cromemco, Intersystems, and other popular 4 MHz Z-80 systems are contained in the manual.

MEM-65064A	*64K A & T*	**$495.00**
MEM-65128A	*128K A & T*	**$639.95**
MEM-65192A	*192K A & T*	**$769.95**
MEM-65256A	*256K A & T*	**$879.95**

ExpandoRAM II

16K to 64K expandable RAM board



• S-100 bus compatible • Up to 4MHz operation • Expandable from 16K to 64K • Uses 16 x 1 4116 memory chips • Page mode operation allows up to 8 memory boards on the bus • Phantom output disable • Invisible on-board refresh

The ExpandoRAM II is compatible with most S-100 CPUs. When other SD System' series II boards are combined with the ExpandoRAM II, they create a microcomputer system with exceptional capabilities and features.

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MEM-32631A	*32K A & T*	**$345.00**
MEM-48632A	*48K A & T*	**$365.00**
MEM-64633A	*64K A & T*	**$385.00**

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Versatile EPROM Programmer

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MEM-99520A	*A & T w/software* ...	**$249.95**

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SBC-200, 256K ExpandoRAM III, Versafloppy II, MPC-4 COSMOS Multi-User Operating System, C BASIC II

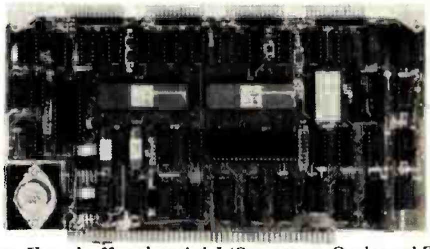
$1995.00

Two Z-80A CPUs (4 MHz), 256K RAM, 5 serial I/O ports with independently programmable baud rates and vectored interrupts, parallel input port, parallel output port, 8 counter/timer channels, real time clock, single and double sided/single or double density disk controller for 5¼" and 8" drives, up to 36K of on-board ROM, CP/M 2.2 compatible COSMOS interrupt driven multi-user disk operating system, allows up to 8 users to run independent jobs concurrently, C BASIC II, control and diagnostic software in PROM included.

-All boards are assembled and tested-

MPC-4

Intelligent communications interface



• Four buffered serial I/O ports • On-board Z-80A processor • Four CTC channels • Independently programmable baud rates • Vectored interrupt capability • Up to 4K of on-board PROM • Up to 2K of on-board RAM • On-board firmware

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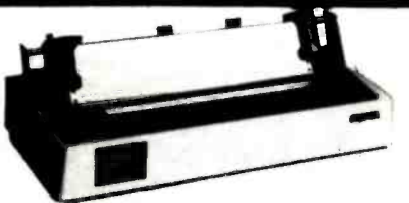

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MEM-99520A	*A & T*	$249.95

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12 Slot (9¾" x 8¾")		
MBS-121B	*Bare board*	$29.95
MBS-121K	*Kit*	$69.95
MBS-121A	*A & T*	$89.95
18 Slot (14½" x 8¾")		
MBS-181B	*Bare board*	$49.95
MBS-181K	*Kit*	$99.95
MBS-181A	*A & T*	$139.95

S-100 RAM Boards

MEMORY BANK - Jade
4 MHz, S-100, bank selectable, expandable from 16K to 64K

MEM-99730B	*Bare Board*	$49.95
MEM-99730K	*Kit no RAM*	$199.95
MEM-32731K	*32K Kit*	$239.95
MEM-64733K	*64K Kit*	$279.95
Assembled & Tested		add $50.00

64K RAM - Calif Computer Sys
4 MHz bank port / bank byte selectable, extended addressing, 16K bank selectable, PHANTOM line allows memory overlay, 8080 / Z-80 / front panel compatible.

MEM-64565A	*A & T*	$575.00

64K STATIC RAM - Mem Merchant
64K static S-100 RAM card, 4-16K banks, up to 8MHz

MEM-64400A	*A & T*	$789.95

32K STATIC RAM - Jade
2 or 4 MHz expandable static RAM board uses 2114L's

MEM-16151K	*16K 4 MHz kit*	$169.95
MEM-32151K	*32K 4 MHz kit*	$299.95
Assembled & tested		add $50.00

16K STATIC RAM - Mem Merchant
4 MHz 16K static RAM board, IEEE S-100, bank selectable, Phantom capability, addressable in 4K blocks, "disable-able" in 1K segments, extended addressing, low power

MEM-16171A	*A & T*	$164.95

S-100 Disk Controllers

DOUBLE-D - Jade
Double density controller with the inside track, on-board Z-80A, printer port, IEEE S-100, can function on an interrupt driven buss*

IOD-1200K	*Kit*	$299.95
IOD-1200A	*A & T*	$375.00
IOD-1200B	*Bare board*	$59.95

DOUBLE DENSITY - Cal Comp Sys
5¼" and 8" disk controller, single or double density, with on-board boot loader ROM, and free CP/M 2.2 and manual set.*

IOD-1300A	*A & T*	$374.95

S-100 I/O Boards

S.P.I.C. - Jade
Our new I/O card with 2 SIO's, 4 CTC's, and 1 PIO

IOI-1045K	*2 CTC's, 1 SIO, 1 PIO*	$179.95
IOI-1045A	*A & T*	$239.95
IOI-1046K	*4 CTC's, 2 SIO's, 1 PIO*	$219.95
IOI-1046A	*A & T*	$299.95
IOI-1045B	*Bare board w/ manual*	$49.95

I/O-4 - S.S.M.
2 serial I/O ports plus 2 parallel I/O ports

IOI-1010K	*Kit*	$179.95
IOI-1010A	*A & T*	$249.95
IOI-1010B	*Bare board*	$35.00

S-100 Mainframes

MAINFRAME - Cal Comp Sys
12 slot S-100 mainframe with 20 amp power supply

ENC-112105	*Kit*	$329.95
ENC-112106	*A & T*	$399.95

EPROM ERASER - Spectronics
Ultra-violet EPROM erasers

XME-3100A	*With out timer*	$69.50
XME-3101	*With timer*	$94.50
XME-3200	*Economy Model*	$39.95

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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" Subassembly Cabinet

END-000420	*Bare cabinet*	$59.95
END-000421	*Cabinet kit*	$225.00
END-000431	*A & T*	$359.95

8" Disk Drive Subsystems
Single Sided, Double Density

END-000423	*Kit w/2 FD100-8Ds*	$924.95
END-000424	*A & T w/2 FD100-8Ds*	$1124.95
END-000433	*Kit w/2 SA-801Rs*	$999.95
END-000434	*A & T w/2 SA-801Rs*	$1195.00

8" Disk Drive Subsystems
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*	$1295.00
END-000437	*A & T w/2 SA-851Rs*	$1495.00

5¼" Disk Drives

Shugart SA400L sngl-sided dbl-density 40 track		
MSM-104000	$234.95 ea	2 for $224.95 ea
Shugart SA450 dbl-sided dbl-density 70 track		
MSM-104500	$349.95 ea	2 for $329.95 ea
Qume DT-5 dbl-sided dbl-density 80 track		
MSM-750050	$359.95 ea	2 for $349.95 ea
MPI B-51 sngl-sided dbl-density 40 track		
MSM-155100	$234.95 ea	2 for $224.95 ea
MPI B-52 dbl-sided dbl-density 40 track		
MSM-155200	$344.95 ea	2 for $334.95 ea
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MSM-155300	$369.95 ea	2 for $359.95 ea
MPI B-92 dbl-sided dbl-density 77 track		
MSM-155400	$469.95 ea	2 for $459.95 ea

8" Disk Drives

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
Qume DT-8 double-sided double-density		
MSF-750080	$524.95 ea	2 for $499.95 ea
Siemens FDD 100-8 sngl-sided dbl-density		
MSF-201120	$384.95 ea	2 for $349.95 ea

BUS PROBE - Jade
S-100 diagnostic analyzer board, dynamic visual display of all 96 IEEE S-100 signals, aids in real time analysis of faulty hardware and software

TSX-200B	*Bare Board*	$59.95
TSX-200K	*Kit*	$119.95
TSX-200A	*A & T*	$149.95

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SN7404N	.22	SN74132N	.69
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SN7420N	.22	SN74153N	.67
SN7421N	.35	SN74154N	1.19
SN7422N	.29	SN74155N	.78
SN7423N	.29	SN74156N	.78
SN7425N	.29	SN74157N	.69
SN7426N	.29	SN74158N	1.65
SN7427N	.25	SN74160N	.88
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SN7437N	.25	SN74164N	.87
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CD4071	.35	74C174	1.35
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74LS26N	.33	74LS197N	.89
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74LS113N	.43	74LS353N	1.19
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74LS122N	.55	74LS365N	.69
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74LS124N	1.35	74LS367N	.69
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74LS126N	.52	74LS373N	1.89
74LS132N	.79	74LS374N	1.89
74LS136N	.49	74LS375N	.69
74LS138N	.85	74LS377N	1.95
74LS139N	.85	74LS385N	1.95
74LS145N	1.25	74LS386N	.65
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74LS153N	.79	74LS395N	1.70
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74LS157N	.85	74LS670N	2.29
74LS158N	.75	81LS95N	1.69
74LS160N	1.05	81LS96N	1.69
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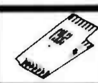

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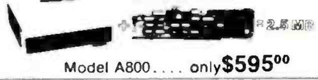

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BRUCE SEALS
Designer of the Static • 64

Those of us who remember back to 1974 when S-100 was in its infancy and assembling from kit your own Altair Computer will recall that the only working add on memory was the 8K static board manufactured by Seals Electronics out of Knoxville Tennessee.

Ed Roberts and William Gates are credited for the design of the Altair computer, but Bruce Seals had the only working memory board.

By the time Mr. Seals' company was dissolved in 1979, Seals Electronics had sold over 47,000 of their 8K memory board.

Since the liquidation of Seals Electronics. Bruce has been hiding from the revenuers and running moonshine in the hills of Tennessee. after extensive negotiations California Digital has convinced Mr. Seals to come out of hiding and design the next generation of static memory boards.

The product that he has engineered is destined to become the next milestone in S-100 memory products.

In the next several months we expect to release a full line of computer products designed by Bruce Seals.

California Digital STATIC • 64

Utilizing the new "2167" ram chip, the Static 64 is the most current technology available in S-100 memory.

24 bit extended addressing, 8 or 16 bit data paths along with 16 bit request and acknowledge make this unique board completely compatable with the IEEE 696 buss standard.

The Static 64 has been engineered to allow each 16K segment of memory to be bank selectable supporting multiuser systems. Other selectable features allow the board to fully integrate with all current bank selecting schemes including Cromex and Alpha-Micro. Designed for DMA operation at clock frequencies in excess of 10 MHz.

The Static 64 is manufactured to meet current military circuit board specifications. IC sockets utilizing ultra-reliable machine screw contacts are used to increase the total integrity of the product. Each board before leaving our facility is subjected to extensive high temperature burn-in and test procedures.

Unconditional one-year warranty with 24 hour repair or replacement on all boards purchased from California Digital. OEM and dealer pricing upon request CAL6400.

$850

EPSON MX80 $475

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Epson MX100 132 column	825.00
Graftrax 80 option	70.00
Apple I/O & cable (8131)	129.00
Serial interface (8141)	79.00
Serial Inter., 2K buf. (8151)	145.00
Cable for TRS-80	35.00
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NEC PC-8023A $635

Dot-matrix, bi-directional, logic-seeking, friction or tractor feed, impact printer. Complete graphics, upper and lower case ASCII, Greek, mathematics along with the ability to print dot graphic screen images directly onto paper.

Proportional spacing and 132 column compressed print make this low cost machine the best value in todays printer market.

PRINTRONIX

P-300 $4500

P-600 $6150

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Epson MX100	PREMX100	825
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Anacom 150	PRA150	1075
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APPLE II $1150

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$2450 HEWLETT PACKARD HP85

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Northstar 64Q	SYSN64Q	3295
Northstar 64D	SYSN64D	2895
NEC/PC8000	SYSPC8000	call
Apple II Plus	SYSAP	1170

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IBM Direct Price $1395

California Digital discount price **$1295**

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$995

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ADDS Regent 40 limited graphics	VDT-R40	1195
ADDS Regent 60 Block mode	VDT-R60	1495
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Hazeltine 1520	VDT-H1520	
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Hewlett Packard 2621P	VDT-HP21P	
IBM 3101-10 character mode green	VDT-3101	1195
IBM 3101-20 block mode	VDT-31012	1395
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Lear Seigler ADM31	VDT-L31	1385
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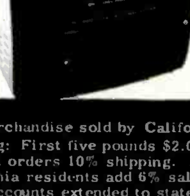
Televideo 920C	VDT-T920	745
Televideo 950C detatchable keybd.	VDT-T950	985
Zenith Z-19	VDT-Z-19	735

VIDEO MONITORS



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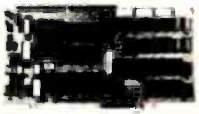
SSM MICROCOMPUTER	
Dual serial parallel interface AIO	
SORRENTO VALLEY ASSOCIATES	
8" floppy controller (Pascal)	360

S-100 BOARDS

Assembled • Tested • Burned-in



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Calif. Computer 2810A Z-80 DMA, 4MHz	BDC-C2810	$250
Godbout Z-80 24 bit, 4MHz	BDC-GZ80	239
Godbout 8085/8088 dual 16 bit processor	BDC-G88	375
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Teletek FDC-1 single board CPU & floppy disk controller plus I/O	BDC-FDCI	695
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TEI 12 slot table	ENM-T12	
TEI 22-slot table	ENM-T22	
Godbout mainfrm.	ENM-GMF	
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Calif. Computer 2065A 64K dynamic memory	BDM-C2065	$429
Calif. Computer 2016 16K static memory	BDM-C2016	259
Calif. Computer 2032 32K static memory	BDM-C2032	585
Godbout Ram 17 64K static memory 16 bit	BDM-G17	1025
SD Systems Expandoram II 16K dynamic	BDM-EX16	295
SD Systems Expandoram II 64K dynamic	BDM-EX64	375
Measurement Systems DMB6400 for Alpha Micro	BDM-M6400	685
EPROM BOARDS		
Digital Research 32K, 2716 proms extra	BDM-DP32	90
SD Systems Prom-100 programmer	BDM-P100	250
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Calif. Computer 2422A with 2.2 CPM	BDF-C2422	329
Godbout "Disk One" features the NEC 765 controller, DMA arbitration	BDI-GD1	395
Measurement Systems 765 chip, single & double density. Error recovery	BDF-MF	419
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Morrow Designs Switchboard 2 serial/4 par'l	BDT-MSB	219
Morrow Designs Multiboard 3 serial/3P. ***	BDT-MMB	275
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2716	2048 x 8	(5V)	(450ns)	5.50	4.95
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4116-200	16,384 x 1		(200ns)	8/15.95	1.80
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2112	256 x 4		(450ns)	2.99	2.79
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74LS03	.25	74LS91	.89	74LS173	.80	74LS352	1.55
74LS04	.25	74LS92	.70	74LS174	.95	74LS353	1.55
74LS05	.25	74LS93	.65	74LS175	.95	74LS363	1.35
74LS08	.35	74LS95	.85	74LS181	2.15	74LS364	1.95
74LS10	.25	74LS96	.95	74LS189	9.95	74LS365	.95
74LS11	.35	74LS107	.40	74LS190	1.00	74LS366	.95
74LS12	.35	74LS109	.40	74LS191	1.00	74LS367	.70
74LS13	.45	74LS112	.45	74LS192	.85	74LS368	.70
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74LS32	.35	74LS137	.99	74LS243	1.85	74LS395	1.65
74LS33	.55	74LS138	.75	74LS244	.99	74LS399	1.70
74LS37	.55	74LS139	.75	74LS245	1.90	74LS424	2.95
74LS38	.35	74LS145	1.20	74LS247	.76	74LS447	.37
74LS40	.35	74LS147	2.49	74LS248	1.25	74LS490	1.95
74LS42	.55	74LS148	1.35	74LS249	.99	74LS668	1.69
74LS47	.75	74LS151	.75	74LS251	1.30	74LS669	1.89
74LS48	.75	74LS153	.75	74LS253	.85	74LS670	2.20
74LS49	.75	74LS154	2.35	74LS257	.85	74LS674	9.65
74LS51	.25	74LS155	1.15	74LS258	.85	74LS682	3.20
74LS54	.35	74LS156	.95	74LS259	2.85	74LS683	2.30
74LS55	.35	74LS157	.75	74LS260	.65	74LS684	2.40
74LS63	1.25	74LS158	.75	74LS266	.55	74LS685	2.40
74LS73	.40	74LS160	.90	74LS273	1.65	74LS688	2.40
74LS74	.45	74LS161	.95	74LS275	3.35	74LS689	2.40
74LS75	.50	74LS162	.95	74LS279	.55	81LS95	1.69
74LS76	.40	74LS163	.95	74LS280	1.98	81LS96	1.69
74LS78	.50	74LS164	.95	74LS283	1.00	81LS97	1.69
74LS83	.75	74LS165	.95	74LS290	1.25	81LS98	1.69

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74C04	.35	74C902	.85	4021	.95	14409	12.95
74C08	.35	74C903	.85	4022	1.15	14410	12.95
74C10	.35	74C905	10.95	4023	.35	14411	11.95
74C14	1.50	74C906	.95	4024	.75	14412	12.95
74C20	.35	74C907	1.00	4025	.35	14419	4.95
74C30	.35	74C908	2.00	4026	1.65	4502	.95
74C32	.50	74C909	2.75	4027	.65	4503	.65
74C42	1.75	74C910	9.95	4028	.80	4508	1.95
74C48	2.10	74C911	10.00	4029	.95	4510	.95
74C73	.65	74C912	10.00	4030	.45	4511	.95
74C74	.85	74C914	1.95	4034	2.95	4512	.95
74C76	.80	74C915	2.00	4035	.85	4514	1.25
74C83	1.95	74C918	2.75	4040	.95	4515	2.25
74C85	1.95	74C920	17.95	4041	1.25	4516	1.55
74C86	.95	74C921	15.95	4042	.75	4518	1.25
74C89	4.50	74C922	5.95	4043	.85	4519	1.25
74C90	1.75	74C923	5.95	4044	.85	4520	1.25
74C93	1.75	74C925	6.75	4046	.95	4522	1.25
74C95	1.75	74C926	7.95	4047	.95	4526	1.25
74C107	1.00	74C927	7.95	4049	.55	4527	1.95
74C150	5.75	74C928	7.95	4050	.55	4528	1.25
74C151	2.25	74C929	19.95	4051	.95	4531	.95
74C154	3.25	74C930	19.95	4053	.95	4532	1.95
74C157	1.75	4000	.35	4060	1.45	4538	1.95
74C160	2.00	4001	.35	4066	.75	4539	1.95
74C161	2.00	4002	.25	4068	.40	4543	2.70
74C162	2.00	4006	.95	4069	.35	4555	.95
76C163	2.00	4007	.29	4070	.35	4556	.95
74C164	2.00	4008	.95	4071	.30	4581	1.95
74C165	2.00	4009	.45	4072	.30	4582	1.95
74C173	2.00	4010	.45	4073	.30	4584	.95
74C174	2.25	4011	.35	4075	.30	4585	.95
74C175	2.25	4012	.25	4076	.95	4702	12.95
74C192	2.25	4013	.45	4078	.30	4724	1.50
74C193	2.25	4014	.95	4081	.30	80C07	.95
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74C200	5.75	4016	.45	4085	.95	80C96	.95
74C221	2.25	4017	1.15	4086	.95	80C97	.95
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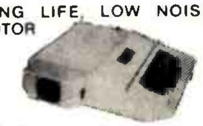

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22 pin ST	.30	.27
24 pin ST	.30	.27
28 pin ST	.40	.32
40 pin ST	.49	.39
ST = SOLDERTAIL		
8 pin WW	.59	.49
14 pin WW	.69	.52
16 pin WW	.69	.58
18 pin WW	.99	.90
20 pin WW	1.09	.98
22 pin WW	1.39	1.28
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7815T	.99	7924T	1.19
7824T	.99		
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7812K	1.39	7912K	1.49
7815K	1.39	79LO5	.79
78LO5	.69	79L12	.79
78L12	.69	79L15	.79
78L15	.69		
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T = TO-220 K = TO-3 L = TO-92

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LM317T	1.95
LM317K	3.95
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LM386V	1.50
LM555V	.39
LM556	.69
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LM567V	1.29
LM723	.49
LM733	.98
LM741V	.29
LM747	.79
LM748V	.59
LM1310	2.90
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MC1350V	1.29
MC1358	1.79
LM1414	1.59
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LM1489	.99
LM1800	2.99
LM1889	2.49
LM3900	.59
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LM3914	3.95
LM3915	3.95
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75451V	.39
75452V	.39
75453V	.39

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74S02	.48	74S85	2.39	74S168	4.65	74S258	1.49
74S03	.48	74S86	1.44	74S169	5.44	74S260	1.83
74S04	.79	74S112	1.59	74S174	1.09	74S274	19.95
74S05	.79	74S113	1.98	74S175	1.09	74S275	19.95
74S08	.48	74S114	1.50	74S181	4.47	74S280	2.90
74S09	.98	74S124	2.77	74S182	2.95	74S287	4.75
74S10	.69	74S132	1.24	74S188	3.95	74S288	4.45
74S11	.88	74S133	.98	74S189	14.95	74S289	6.98
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74S20	.68	74S135	1.48	74S195	1.89	74S373	3.45
74S22	.98	74S138	1.08	74S196	4.90	74S374	3.45
74S30	.48	74S139	1.25	74S197	4.25	74S381	7.95
74S32	.98	74S140	1.45	74S201	14.95	74S387	5.75
74S37	1.87	74S151	1.19	74S225	8.95	74S412	2.98
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74S64	.79	74S161	2.85	74S251	1.90	74S482	15.60
74S65	1.25	74S162	3.70	74S253	7.45	74S570	7.80
						74S571	7.80

7400 SERIES

7400	.19	7451	.23	74136	.50	74186	18.50
7401	.19	7453	.23	74141	.65	74190	1.15
7402	.19	7454	.23	74142	2.95	74191	1.15
7403	.19	7460	.23	74143	2.95	74192	.79
7404	.19	7470	.35	74144	2.95	74193	.79
7405	.22	7472	.29	74145	.60	74194	.85
7406	.22	7473	.34	74147	1.75	74195	.85
7407	.22	7474	.35	74148	1.20	74196	.79
7408	.24	7475	.49	74150	1.35	74197	.75
7409	.19	7476	.35	74151	.65	74198	1.35
7410	.19	7480	.59	74152	.65	74199	1.35
7411	.25	7481	1.10	74153	.55	74221	1.35
7412	.30	7482	.95	74154	1.40	74246	1.35
7413	.35	7483	.50	74155	.75	74247	1.25
7414	.55	7485	.65	74156	.65	74248	1.85
7416	.25	7486	.35	74157	.55	74249	1.95
7417	.25	7489	4.95	74159	1.65	74251	.75
7420	.19	7490	.35	74160	.85	74259	2.25
7421	.35	7491	.40	74161	.70	74265	1.35
7422	.29	7492	.50	74162	.85	74273	1.95
7423	.29	7493	.49	74163	.85	74276	1.25
7425	.29	7494	.65	74164	.85	74279	.75
7426	.29	7495	.55	74165	.85	74283	2.00
7427	.29	7496	.70	74166	1.00	74284	3.75
7428	.45	7497	2.75	74167	2.95	74285	3.75
7430	.19	74100	1.00	74170	1.65	74290	.95
7432	.29	74107	.30	74172	5.95	74293	.75
7433	.45	74109	.45	74173	.75	74298	.85
7437	.29	74110	.45	74174	.89	74351	2.25
7438	.29	74111	.55	74175	.89	74365	.65
7440	.19	74116	1.55	74176	.89	74366	.65
7442	.49	74120	1.20	74177	.75	74367	.65
7443	.65	74121	.29	74178	1.15	74368	.65
7444	.69	74122	.45	74179	1.75	74376	2.20
7445	.69	74123	.55	74180	.75	74390	1.75
7446	.59	74125	.45	74181	2.25	74393	1.35
7447	.69	74126	.45	74182	.75	74425	3.15
7448	.69	74128	.55	74184	2.00	74426	.85
7450	.19	74132	.45	74185	2.00	74490	2.55

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1 Infinity:
First in a series of t-shirts by Scott Kim

Inversions

An "inversion" is a word that has been written so that it reads symmetrically.

For instance, words that are the same upside down and right side up are inversions. A few words exist in the English language that do this naturally, such as "SWIMS" and "NOON." But alas, the great majority of words, when turned upside down, don't do anything interesting at all.

Fortunately for lovers of inversions, letters are quite flexible. Look around you and you will see the letter "a" written in hundreds of different ways. And all of them we have learned to read as the same letter.

By bending and stretching the shapes of letters, we can turn ordinary asymmetrical words into symmetrical inversions. Not all words will work, but when they do, the results are inevitably fascinating.

Scott Kim's new book ***Inversions: a Catalog of Calligraphic Cartwheels,*** published by Byte Books, is a collection of more than 60 inversions, exploring a wide range of ideas and lettering styles.

In the accompanying text, Scott explains how inversions are created, so that you may try your hand at them.

"Scott Kim's Inversions ... is one of the most astonishing and delightful books ever printed ... Over the years Kim has developed the magical ability to take just about any word or short phrase and letter it in such a way that it exhibits some kind of striking geometrical symmetry."
— Martin Gardner,
Scientific American

Infinity

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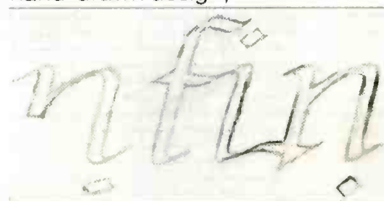
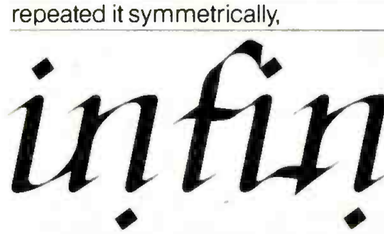
Infinity

In this design, Scott Kim mixes idea and image, art and technology, in a swirling evocation of infinity. This intricate design was created with the aid of a computer program, which took a basic hand-drawn design,



repeated it symmetrically,



then bent it into a continuously expanding spiral.

As you look at the design, you'll discover that it can be read in two different ways. Notice that the letters "fi" when turned upside down become the "y" at the end of "infinity." And so the spiral can be read as either "infinity" going in or "infinity" coming out! Which do you see?

Infinity is the first in a series of wearable wordplays from the book ***Inversions: a Catalog of Calligraphic Cartwheels*** by Scott Kim. The book is available through your local bookstore, or by calling Byte Books toll-free at 800-258-5420.

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WWB-2 Wire Wrap Board, List $65 . . . $38

CROMEMCO SOFTWARE

(Specify 8" or 5¼")

CROMIX Multi-User, List $595 . . . . . . $249
FDA Macro Assembler, List $295 . . . . $249
FDB 16K Extended Basic, List $195 . . $165
FDC COBOL Compiler, List $595 . . . . $299
FDF Fortran IV Compiler, List $295 . . $179
FDR RATFOR includes Fortran IV, List $395 . . . . $335
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DBM Data Base Management w/Report, List $395 . . . . $249
WPS Word Processing System, List $295 . . . . $249
TSS Trace System Simulator, List $195 . . . . $95
WRMR Writemaster Word Processing, List $595 . . . . $499
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Mini Micro Mart, Inc.

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TWX 710-541-0431

VISA

Circle 233 on inquiry card.

BBPDBGBTSK SuperSixteen CSC $4095.00
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Power Supply-Kit. 23 lbs.
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BBGBTBOX RACK Rack Mount Main Frame $329.00
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Apple Centronics 8 bit parallel interface

PRIORITY ONE ELECTRONICS

S-100 CPU

CPU-Z - GODBOUT

2/4 MHZ Z80 CPU 24 Bit Addressing

BBGBT 160A	A & T	$199.00
BBGBT 160C	CSC 3-6 MHZ	$375.00

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6 or 8 MZ Provides true 16 Bit Power with a standard 8 bit S-100 bus.

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SOLID STATE DISK DRIVE, 3500% FASTER!

Not Really, But the Next Best Thing For Godbout 8085/88 Users. Call for Details on M-Drive. See Page 340 of November **BYTE**

BBGBT MD 128K	$1,550.00
BBGBT MD 256K	$3,000.00

2810 Z80 CPU-CA. COMP. SYST.

2/4 MHZ Z80A CPU with RS232C Serial I/O Port complete with Monitor PROM for 2422 Disk Controller

BBCCS 2810A	A & T	$280.00

CB2 Z80 CPU - S.S.M.

2/4 MHZ will accept 2716, or 2732, or RAM RUN/STOP and single step switches

BBSSMCB2K	Kit	$260.00
BBSSMCB2A	A & T	$310.00
BBSSMZ80M	SSMZ80 Monitor	$89.00

S-100 10 MHZ STATIC RAM

NEW LOW PRICES!

32K STATIC RAM - GODBOUT

RAM 20 10 MHZ, 4K byte block disable, bank select or 24 bit addressing available 8, 16, 24 or 32K

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
BBGBT164AA8	8K A&T	$210.00	$190.00
BBGBT164AC8	8K CSC	$280.00	$260.00
BBGBT164AA16	16K A&T	$285.00	$260.00
BBGBT164AC16	16K CSC	$355.00	$325.00
BBGBT164AA24	24K A&T	$355.00	$325.00
BBGBT164AC24	24K CSC	$425.00	$385.00
BBGBT164AA32	32K A&T	$425.00	$385.00
BBGBT164AC32	32K CSC	$495.00	$450.00

64K STATIC RAM - GODBOUT

RAM 17, 10 MHZ, 2 Watt, DMA Compatable 24 Bit Addressing

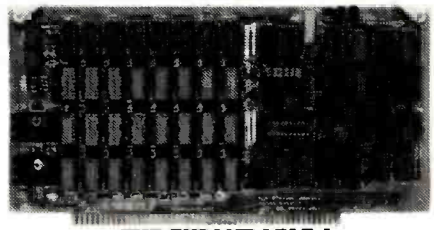
BBGBT175A46	48K A&T	$650.00	$619.00
BBGBT175C48	48K CSC 200hr.	$750.00	$710.00
BBGBT175A64	64K A&T	$795.00	$755.00
BBGBT175C64	64K CSC 200hr.	$895.00	$850.00

NEW! 32K x 16 BIT STATIC RAM - GODBOUT

RAM 16 10 MHZ, 32K x 16 or 64K x 8 IEEE/696 16 BIT 2 Watt, 24 Bit Addressing

BBGBT180A	64K A&T	$895.00	$850.00
BBGBT180C	64K CSC	$995.00	$945.00

S-100 DYNAMIC RAM



THE EXPANDABLE 1
PRIORITY 1 ELECTRONICS

THE EXPANDABLE 1™ 64K Dynamic Ram board provides your S-100 system with 64K of reliable, high-speed dynamic RAM. Compatable with most of the major S-100 systems on the market, including those with front panels, it supports DMA operations and requires no Wait states with current microprocessors. ● User expandable from 16 to 64K ● Supports DMA ● Designed to IEEE proposed S-100 bus standards ● 2 or 4 MHz operation ● Operates with either an 8080 or Z-80 based S-100 system, providing processor-transparent refreshes with both ● Supports IMSAI-type front panels ● Jumper-selectable Phantom input ● Uses Popular 4116 RAMS ● All ICs in sockets ● Any 16K block can be made bank-independent ● Fully buffered address and data lines ● Fail-safe refresh circuitry for extended Wait states ● Board configuration with reliable, easy-to-configure Berg jumpers

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BBPRIEXP132	32K Assembled & Tested	$339.00
BBPRIEXP148	48K Assembled & Tested	$379.00
BBPRIEXP164	64K Assembled & Tested	$409.00

S-100 DISK CONTROLLERS

7400

SN7400N	.20	SN7472N	.29	SN74156N	.79
SN7401N	.20	SN7473N	.35	SN74157N	.69
SN7402N	.25	SN7474N	.35	SN74160N	.89
SN7403N	.25	SN7475N	.49	SN74161N	.89
SN7404N	.25	SN7476N	.35	SN74162N	.89
SN7405N	.29	SN7479N	5.00	SN74163N	.89
SN7406N	.35	SN7480N	.50	SN74164N	.89
SN7407N	.35	SN7482N	.99	SN74165N	.89
SN7408N	.29	SN7483N	.69	SN74166N	1.25
SN7409N	.29	SN7485N	.89	SN74167N	2.79
SN7410N	.25	SN7486N	.35	SN74170N	1.95
SN7411N	.29	SN7489N	1.75	SN74172N	4.95
SN7412N	.35	SN7490N	.49	SN74173N	1.39
SN7413N	.40	SN7491N	.59	SN74174N	.99
SN7414N	.69	SN7492N	.45	SN74175N	.89
SN7416N	.29	SN7493N	.45	SN74176N	.79
SN7417N	.29	SN7494N	.69	SN74177N	.79
SN7420N	.25	SN7495N	.69	SN74179N	1.49
SN7421N	.29	SN7496N	.69	SN74180N	.79
SN7422N	.45	SN7497N	3.00	SN74181N	2.25
SN7423N	.29	SN74100N	1.49	SN74182N	.79
SN7425N	.29	SN74104N	.89	SN74184N	2.49
SN7426N	.29	SN74105N	.89	SN74185N	2.49
SN7427N	.25	SN74107N	.35	SN74190N	1.25
SN7428N	.49	SN74109N	.39	SN74191N	1.25
SN7430N	.25	SN74116N	1.95	SN74192N	.89
SN7432N	.29	SN74121N	.39	SN74193N	.89
SN7437N	.25	SN74122N	.55	SN74194N	.89
SN7438N	.40	SN74123N	.59	SN74195N	.69
SN7439N	.25	SN74125N	.49	SN74196N	.89
SN7440N	.20	SN74126N	.49	SN74197N	.89
SN7441N	.89	SN74132N	.75	SN74198N	1.49
SN7442N	.59	SN74136N	.75	SN74199N	1.49
SN7443N	1.10	SN74141N	.99	SN74221N	1.25
SN7444N	1.10	SN74142N	3.25	SN74251N	.99
SN7445N	.89	SN74143N	3.49	SN74276N	1.95
SN7446N	.79	SN74144N	3.49	SN74279N	.79
SN7447N	.69	SN74145N	.79	SN74283N	1.49
SN7448N	.79	SN74147N	1.95	SN74284N	3.95
SN7450N	.20	SN74148N	1.29	SN74285N	3.95
SN7451N	.20	SN74150N	1.25	SN74365N	.69
SN7453N	.20	SN74151N	.69	SN74366N	.69
SN7454N	.20	SN74152N	.69	SN74367N	.69
SN7459A	.25	SN74153N	.79	SN74368N	.69
SN7460N	.20	SN74154N	1.25	SN74390N	1.49
SN7470N	.29	SN74155N	.79	SN74393N	1.49

74LS

74LS00	.29			74LS192	1.15
74LS01	.29	74LS92	.75	74LS193	1.15
74LS02	.29	74LS93	.75	74LS194	1.15
74LS03	.29	74LS95	.99	74LS195	1.15
74LS04	.35	74LS96	1.15	74LS197	1.19
74LS05	.35	74LS107	.45	74LS221	1.19
74LS08	.35	74LS109	.45	74LS240	1.49
74LS09	.35	74LS112	.45	74LS241	1.49
74LS10	.35	74LS113	.49	74LS242	1.49
74LS11	.39	74LS114	.49	74LS243	1.49
74LS12	.35	74LS122	.89	74LS244	1.49
74LS13	.59	74LS123	1.25	74LS245	2.95
74LS14	.99	74LS125	.59	74LS247	1.19
74LS15	.35	74LS126	.59	74LS248	1.19
74LS20	.35	74LS132	.99	74LS249	1.19
74LS21	.35	74LS133	.89	74LS251	.99
74LS22	.35	74LS136	.49	74LS253	.99
74LS26	.35	74LS138	.89	74LS257	.89
74LS27	.35	74LS139	.89	74LS258	.69
74LS28	.35	74LS151	.89	74LS260	.69
74LS30	.35	74LS153	.89	74LS266	.69
74LS32	.35	74LS154	1.75	74LS273	1.95
74LS33	.59	74LS155	.89	74LS279	.89
74LS37	.45	74LS156	.89	74LS283	.89
74LS38	.39	74LS157	.89	74LS290	.99
74LS40	.35	74LS158	.89	74LS293	.99
74LS42	.89	74LS160	1.15	74LS298	1.25
74LS47	.89	74LS161	1.15	74LS352	1.29
74LS48	1.15	74LS162	1.15	74LS353	1.29
74LS49	1.15	74LS163	1.15	74LS365	.69
74LS51	.35	74LS164	1.15	74LS366	.69
74LS54	.35	74LS165	1.15	74LS367	.69
74LS55	.35	74LS168	1.19	74LS368	.69
74LS73	.45	74LS169	1.19	74LS373	1.95
74LS74	.45	74LS170	1.95	74LS374	1.95
74LS75	.59	74LS173	.99	74LS375	.89
74LS76	.45	74LS174	.99	74LS386	.69
74LS78	.49	74LS175	.99	74LS393	2.49
74LS83	.89	74LS181	2.95	74LS399	2.49
74LS85	1.25	74LS190	1.25	74LS670	2.49
74LS86	.49	74LS191	1.25	81LS95	1.95
74LS90	.69			81LS97	1.95

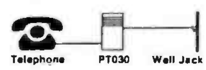
74S

74S00	.45			74S243	3.25
74S02	.45			74S244	3.25
74S03	.45	74S124	3.95	74S251	1.45
74S04	.55	74S133	.55	74S253	1.45
74S05	.55	74S134	.69	74S257	1.35
74S08	.50	74S135	1.19	74S258	1.35
74S09	.50	74S136	1.75	74S260	.79
74S10	.45	74S138	1.35	74S280	2.95
74S11	.45	74S139	1.35	74S287	3.25
74S15	.45	74S140	.79	74S288	2.75
74S20	.45	74S151	1.35	74S373	3.49

Phone Tunes

As Seen on "Good Morning America"

Replaces the Telephone Ringer Bell with a Selection of 30 Familiar Tunes



Each Unit will play any of the following tunes:

- Rule Brittania
- O Canada
- Colonel Bogey
- Westminister Chimes
- Mexican Hat Dance
- Twinkle, Twinkle Little Star
- Deutschlandlied
- God Save the Queen
- Close Encounters
- Happy Birthday
- Wedding March
- Jingle Bells
- Auld Lang Syne
- Soldiers Chorus
- Sailor's Hornpipe
- Chargel
- Greensleeves
- Lorelei
- Eyes of Texas
- Star Spangled Banner
- Oranges and Lemons
- Wilhelmus
- Mozart Sonata
- Pomp & Circumstance
- William Tell Overture
- Bach Toccata in D Minor
- Shave and a Haircut
- Blue Danube Waltz
- Beethoven's 5th
- La Marseillaise

FEATURES

Replaces monotonous telephone ringer bell. Easily connects to any standard telephone. Can be used alongside regular phone or replace a remote ringer elsewhere in building or outside. FCC approved. Can be used on any telephone system — worldwide. Use a different tune to identify extension phones. Microprocessor controlled. Adjustable volume control and variable tune speed control. Operates on two 9-volt batteries or AC Adapter (not included).

PT030 Phone Tunes **$49.95**
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XC556Y	.200"	yellow	4/$1	XC209G	.125"	green	4/$1
XC556C	.200"	clear	4/$1	XC209Y	.125"	yellow	4/$1
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XC22G	.200"	green	4/$1	XC526G	.185"	green	4/$1
XC22Y	.200"	yellow	4/$1	XC526Y	.185"	yellow	4/$1
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.200(T1¾) Red/Green

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Part No.	1-99	100+
XC5491	.79	.69

XC556 RED LED, METAL MTG. HDW. 2-4" LEADS.

RL-2 . . **$.39 ea. or 3/$1.00**

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D.D. — Double Digit
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RHD — Right Hand Decimal

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MAN 2	5x7 D.M.—red	.300	4.95	DL704	C.C.—red	.300	1.25
MAN 3	C.C.—red	.125	.25	DL707	C.A.—red	.300	1.25
MAN 52	C.A.—green	.300	.99	DL728	C.C.—red	.500	1.49
MAN 54	C.C.—green	.300	.99	DL741	C.A.—red	.600	1.25
MAN 71	C.A.—red	.300	.75	DL747	C.A.—red	.600	1.49
MAN 72	C.A.—red	.300	.75	DL750	C.C.—red	.600	1.49
MAN 74	C.C.—red	.300	1.25	DLO847	C.A.—orange	.800	1.49
MAN 82	C.A.—yellow	.300	.49	DLO850	C.C.—orange	.800	1.49
MAN 84	C.C.—yellow	.300	.99	DL33B	C.C.—red	.110	.35
MAN 3620	C.A.—orange	.300	.49	FND358	C.C. ± 1	.357	.99
MAN 3630	C.A.—orange ± 1	.300	.99	FND357	C.C.	.357	.75
MAN 3640	C.C.—orange	.300	.99	FND500	C.C. (FND503)	.500	.99
MAN 4610	C.A.—orange	.400	.99	FND507	C.A. (FND510)	.500	.99
MAN 6610	C.A.—orange—DD	.560	.99	HDSP-3401	C.A.—red	.800	1.50
MAN 6630	C.A.—orange ± 1	.560	.99	HDSP-3403	C.C.—red	.800	1.50
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MAN 6650	C.C.—orange ± 1	.560	.99	5082-7751	C.A., R.H.D.—red	.430	1.25
MAN 6660	C.A.—orange	.560	.99	5082-7760	C.C., R.H.D.—red	.430	1.25
MAN 6710	C.A.—red—DD	.560	.99	5082-7300	4x7 Numeric (RHD)	.600	22.00
MAN 6740	C.C.—red—DD	.560	.99	5082-7302	4x7 Numeric (LHD)	.600	22.00
MAN 6750	C.C.—red ± 1	.560	.99	5082-7340	4x7 Hxdcl. (0-9/A-F)	.600	22.50
DLO304	C.C.—orange	.300	1.25	4N28	Photo Xsistor Opto-Isol.		.69
DLO307	C.A.—orange	.300	1.25	LIT-1	Photo Xsistor Opto-Isol.		.69
DLG500	C.C.—green	.500	1.25	MOC3010	Optically Isol. Triac Driver		1.25

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500	200	2.49	10,000	18	3.95	27,000	10	2.95
1,250	3	.99	11,000	18	4.95	32,500	25	4.95
1,500	25	1.95	11,000	55	5.49	40,000	25	5.95
1,500	50	2.95	11,000	60	5.95	43,000	10	5.95
2,000	10	2.95	13,000	16	2.95	50,000	20	7.95
2,250	100	3.95	14,000	13	2.95	52,000	20	5.95
2,300	33	2.95	16,000	35	3.95	55,000	15	5.95
2,500	15	2.95	18,000	10	3.95	58,000	20	5.95
3,000	25	1.95	20,000	20	2.95	65,000	10	7.95
3,600	40	3.95	20,000	55	3.95	73,000	5	7.95
4,500	50	3.95	21,000	15	3.05	80,000	15	9.95
5,500	25	4.49	23,000	7	1.95	90,000	10	8.95
6,100	40	2.49	23,000	10	2.95	160,000	10	8.95
6,600	50	4.95	23,000	20	3.95	200,000	3	12.95

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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	.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

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16 pin ST	.30	.27	.25
18 pin ST	.35	.32	.30
24 pin ST	.49	.45	.42
28 pin ST	.99	.90	.81
36 pin ST	1.39	1.26	1.15
40 pin ST	1.59	1.45	1.30

WIRE WRAP SOCKETS (GOLD) LEVEL #3

INTERSIL

Part No.	Function	Price
7045IPI	CMOS Precision Timer	14.95
7045EV/Kit*	Stopwatch Chip, XTL	24.95
7106CPL	3½ Digit A/D (LCD Drive)	16.95
7106EV/Kit*	IC, Circuit Board, Display	34.95
7107CPL	3½ Digit A/D (LED Drive)	15.95
7107EV/Kit*	IC, Circuit Board, Display	29.95
7116CPL	3½ Digit A/D LCD Dis. HLD.	18.95
7117CPL	3½ Digit A/D LED Dis. HLD.	17.95
7201IDR	Low Battery Volt Indicator	2.25
7205IPG	CMOS LED Stopwatch/Timer	12.95
7205EV/Kit*	Stopwatch Chip, XTL	19.95
7206CJPE	Tone Generator	5.15
7206CEV/Kit*	Tone Generator Chip, XTL	12.95
7207AIPD	Oscillator Controller	6.50
7207AEV/Kit*	Freq. Counter Chip, XTL	13.95
7208IPI	Seven Decade Counter	17.95
7209IPA	Clock Generator	3.95
7215IPG	4 Func. CMOS Stopwatch CKT	13.95
7215EV/Kit*	4 Func. Stopwatch Chip, XTL	19.95
7216AIJI	8-Digit Univ. Counter C.A.	32.00
7216CIJI	8-Digit Freq. Counter C.A.	26.95
7216DIPI	8-Digit Freq. Counter C.C.	21.95
7217IJI	4-Digit LED Up/Down Counter	12.95
7218CIJI	8-Digit Univ. LED Drive	10.95
7224IPL	LCD 4½ Digit Up Counter DRI	11.25
7226AIJL	8-Digit Univ. Counter	31.95
7226AEV/Kit*	5 Function Counter Chip, XTL	74.95
7240IJE	CMOS Bin Prog. Timer/Counter	4.95
7242IJA	CMOS Divide-by-256 RC Timer	2.05
7250IJE	CMOS BCD Prog. Timer/Counter	6.00
7260IJE	CMOS BCD Prog. Timer/Counter	5.25
7555IPA	CMOS 555 Timer (8 pin)	1.45
7556IPD	CMOS 556 Timer (14 pin)	2.20
7611BCPA	CMOS Op Amp Comparator 5MV	2.25
7612BCPA	CMOS Op Amp Ext. Cmvr. 5MV	2.95
7621BCPA	CMOS Dual Op Amp Comp. 5MV	3.95
7631CCPE	CMOS Tri Op Amp Comp. 10MV	5.35
7641CCPD	CMOS Quad Op Amp Comp. 10MV	7.50
7642CCPD	CMOS Quad Op Amp Comp. 10MV	7.50
7660CPA	Voltage Converter	2.95
8038CCPD	Waveform Generator	4.95
8048CCPE	Monolithic Logarithmic Amp	21.60
8069CCQ	50ppm Band—GAP Volt Ref. Diode	2.50
8211CPA	Volt Ref/Indicator	2.95
8212CPA	Volt Ref/Indicator	2.95

74C

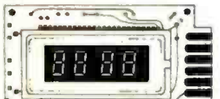
74C00	.39			74C221	1.95
74C02	.39	74C95	1.59	74C240	2.25
74C04	.39	74C107	.89	74C244	2.25
74C08	.39	74C151	2.95	74C373	2.49
74C10	.39	74C154	3.95	74C374	2.59
74C14	.75	74C157	2.25	74C901	.69
74C20	.39	74C160	1.69	74C903	.69
74C30	.39	74C161	1.60	74C911	10.95
74C42	1.39	74C162	1.49	74C912	10.95
74C48	1.95	74C163	1.69	74C915	1.69
74C73	.79	74C164	1.59	74C917	10.95
74C74	.79	74C173	1.39	74C922	5.49
74C85	1.95	74C174	1.39	74C923	5.75
74C86	.99	74C175	1.19	74C925	7.50
74C89	6.95	74C192	1.69	74C926	7.50
74C90	1.29	74C193	1.69	80C95	.79
74C93	1.29	74C195	1.59	80C97	.79

LINEAR

LH0002CN	6.85			LM702H	.79
LM10CLH	4.50			LM703CN	.89
LM11CLH	4.75	LM340T-5	1.25	LM709N	.29
LH0070-OH	4.95	LM340T-12	1.25	LM710N	.79
TL071CP	.79	LM340T-15	1.25	LM711N	.79
TL072CP	1.39	LM341P-5	.75	LM723N	.69
TL074CN	2.49	LM341P-12	.75	LM733N	1.00
LH0082CD	35.80	LM341P-15	.75	LM739N	1.19
TL082CP	1.19	LM342P-5	.69	LM741CN	.35
TL084CN	2.19	LM342P-12	.69	MC1741SCG	3.00
LH0094CD	36.80	LM342P-15	.69	LM747N	.79
LM300H	.99	LM348N	1.25	LM748N	.59
LM301CN	.35	LM350K	5.75	LM1014N	2.75
LM302H	1.95	LF351N	.60	LM1310N	1.95
LM304H	1.95	LF353N	1.00	LM1458CN	.59
LM305H	.99	LF355N	1.10	LM1488N	1.25
LM307CN	.45	LF356N	1.10	LM1489N	1.25
LM308CN	1.00	LM358N	1.00	LM1496N	1.95
LM309H	1.95	LM359N	1.79	LM1556V	1.75
LM309K	1.25	LM370N	4.49	LM1800N	2.95
LM310CN	1.75	LM373N	3.25	LM1871N	5.49
LM311/CN	.90	LM377N	2.95	LM1872N	5.49
LM312H	2.49	LM380N	1.25	LM1877N-9	3.25
LM317MP	1.15	LM381N	1.95	LM1889N	3.20
LM317T	1.75	LM382N	1.79	LM1896N	1.75
LM317K	3.95	LM384N	1.95	LM2002T	1.49
LM318CN	1.95	LM386N-3	1.29	LM2877P	2.05
LM319N	1.95	LM387N	1.45	LM2878P	2.25
LM320K-5	1.35	LM389N	1.35	LM2896P-1	2.25
LM320K-12	1.35	LM392N	.69	LM3189N	2.95
LM320K-15	1.35	LF398N	4.00	LM3900N	.69
LM320T-5	1.25	LM399H	5.00	LM3905CN	1.25
LM320T-12	1.25	TL494CN	4.49	LM3909N	1.15
LM320T-15	1.25	TL496CP	1.75	LM3914N	3.95
LM323K	5.95	NE510A	6.00	LM3915N	3.95

National Semiconductor Clock Modules

12VDC AUTOMOTIVE/ INSTRUMENT CLOCK



APPLICATIONS:
- In-dash autoclocks
- After-market auto/RV clocks
- Aircraft-marine clks.
- 12VDC oper. instru.
- Portable/battery powered instrumnts.

Features: Bright 0.3" green display. Internal crystal time-base. ± 0.5 sec./day accur. Auto.display brightness control logic. Display color filterable to blue, blue-green, green & yellow. Complete—just add switches and lens.

MA1003 Module (3.05"L×1.75"H×.98"D) . **$16.95**

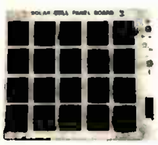
CLOCK MODULES

MA1023	.7" Red Digital LED Clock Module	8.95
MA1026	.7" Dig. LED Alarm Clock/Thermometer	18.95
MA5036	.3" Red Digital LED Clock/Timer	6.95
MA1002	.5" Red Digital LED Clock & Xformer	9.95
MA1010	.8" Red Digital LED Clock	7.95
MA1032	CBA .5" Digital LCD Clock	17.95
MA1043	.7" Green Digital LED Clock	8.95

TRANSFORMERS

102-P20	Xformer for MA1023, 1043 & 5036 Mods.	3.49
102-P22	Xformer for MA1026 Clock Modules	3.49
102-P24	Xformer for MA1010 Clock Modules	3.49

NEW! *Sun Power Your Electronics!* SOLAR CELL PANEL KIT



Features:
- Output: 10VDC, to 100mA in Series 5VDC, to 200mA in Parallel
- Panel may be easily connected for Series or Parallel out
- Over 11 square inches of active cell surface
- Voltage line tap @ 0.5V increments
- Provision for charging batteries
- Overall panel size: 4¾"L x 4⅗"H x ½"D

The JE305 Solar Cell Panel Kit contains 20 each solar cells. On the panel board are power line taps which allow the user to select voltages (one voltage at a time) from 0.5VDC to 10VDC. The applications of each panel can be further expanded by coupling additional panels in series for more voltage or in parallel for more current. The premium grade solar cells provide the current necessary for the operation of most portable transistor radios, small battery powered cassette tape players and unlimited experimental solar projects.

JE305 . . . . $39.95

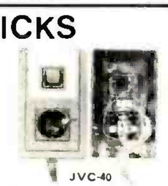
EPROM Erasing Lamp

- Erases 2708, 2716, 1702A, 5203Q, 5204Q, etc.
- Erases up to 4 chips within 20 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 7-5/8" x 2-7/8" x 2"
- Complete with holding tray for 4 chips.

UVS-11EL Replacement Bulb $16.95

UVS-11E $79.95

JOYSTICKS



JS-5K	5K Linear Taper Pots	$5.25
JS-100K	100K Linear Taper Pots	$4.95
JVC-40	40K (2) Video Controller in case	$4.95

ALLIGATOR CLIP TEST LEADS

Heavy-duty leads, color coded. Insulated alligator clip on each end. 15" long. Two each black, red, blue, white and yellow.

#ALCP (10 per pack) . . . . $2.95/pkg.

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

(Picture not shown but similar in construction to above)

JE200	Reg. Power Supply Kit (5VDC, 1 amp)	$14.95
JE205	Adapter Brd. (to JE200) ±5, ±9 & ±12V.	$12.95
JE210	Var. Pwr. Sply. Kit, 5-15VDC, to 1.5amp.	$19.95

MICROPROCESSOR COMPONENTS

8080A/8080A SUPPORT DEVICES

INS8080A	CPU	4.95
DP8212	8-Bit Input/Output	3.75
DP8214	Priority Interrupt Control	5.95
DP8216	Bi-Directional Bus Driver	3.49
DP8224	Clock Generator/Driver	3.95
DP8226	Bus Driver	3.49
DP8228	System Controller/Bus Driver	4.95
DP8238	System Controller	5.95
INS8243	I/O Expander for 48 Series	9.95
INS8250	Asynchronous Comm. Element	16.95
DP8251	Prog. Comm. I/O (USART)	6.95
DP8253	Prog. Interval Timer	8.95
DP8255	Prog. Peripheral I/O (PPI)	5.95
DP8257	Prog. DMA Control	9.95
DP8259	Prog. Interrupt Control	9.95
DP8275	Prog. CRT Controller	39.95
DP8279	Prog. Keyboard/Display Interface	9.95
DP8303	System Timing Element	6.95
DP8304	8-Bit Bi-Directional Receiver	3.95
DP8307	8-Bit Bi-Directional Receiver	3.95
DP8308	8-Bit Bi-Directional Receiver	3.95
DP8310	Octal Latched Peripheral Driver	5.25
DP8311	Octal Latched Peripheral Driver	5.25

6800/6800 SUPPORT DEVICES

MC6800	MPU	7.95
MC6802CP	MPU with Clock and RAM	14.95
MC6810API	128x8 Static RAM	4.95
MC6821	Peripheral Inter. Adapt (MC6820)	7.49
MC6828	Priority Interrupt Controller	17.95
MC6830L8	1024x8-Bit ROM (MC68A30-8)	14.95
MC6850	Asynchronous Comm. Adapter	6.95
MC6852	Synchronous Serial Data Adapter	6.95
MC6860	0-600bps Digital MODEM	10.95
MC6862	2400bps Modulator	12.95
MC6880A	Quad 3-State Bus. Trans. (MC8T26)	2.25

MICROPROCESSOR CHIPS

Z80 (780C)	CPU (MK3880N) (2MHz)	11.95
Z80A (780-1)	CPU (MK3880N-4) (4MHz)	13.95
CDP1802	CPU	19.95
2650	MPU	16.95
IDM2901AOC	CPU—4-Bit Slice (Com. Temp. Grade)	19.95
MCS6502	MPU w/Clock (65K Bytes Memory)	11.95
INS8035N-6	MPU—8-Bit (6MHz)	7.95
INS8039N-6	CPU—Sgl. Chip 8-Bit (128 bytes RAM)	9.95
INS8040N-6	CPU (256 Bytes RAM)	24.95
INS8070N	CPU—64 Bytes RAM	24.95
INS8073N	CPU w/Basic Micro Interpreter	29.95
P8085	CPU	9.95
TMS9900JL	MPU—16-Bit	39.95

SHIFT REGISTERS

MM500H	Dual 25-Bit Dynamic	.50
MM503H	Dual 50-Bit Dynamic	.50
MM506H	Dual 100-Bit Static	.50
MM510H	Dual 64-Bit Accumulator	.50
MM1402N	256-Bit Dynamic	2.95
MM5013N	1024-Bit Dynamic/Accumulator	1.95
MM5016H	500/512-Bit Dynamic	1.95
MM5034N	Octal 80-Bit	9.95
MM5035N	Octal 80-Bit	9.95
2504V (1404A)	1024-Bit Dynamic	1.95
2518N	Hex 32-Bit Static	3.95
2522V	Dual 132-Bit Static	2.95
2524V	512-Bit Dynamic	.99
2525V	1024-Bit Dynamic	2.95
2527V	Dual 256-Bit Static	2.95
2528V	Dual 250-Bit Static	4.00
2529V	Dual 240-Bit Static	4.00
2532N	Quad 80-Bit Static	2.95
3341PC	Fifo (Dual 80)	6.95

DATA ACQUISITION

AF100-1CN	Universal Active Filter 2.5%	5.95
AF121-1CJ	Touch Tone Low Band Filter	19.95
AF122-1CJ	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	JFET Input Op Amp	1.10
LF398N	Sample & Hold Amplifiers	3.95
LM399H	Temp. Comp. Prec. Ref. (.5ppm/C°)	5.00
ADC0804LCN	8-Bit A/D Converter (1 LSB)	6.95
DAC0806LCN	8-Bit D/A Converter (0.78% Lin.)	2.25

DATA ACQUISITION (CONTINUED)

ADC0809CCN	8-Bit A/D Converter (8-Ch. Multi.)	5.25
ADC0817CCN	8-Bit A/D Converter (16-Ch. Multi.)	10.95
DAC1000LCN	10-Bit D/A Conv. Micro. Comp. (0.05%)	13.95
DAC1008LCN	10-Bit D/A Conv. Micro. Comp. (0.20%)	8.95
DAC1020LCN	10-Bit D/A Converter (0.05% Lin.)	8.49
DAC1022LCN	10-Bit D/A Converter (0.20% Lin.)	5.95
DAC1222LCN	12-Bit D/A Converter (0.20% Lin.)	9.95
CD4051N	8-Channel Multiplexer	1.19
AY-5-1013	30K BAUD UART	6.95

RAM'S

1101	256x1 Static	1.49
1103	1024x1 Dynamic	.99
2101 (8101)	256x4 Static	3.95
2102	1024x1 Static	1.75
21L02	1024x1 Static	1.95
2111 (8111)	256x4 Static	3.95
2112	256x4 Static MOS	4.95
2114	1024x4 Static 450ns	3.25
2114L	1024x4 Static 450ns Low Power	3.49
2114-2	1024x4 Static 200ns	3.95
2114L-2	1024x4 Static 200ns Low Power	4.95
74S200	256x1 Static	6.95
4116N-4 (UPD416)	16K Dynamic 250ns (MM5290N-4)	2.95
4164N-3	64K Dynamic 200ns	19.95
MM2147J	4096x1 Fast 70ns	7.95
5101	256x4 Static	7.95
MM5261	1024x1 Dynamic Fully Decoded	.99
MM5262	2Kx1 Dynamic	.49
MM5280/2107	4096x1 Dynamic	4.95
MM5290N-2 (4116)	16K Dynamic 150ns (UPD416C-3)	3.95
MM5298J-3A	8K Dyn. 200ns (lower ½ of MM5290J)	1.95
HM6116-4	16K (2Kx8) Static 200ns	14.95
82S25	64 Bit RAM (16x4OC)	3.49
UPD414/MK4027	4K Dynamic 16-pin	4.95
TMS4044-45NL	4K Static	9.95
TMS4045	1024x4 Static	9.95

PROMS/EPROMS

1702A	2K UV Erasable PROM	5.95
2708	8K EPROM	4.95
TMS2716	16K EPROM (-5V, +5V, +12V)	9.95
2716Intel(2516)TI	16K EPROM (Single +5V)	8.95
2732Intel TI	32K EPROM	17.95
2758	8K EPROM (450ns) (Single +5V)	7.49
2764Q	64K EPROM (Hitachi HN462764)	49.95
5203	2048 PROM	14.95
82S23(74S188)	32x8 PROM (Open Collector)	3.95
82S115	4096 Bipolar PROM	14.95
82S123(74S288)	32x8 Tri-State Bipolar PROM	3.95
82S185	8K PROM	16.95

— Over 30 More PROMS Listed in Our Catalog —

ROM'S

2513(2140)	Character Generator (Upper Case)	9.95
2513(3021)	Character Generator (Lower Case)	9.95

NMOS READ ONLY MEMORIES

MCM66710P	128x9x7 ASCII Shifted w/Greek	13.50
MCM66740P	128x9x7 Math Symbol & Pictures	13.50
MCM66750P	128x9x7 Alpha. Control Char. Gen.	13.50

MICROPROCESSOR MANUALS

M-Z80	User Manual	7.50
M-CDP1802	User Manual	7.50
M-2650	User Manual	5.00

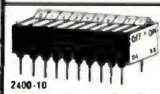
SPECIAL FUNCTION

DS0025CN	Dual MOS Clock Driver (5MZ)	3.50
DS0026CN	Dual MOS Clock Driver (5MZ)	1.95
INS1771N-1	Floppy Disc Controller	24.95
INS2651N	Communication Chip	19.95
MM58167N	Microprocessor Real Time Clock	8.95
MM58174N	Microprocessor Compatible Clock	11.95
COP402N	Microcontroller with 64-Digit RAM and Direct LED Drive	6.95
COP402MN	Microcontroller with 64-Digit RAM & Direct LED Drive w/N Buss Int.	7.49
COP470N	12-Seg.VAC Fluor. Driver (20-pin pkg.)	3.25

TELEPHONE/KEYBOARD CHIPS

AY-5-9100	Push Button Telephone Dialer	14.95
AY-5-9200	Repertory Dialer	14.95
AY-5-9500	CMOS Clock Generator	4.95
AY-5-2376	Keyboard Encoder (88 keys)	11.95
HD0165-5	Keyboard Encoder (16 keys)	7.95
74C922	Keyboard Encoder (16 keys)	5.49
74C923	Keyboard Encoder (20 keys)	5.75
MM53190N	Push Button Pulse Dialer	7.95
MM57499N	96/144-Key Serial Keyboard Encoder	8.95

EECO Rocker DIP Switch — "Mini-Dip™" 2400 Series

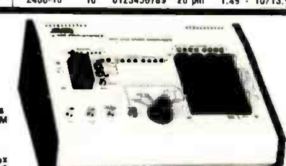


THE MOST UNIQUE DIP SWITCH AVAILABLE!

MINI-DIP is designed to retrofit all major brands of Dip switches. Unique features include locking rod design to prevent accidental actuation and gold self-wiping contact. One-piece housing and press-fit terminals prevent contamination. 2-10 station Form "A" and 1-5 station Form "C."
- Terminals on .100 x .300 (2.54 x 7.62) centers • PCB or dip socket mountable • Positive cleaning/wiping action with gold contact • Total seal and bottom seal

Part No.	Pos.	Configuration	Socket	Price	Part No.	Pos.	Configuration	Socket	Price
2400-2	2	12	8 pin	.79 - 10/ 6.95	2400-6	6	123456	14 pin	1.09 - 10/ 9.95
2400-3	3	123	8 pin	.89 - 10/ 7.95	2400-7	7	1234567	14 pin	1.19 - 10/10.95
2400-4	4	1234	8 pin	.99 - 10/ 8.95	2400-8	8	12345678	16 pin	1.29 - 10/11.95
2400-ABCO	4	ABCO	8 pin	.99 - 10/ 8.95	2400-9	9	123456789	18 pin	1.39 - 10/12.95
2400-5C	6	C54321	14 pin	1.09 - 10/ 9.95	2400-10	10	0123456789	20 pin	1.49 - 10/13.95

JE608 PROGRAMMER
2704/2708 EPROM PROGRAMMER



GENERAL APPLICATIONS:
- To program EPROMS 2704 and 2708.
- Developmental system for microcomputer circuits
- To read the contents of a pre-programmed EPROM
- To compare EPROM(s) for content differences
- To emulate a programmed EPROM
- To store program in RAMS for alterations
- Three separate Display Registers: 8 LED's for Hex Key entries, 10 LED's (2¹-2¹⁰) for Address Register and 8 LED's for Data Memory Register. The Data Memory Register displays the content of the RAMs from the EPROM Chip. Development of microprocessor systems by means of a ribbon cable from the programmer panel test socket to the EPROM socket on the microprocessor board. Rapid checking verification of programmed data changes. User may move data from a master to RAM's or write into RAM's with keyboard entries. Allows manual stepping manipulation (up and down) at any address location. Stand-alone EPROM Programmer consisting of: A 19-key Hexadecimal Keyboard assembly, Programmer Board assembly with 4 power supplies and a LED/Test Socket Panel Board assembly. The Test Socket is zero force insertion type. Power requirements: 115VAC, 60Hz, 6W. Compact desk-top enclosure: Color-coordinated designer's case with light tan panels and molded end pieces in mocha brown. Size: 3¼"H x 11"W x 8¼"D. Weight: 5 lbs.

The JE608 EPROM Programmer is a completely self-contained unit which is independent of computer control and requires no additional systems for its operations. The EPROM can be programmed from the Hexadecimal Keyboard or from a pre-programmed EPROM. The JE608 Programmer can emulate a programmed EPROM by the use of its internal RAM circuits. This will allow the user to test or pretest a program for a system, prior to programming a chip. Any changes in the program can be entered directly into the memory circuits with the Hexadecimal Keyboard so that rewriting the EPROM is not necessary. The JE608 Programmer contains a Programmer/Board w/26 IC's & includes power supplies of: -5V, +5V, +12V and +26V. The Hexadecimal Keyboard and LED/Test Socket Panel board are separate assemblies within the system.

JE608K Kit $399.95

JE608A Assembled and Tested $499.95

JE608-16K ADAPTER BOARD
FOR 2716/2758 EPROMS

GENERAL DESCRIPTION: The JE608-16K Adapter Board allows the JE608 Programmer to be modified for the additional programming of the 2716 and 2758 EPROMS. The adapter provides for adding an address switch for the 2¹¹ bit and also for selecting the proper power and timing pulses to be applied to the EPROM. Programming and emulating the 2716 (16K) EPROM is done separately to each half (1024x8) of the EPROM because of the existing 8K RAM capacity in the JE608 Programmer.

JE608-16K	Adapter Board Kit	$29.95
JE608-Upgrade	(Send assembled JE608 to factory for adapter installation of the JE608-16K Adapter Board Kit)	$99.95
JE608A-16K Mod.	Assembled JE608 w/Adapter (JE608-16K) Installed	$599.95

$10.00 Min. Order — U.S. Funds Only
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BOOKS
National Semiconductor — Intersil — Intel

30001	National CMOS Data Book (640 pages) 74C, CD4000, and A/D Converters	$6.95
30002	National Interface Data Book (704 pages) DP, DS8000, DS3800, DS75000, etc.	$6.95
30003	National Linear Data Book (1376 pages) LM, LF, ADC, DAC, LH Series	$8.95
30004	National Series 80 — Board Level Computer (224 pages)	$4.95
30005	National TTL Logic Data Book (624 pages) 7400,LS,L,H,S, and DM8000 Series	$8.95
30006	Buy above (3) 30001,3,5 as a set	$19.95/lot
30009	Intersil Data Book (1074 pages)	$6.95
010400	Intel Component Data Catalog — Full data sheets for Intel's products incl. memory devices, microproc., peripherals & indust./mil. products (1328 pages)	$10.00
206610	Intel Peripheral Design Handbook — Full data sheets, appl. notes for Intel peripheral device components (644 pages)	$7.60

AC and DC Wall Transformers

With Universal Plug and 9V Battery Snap

Selective voltages: 6,9,12VDC. Polarity selection (+/-), six-foot line from adapter to plugs — six-inch line from adapter to battery snap, 120V/60Hz 300mA.

Part No.	Input	Output	Price
AC 250	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
DC6912	120V/60Hz	6,9,12VDC 300mA	$9.95
DV9200	117V/60Hz	9VDC 200mA	$3.25
DC900	120V/60Hz	9VDC 500mA	$3.95

CONNECTORS

DB25P	D-Subminiature Plug	$2.95
DB25S	D-Subminiature Socket	$3.50
D20418-2	Screw Lock Hdwr. (2) DB25S/P	2/$.99
DB51226	Cover for DB25P/S	$1.75
22/44SE	P.C. Edge (22/44 Pin)	$2.95
UG88/U	BNC Plug	$1.79
UG89/U	BNC Jack	$3.79
UG175/U	UHF Adapter	$ .49
SO239	UHF Panel Recp.	$1.29
PL258	UHF Adapter	$1.60
PL259	UHF Plug	$1.60
UG260/U	BNC Plug	$1.79
UG1094/U	BNC Bulkhead Recp.	$1.29

TRS-80 16K Conversion Kit

Expand your 4K TRS-80 System to 16K.
Kit comes complete with:
★ 8 ea. MM5290 (UPD416/4116) 16K Dyn. Rams (*NS)
★ Documentation for Conversion

TRS-16K2	*150NS	$29.95
TRS-16K3	*200NS	$24.95
TRS-16K4	*250NS	$19.95

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**

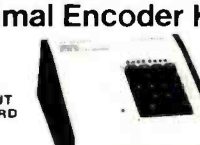
K62 62-Key Keyboard (Keyboard only) . . . **$ 34.95**

DTE-AK (case only — 3¼"Hx11"Wx8¾"D) **$ 49.95**

NEW! JE212 — Negative 12VDC Adapter Board Kit for JE610 ASCII KEYBOARD KIT
Provides -12VDC from incoming 5VDC . . $9.95

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 8¾"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"Hx8¾"Wx8¾"D) **$44.95**

Circle 164 on inquiry card.

• Shugart 851's — $575.00
• Qume DT-8's — $540.00
• 2810 CPU

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$5.00 Processing and Handling added to each order PLUS
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- MPI-88G $725.00
- EPSON MX 80 ...... CALL
- EPSON MX 100 ..... CALL
- Anadex 9501 .... $1,235.00 Graphic Printer

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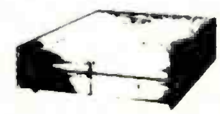
★ SPECIAL ★ SPECIAL ★ SPECIAL ★

- CCS 2200 System Tested and Assembled Only — $1,600.00

FEATURES

- 12 Slot Mainframe
- 4 mhz CPU
- 64K Dynamic Memory
- Dbl. Density Disk Controller
- Output Voltage
  + 8VDC @ 20 A,
  + 16VDC @ 4 A,
  − 16 VDC @ 4 A
  (10% tolerance)

DUAL DRIVE SUBSYSTEM



FEATURES

- Power One CP-206
- 2-801R Shugart Drives
- Data, AC & DC Cables
  All for only $1045.00
- 2-851R Subsystem .. $1,395.00
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***

- W/no Drives $245.00

INCLUDES

- CP 206
- Data Cables
- AC & DC Cables
- Tested and Assembled
- Vertical Enclosure
  5¼" $595.00 .... 8" $1,295.00

S-100-MOD (Kit) $199.00

Complete S-100 12 Slot Main Frame. Ample system power with regulated power for drives. Excellent for Subsystem or Hobby use. Four hours to build. (6 conn., incl., less fans)

POWER RATING — 30AOF ± 8V
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CCS DATA BASED SOFTWARE

- AP/AR/GL/PR . Only — $450.00
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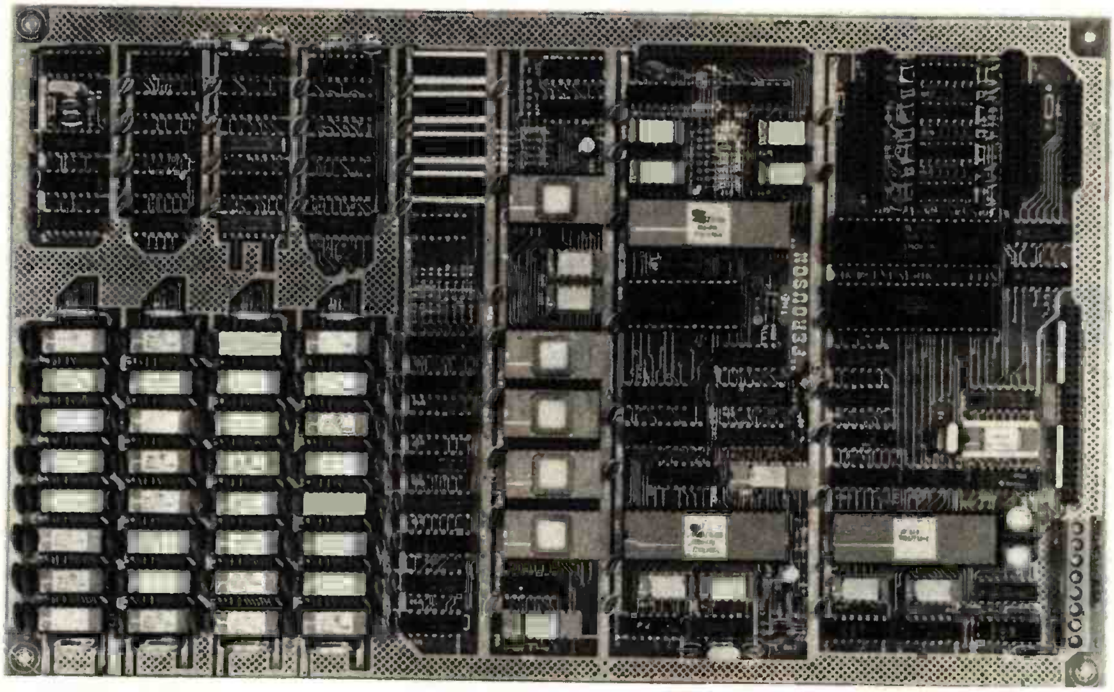
Z-80 CPU! 64K RAM!

NEW!



PARTIALLY ASSEMBLED KITS
For All Sockets Installed
And Soldered Add $50.

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Full Documentation and
Schematics — $5.

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THE FERGUSON PROJECT: Three years in the works, and maybe too good to be true. A tribute to hard headed, no compromise, high performance, American engineering! The Big Board gives you all the most needed computing features on one board at a very reasonable cost. The Big Board was designed from scratch to run the latest version of CP/M*. Just imagine all the off-the-shelf software that can be run on the Big Board without any modifications needed! Take a Big Board, add a couple of 8 inch disc drives, power supply, an enclosure, C.R.T., and you have a total Business System for about 1/3 the cost you might expect to pay.

$499.00 ** (64K KIT BASIC I/O)

SIZE: 8½ x 13¾ IN.
SAME AS AN 8 IN. DRIVE.
REQUIRES: +5V @ 3 AMPS
+ - 12V @ .5 AMPS.

FULLY SOCKETED!

FEATURES: (Remember, all this on one board!)

64K RAM

Uses Industry standard 4116 RAM'S. All 64K is available to the user, our VIDEO and EPROM sections do not make holes in system RAM. Also, very special care was taken in the RAM array PC layout to eliminate potential noise and glitches.

Z-80 CPU

Running at 2.5 MHZ. Handles all 4116 RAM refresh and supports Mode 2 INTERUPTS. Fully buffered and runs 8080 software.

SERIAL I/O (OPTIONAL)

Full 2 channels using the Z80 SIO and the SMC 8116 Baud Rate Generator. FULL RS232! For synchronous or asynchronous communication. In synchronous mode, the clocks can be transmitted or received by a modem. Both channels can be set up for either data-communication or data-terminals. Supports mode 2 Int. Price for all parts and connectors: $65.

BASIC I/O

Consists of a separate parallel port (Z80 PIO) for use with an ASCII encoded keyboard for input. Output would be on the 80 x 24 Video Display.

24 x 80 CHARACTER VIDEO

With a crisp, flicker-free display that looks extremely sharp even on small monitors. Hardware scroll and full cursor control. Composite video or split video and sync. Character set is supplied on a 2716 style ROM, making customized fonts easy. Sync pulses can be any desired length or polarity. Video may be inverted or true. 5 x 7 Matrix - Upper & Lower Case

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Uses WD1771 controller chip with a TTL Data Separator for enhanced reliability. IBM 3740 compatible. Supports up to four 8 inch disc drives. Directly compatible with standard Shugart drives such as the SA800 or SA801. Drives can be configured for remote AC off-on. Runs CP/M* 2.2.

TWO PORT PARALLEL I/O (OPTIONAL)

Uses Z-80 PIO. Full 16 bits, fully buffered, bi-directional. User selectable hand shake polarity. Set of all parts and connectors for parallel I/O: $19.95

REAL TIME CLOCK (OPTIONAL)

Uses Z-80 CTC. Can be configured as a Counter on Real Time Clock. Set of all parts: $9.95

BLANK PC BOARD — $175

The blank Big Board PC Board comes complete with full documentation (including schematics), the character ROM, the PFM 3.3 MONITOR ROM, and a diskette with the source of our BIOS, BOOT, and PFM 3.3 MONITOR.

CP/M* 2.2 FOR BIG BOARD

The popular CP/M* D.O.S. to run on Big Board is available for $159.00.

PRICE CUT!

PFM 3.3 2K SYSTEM MONITOR

The real power of the Big Board lies in its PFM 3.0 on board monitor. PFM commands include: Dump Memory, Boot CP/M*, Copy, Examine, Fill Memory, Test Memory, Go To, Read and Write I/O Ports, Disc Read (Drive, Track, Sector), and Search. PFM occupies one of the four 2716 EPROM locations provided.

Z-80 is a Trademark of Zilog.

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TERMS: Shipments will be made approximately 3 to 6 weeks after we receive your order. VISA, MC, cash accepted. We will accept COD's (for the Big Board only) with a $75 deposit. Balance UPS COD. Add $4.00 shipping.

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**1 TO 4 PIECE DOMESTIC USA PRICE.

Circle 107 on inquiry card.

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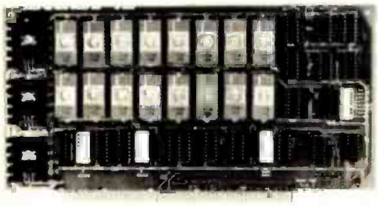
32K S-100 EPROM CARD
NEW!



$79.95
KIT

USES 2716's

Blank PC Board - $34

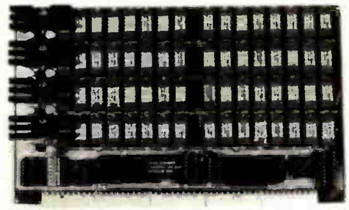
ASSEMBLED & TESTED
ADD $30

SPECIAL: 2716 EPROM's (450 NS) Are $9.95 Ea. With Above Kit.

KIT FEATURES
1. Uses +5V only 2716 (2Kx8) EPROM's
2. Allows up to 32K of software on line!
3. IEEE S-100 Compatible.
4. Addressable as two independent 16K blocks.
5. Cromemco extended or Northstar bank select.
6. On board wait state circuitry if needed.
7. Any or all EPROM locations can be disabled.
8. Double sided PC board, solder-masked, silk-screened.
9. Gold plated contact fingers.
10. Unselected EPROM's automatically powered down for low power.
11. Fully buffered and bypassed.
12. Easy and quick to assemble.

32K SS-50 RAM

$259^{95} KIT



For 2MHZ
Add $10

Blank PC Board
$50

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6800 - 6809 Buss

Support IC's
and Caps
$19.95

Complete Socket Set
$21.00

Fully Assembled,
Tested, Burned In
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At Last! An affordable 32K Static RAM with full 6809 Capability.

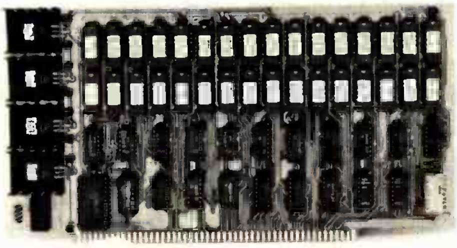
FEATURES:
1. Uses proven low power 2114 Static RAMS.
2. Supports SS50C - EXTENDED ADDRESSING.
3. All parts and sockets included.
4. Dip Switch address select as a 32K block.
5. Extended addressing can be disabled.
6. Works with all existing 6800 SS50 systems.
7. Fully bypassed. PC Board is double sided, plated thru, with silk screen.

16K STATIC RAM KIT-S 100 BUSS

PRICE CUT!

$149^{95} KIT

FOR 4MHZ
ADD $10



KIT FEATURES:
1. Addressable as four separate 4K Blocks.
2. ON BOARD BANK SELECT circuitry. (Cromemco Standard!). Allows up to 512K on line!
3. Uses 2114 (450NS) 4K Static Rams.
4. ON BOARD SELECTABLE WAIT STATES.
5. Double sided PC Board, with solder mask and silk screened layout. Gold plated contact fingers.
6. All address and data lines fully buffered.
7. Kit includes ALL parts and sockets.
8. PHANTOM is jumpered to PIN 67.
9. LOW POWER: under 1.5 amps TYPICAL from the +8 Volt Buss.
10. Blank PC Board can be populated as any multiple of 4K.

BLANK PC BOARD W/DATA-$33
LOW PROFILE SOCKET SET-$12
SUPPORT IC'S & CAPS-$19.95
ASSEMBLED & TESTED-ADD $35

OUR #1 SELLING
RAM BOARD!

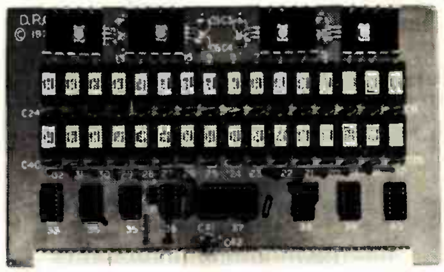
16K STATIC RAM SS-50 BUSS

PRICE CUT!

$139^{95} KIT

FULLY STATIC!

FOR 2MHZ
ADD $10



FOR SWTPC
6800 BUSS!

ASSEMBLED AND
TESTED - $35

KIT FEATURES
1. Addressable on 16K Boundaries
2. Uses 2114 Static Ram
3. Fully Bypassed
4. Double sided PC Board Solder mask and silk screened layout
5. All Parts and Sockets included
6. Low Power Under 15 Amps Typical

BLANK PC BOARD—$35 COMPLETE SOCKET SET—$12
SUPPORT IC'S AND CAPS—$19.95

NEW! STEREO! NEW!
S-100 SOUND COMPUTER BOARD

At last, an S-100 Board that unleashes the full power of two unbelievable General Instruments AY3-8910 NMOS computer sound IC's. Allows you under total computer control to generate an infinite number of special sound effects for games or any other program. Sounds can be called in BASIC, ASSEMBLY LANGUAGE, etc.

COMPLETE KIT!
$84^{95}
(WITH DATA MANUAL)

BLANK PC
BOARD W/DATA
$31

KIT FEATURES:
* TWO GI SOUND COMPUTER IC'S.
* FOUR PARALLEL I/O PORTS ON BOARD.
* USES ON BOARD AUDIO AMPS OR YOUR STEREO.
* ON BOARD PROTO TYPING AREA.
* ALL SOCKETS, PARTS AND HARDWARE ARE INCLUDED.
* PC BOARD IS SOLDERMASKED, SILK SCREENED, WITH GOLD CONTACTS.
* EASY, QUICK, AND FUN TO BUILD, WITH FULL INSTRUCTIONS.
* USES PROGRAMMED I/O FOR MAXIMUM SYSTEM FLEXIBILITY.

Both Basic and Assembly Language Programming examples are included.

SOFTWARE:

SCL™ is now available! Our Sound Command Language makes writing Sound Effects programs a SNAP! SCL™ also includes routines for Register-Examine-Modify, Memory-Examine-Modify, and Play-Memory. SCL™ is available on CP/M* compatible diskette or 2708 or 2716. Diskette - $24.95 2708 - $19.95 2716 - $29.95. Diskette includes the source. EPROM'S are ORG at E000H. (Diskette is 8 Inch Soft Sectored)

SPECIAL PURCHASE!

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TR1602B — SAME AS TMS6011,
AY5-1013, ETC. 40 PIN DIP

TR1602B

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SMC #CRT 5037. PROGRAMMABLE FOR 80 x 24, ETC. VERY RARE SURPLUS FIND. WITH PIN OUT. $12.95 EACH.

4K STATIC RAM

National Semi. MM5257. Arranged 4K x 1. +5V, 18 PIN DIP. A Lower Power, Plug in Replacement for TMS 4044. 450 NS. Several Boards on the Market Will Accept These Rams. SUPER SURPLUS PURCHASE! PRIME NEW UNITS!

8 FOR $16 32 FOR $59.95

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AY3-8910. As featured In July, 1979 BYTE! A fantastically powerful Sound & Music Generator. Perfect for use with any 8 Bit Microprocessor. Contains: 3 Tone Channels, Noise Generator, 3 Channels of Amplitude Control. 16 bit Envelope Period Control, 2-8 Bit Parallel I/O. 3 D to A Converters, plus much more! All in one 40 Pin DIP. Super easy interface to the S-100 or other busses. $11.95 PRICE CUT!

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ALL SALES ARE MADE SUBJECT TO THE TERMS OF OUR 90 DAY LIMITED WARRANTY. A COPY OF THIS WARRANTY IS AVAILABLE FREE, ON REQUEST.

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Circle 107 on inquiry card.

Unclassified Ads

FOR SALE: Anderson Jacobson AJ 841 Selectric terminal, RS-232C-type serial interface needs some work. Asking $500. Nancy McCarty, 422 Washington St., Auburn, ME 04220, (207) 784-5354.

FOR SALE: Computers in Medicine: An Introduction by Derek Enlander. This is a good book on the subject. I have extra copies from a course. $15 including postage. Tobin, 444 East 75th St., New York, NY 10021.

SORCERER OWNERS: Do you have any programs or information you would like to trade? I have 100 programs to offer. Rick Carlsen, 247 Bath Rd., Apt. #710, Kingston, Ontario K7M 2X9 Canada.

WANTED: Alpha Micro hardware, compatible hardware, and peripherals. Also want a Cromemco Z2 mainframe. Must be reasonable. Steve Waechter, 3691 Linnet Dr., Lake Elsinore, CA 92330, (714) 674-3071.

FOR SALE: HP-85 computer with 16 K, five data cartridges, carrying case, many programs, and all accessories. In excellent condition; $2500. Also, HP-2621P video-display terminal with 80 by 24 display, internal thermal printer, and 12 rolls of paper; $1500. Barry McDonald, 103 Godwin Ave., Midland Park, NJ 07432.

FOR SALE: LEX-11 modem with wall mount transformer equal to Bell 103A; $100 or best offer. California Computer Systems #2718 parallel/serial interface board for S-100; $200 or best offer. M.R. Essig, 1005 Market St. #208, San Francisco, CA 94103, (415) 861-5482.

FOR SALE: Polymorphic 8813 engineering computer (can run under CP/M) with 56 K programmable memory, floating-point hardware, two disk drives, serial interface, BASIC, FORTRAN, Word Master, Finite Element Analysis, and miscellaneous engineering software. $3000. R. Krofick, 520 Blankschool Rd., Greensburg, PA 15601, (412) 832-9759.

FOR SALE: SSM AIO serial/parallel interface card (assembled); $130. Mountain Computer Supertalker speech synthesizer; $180. For Apple II. David Chau, 87 Valley Rd., Larchmont, NY 10538, (212) 834-4851.

FOR SALE: RS-232 cables. New and unused. 6½ feet long with hoods. Pins 1 through 7 and 20 are connected, male to female (can be used as extensions). $10 each. Will rewire—specify gender and whether null modem or normal wiring—for $1 each. Please add $2 shipping. I have 30 of these. Mark Whitis, 7415 Colton Lane, Manassas, VA 22110.

FOR SALE: Assembled and working Heathkit H-8 with 16 K memory and H-8-5 serial cassette interface board. Also, H-9 video-display terminal. Included are Extended BASIC, regular BASIC, TED-8, HASL-8, and all operations manuals. Best offer received by 30 days after this issue is published takes it all. Jerry Gunn, 5317 North Diane Court, Peoria, IL 61615.

FOR SALE: Micro-Sci A70 disk drive with controller and system master disk. Used less than six months. $550, shipping included. Warren Spivack, 6625 Avenue M, Brooklyn, NY 11234, (212) 494-5250 days.

WANTED: A few copies of magazines: Popular Electronics for January to May 1981 and Microsystems, vol. 1, no. 1 and 3; vol. 2, no. 2. Will sell or trade BYTEs for 1978 and 1979. O.K. Hudson, 334 Olney Dr., San Antonio, TX 78209, (512) 828-1738.

FOR SALE: Heath H-10A paper-tape punch/reader with paper-tape software kit for H-11A, in excellent condition; $100. Heath H-11-5 serial interface card and cable, no manual, in excellent condition; $100. John Emberley, 5614 Nicollet Ave. S, Minneapolis, MN 55419, (612) 866-8364 between 9 a.m. and 2 p.m.

WANTED: Front panel for Cromemco, Intersystems, IMSAI, or Altair S-100 computer, in that order of preference. Will consider buying entire mainframe less boards. Gary Sanford, POB 1689, Lowell, MA 01853, (617) 263-2389 evenings.

WANTED: Used TRS-80 Model II business computer and daisy-wheel printer II, plus table and accessories. Good condition, prefer warranty. Joe Boyd, POB 6, West Union, WV 26456.

FOR SALE: Working ASR33 terminal with RS-232C interface. Includes paper-tape reader and punch. Also includes stand, schematic diagrams, and technical manual. $400 or best offer. Joseph Mueck, 943 Hyacinth Dr., Delray Beach, FL 33444, (305) 272-2779.

WANTED: Any and all information regarding the VideoBrain computer (e.g., source of cartridges, operating manuals, etc.). Currently working to enable the VideoBrain to run TRS-80 programs. Bryan McPhee, 418 Virginia Dr., Browns Mills, NJ 08015.

FOR SALE: Two REMEX RFD-4000 double-sided 8-inch disk drives. Each with formatted capacity of 1.2 megabytes. Fast step time of 3 ms. Doorlocks and write protect. Power supply. Used a total of 11 hours. $1000 or best offer. David Tulbert, 6700 Grauer Rd., Niagara Falls, NY 14305, (716) 297-6347.

FOR SALE: Two Micropolis Mod I drives (one never used) with WordStar and manuals. $400. Jack Koch, POB 765, Cherry Hill, NJ 08003.

FOR SALE: Compucolor II microcomputer with 16 K memory, built-in floppy plus add-on drive, sound generator, two keyboards (one expanded, one standard), all manuals, cables, and lots of software. Best offer or would consider satellite receiving equipment or other interesting trades. M.A. Franco, 232 Holiday Village, Enterprise, AL 36330.

FOR SALE: Vector Graphics 8080 processor, Bitstreamer I/O board, Tarbell single-density 8-inch controller, two Shugart 801R drives, 64 K IMS static programmable memory (bank selectable). All in new Integrand Main/Frame. $3000. With SOROC IQ 120; $3660. With SOROC and new Epson MX-80; $4100. Can upgrade to Z80, double density, and TI-810. Ralph Partlow, 6551 Southwest 8th St., Pembroke Pines, FL 33023, (305) 962-8307.

WANTED: The Cheap Video Cookbook by Don Lancaster. Will pay $6 if you will wait one month for payment. Also want four Z80 assembler programs. Will pay $0.50 each. Unused programs will go back to sender, so include return address. Eric Schissel, 30 Entrance Rd., Roslyn, NY 11577.

NEEDED: Repair manual and other manuals for Flexwriter (recorder-reproducer) Model FL made by Commercial Controls Corp. Also, need North Star BASIC floppy disk Release 5 or later. Will pay reasonable reproduction charges. State cost. Harry Mazur, 1450 Chestnut Pl., Boulder, CO 80302, (303) 447-0306.

FOR SALE: PDP-11/15 with 16 K bytes of core memory, Teletype interface, cable, and Teletype ASR33 with stand. Complete documentation. Only $1200. C.F. Shank, POB 248627, University Branch, Miami, FL 33124, (305) 625-3269.

NEEDED: Replacement print head for Epson TX-80 (not MX-80) printer. Have been unable to obtain from local Epson representative. Will buy from dealer or individual. Samuel Gamoran, 228 Graham St., Highland Park, NJ 08904, (201) 949-3625 days, 246-7572 evenings.

FOR SALE: Pertec Attache 8080 S-100 system. $1500 or best offer. 32 K static memory, 9-inch monitor, keyboard, PROM board, 16 by 64 video, Pertec 510 8-inch floppy, Wameco disk controller, and cabinets. Also, Z80/S-100 processor card ($125) and Digital Group Phi-Deck (4) system in dress cabinets with controller board ($200). Dean I. Lawry, POB 1157, Corrales, NM 87048, (505) 898-5145.

FOR SALE: Atari 400 with 8 K and a set of paddles. Just like new. Or will trade Atari 400 and $200 for Atari 800 in good condition. Dave Zalokar, 1845 Gerda SE, Kentwood, MI 49508.

FOR SALE: North Star Horizon 2. Includes two 5-inch double-density disks, 48 K programmable memory, sound-generation board, software, documentation, and Hazeltine 1500 24 by 80 super terminal. Complete system: $2900. Duane Brummel, Rte. 2, Brooklyn, WI 53521, (608) 835-7554.

FOR SALE: ADDS Regent 25 video-display terminal; $800. Little used and in excellent condition. Display is 24 lines by 80 characters per line. Separate 18-key numeric data entry and cursor control pad. Cursor addressing. David Bainum, POB 139, Hartford, KS 66854, (316) 343-6255 after 6 p.m. weekdays.

FOR SALE: BYTE from June 1977 to July 1981. Excellent condition. Dennis R. Yelle, 655 South Fair Oaks Apt. P306, Sunnyvale, CA 94086, (408) 245-6335.

WANTED: DEC PDP-8, PDP-11, and LSI-11 computers, parts, boards, manuals, peripherals, documentation, courses, etc., working or not. Also interested in DEC-compatible items and software that works. H. Kolesnik, 5277 South Kenton Way, Englewood, CO 80111, (303) 779-5256.

FOR SALE: Heathkit H-89 with 48 K programmable memory, cassette interface, and two floppy-disk drives (open slot for third drive). Includes HDOS, Microsoft BASIC, cassette operating system, and many miscellaneous software products (business, financial, games, etc.). Complete with all manuals, $2500 for all. I will pay postage for delivery. Bill Jimerson, 15115 Parthenia #178, Sepulveda, CA 91343.

FOR SALE: 16 K Commodore PET with built-in cassette drive; $649. Also available: Toolkit read-only memory, Channel Data System's Omnifile and CB2 sound system Port Noise, CURSOR magazine tapes #1, 7, 21, 23-28, Commodore's Spacetrek, Blackjack, and A Treasure Trove of Games, United Software of America's Checkbook, Radio Shack Line Printer Two; $599. Steven Dean, POB 1083, Springfield, VA 22151, (703) 978-3322.

FOR SALE: Versatile 3B computer, all units in one enclosure. Ten-slot S-100 bus with Spacebyte 8085 processor, dual Mod I Micropolis disk drives, 32 K Dynabyte static memory, two RS-232 serial and three parallel ports. Ball 9-inch monitor, 80 by 24 Dynabyte video board, and numeric keypad. Software included: MDOS and BASIC, Versatile business package, games, and more. In excellent condition. $2495, original price $4000. Ralph Pullmann, 2765 Sierra Dr., Colorado Springs, CO 80917, (303) 599-0712.

FOR SALE: Commodore CBM 8032B; $995. 2040 disk drives; $995. 2022 tractor printer; $595. Unused, except to check system out, and works fine. Will ship in original cartons with all cables and manuals. Compumax accounting software included free with purchase of system. 16/32 service kit; $195. Louis Robert, POB 144, Hessmer, LA 71341, (318) 563-4428.

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Ciarcia Wins BOMB

It looks like Steve Ciarcia has out-"poled" his competition. Steve won the November BOMB with his article, "Switching Power Supplies, An Introduction," a fine tutorial on the design and construction of a nonisolated, single-ended, switching voltage regulator. He will receive the $100 prize. Kathryn S. Barley and James R. Driscoll's "A Survey of Data-Base Management Systems for Microcomputers" took second place. They will share the $50 prize. Third place goes to Michael Gagle, Gary J. Koehler, and Andrew Whinston for their article, "Data-Base Management Systems: Powerful Newcomers to Microcomputers."