# BYTE®

the small systems journal

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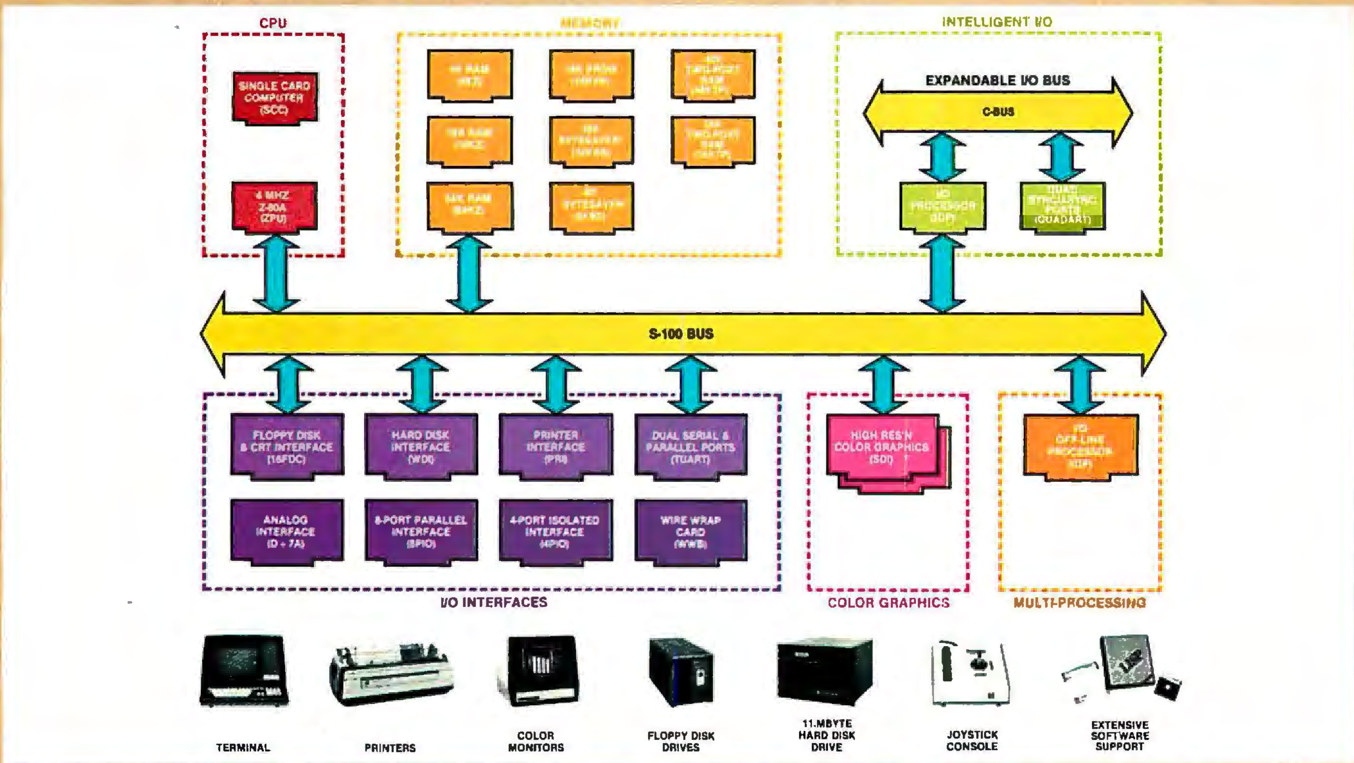
OPERATING SYSTEMS




# What Cromemco computer card capability can do for you

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These are all cards that plug into our S-100 bus microcomputers.

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

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## CONTACT YOUR CROMEMCO REP

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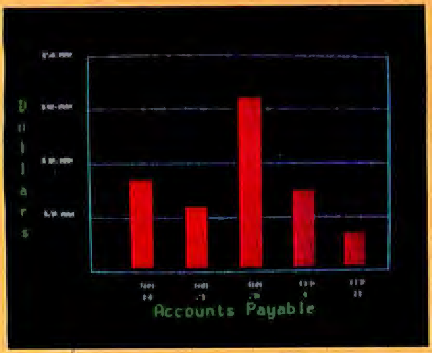
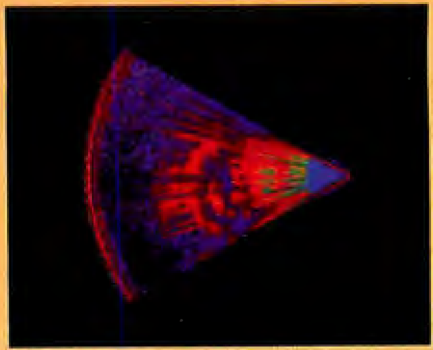
Tomorrow's computers today

Circle 98 on inquiry card.




Management Information Display



Ultrasonic heart sector scan

High-resolution display with alphanumerics

# Get the professional color display that has BASIC/FORTRAN simplicity

## LOW-PRICED, TOO

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

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

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

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

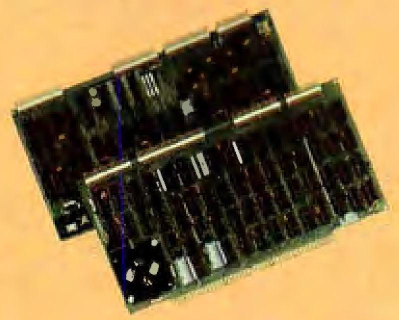
The resolution surpasses that of a color TV picture.

## BASIC/FORTRAN programming

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

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

*U.S. Pat. No. 4121283



Model SDI High-Resolution Color Graphics Interface

## HIGH RESOLUTION

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

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


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

## DISPLAY MEMORY

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

## CONTACT YOUR REP NOW

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

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

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Circle 98 on inquiry card.

# In The Queue

Volume 6, Number 6 June 1981

## Features



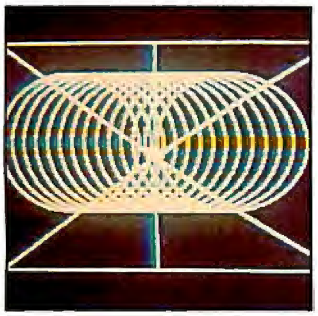
## Reviews



## Nucleus



BYTE



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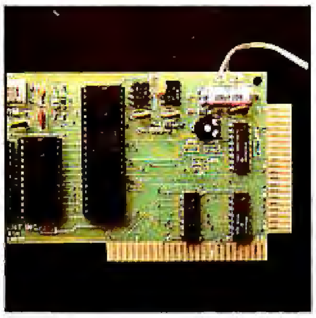

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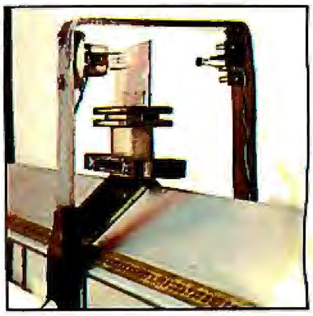

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# In This Issue

It's the operating systems that turn a hunk of hardware into a clever machine. As Robert Tinney's cover drawing depicts, they are the brains behind the brawn of today's computing systems.

This month two articles analyze the most popular operating system, "CP/M: A Family of 8- and 16-Bit Operating Systems," by Gary Kildall, and James Larson's "The Ins and Outs of CP/M." If you can get by the title of Chris Morgan's editorial — "The New 16-Bit Operating Systems, or, the Search for Benutzerfreundlichkeit" — you'll discover what form the operating systems of the future may take. And Robert Greenberg presents what may be the next popular operating system in his article, "The UNIX Operating System and the XENIX Standard Operating Environment."

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# Editorial

# The New 16-Bit Operating Systems, or, The Search for Benützerfreundlichkeit

*by Chris Morgan, Editor in Chief*

*"Benützerfreundlichkeit: (literally 'user friendliness') The philosophy that a system should be constructed with the interests of the user as the chief concern."*

*—from* The Practical Guide to Structured Systems Design *by Meilir Page-Jones, Yourdon Press, New York, 1980, page 338.*

Sam Goldwyn, the "G" of MGM, was famous for his inside-out logic. He once said, "A verbal agreement isn't worth the paper it's written on." This month's topic prompted me to coin a "Goldwynism" of my own: "The best time to talk about the future is before it happens."

In one sense 16-bit microcomputers are definitely here, yet in another they are strangers to us. The personal-computer community still lives in an 8-bit world, straining all 8 bits of every word to perform miracles.

But all that can and must change. Opponents of 16-bit systems cite cost and software conversion problems as the two main justifications for staying with 8 bits. Yet, how can software keep pace with the increased demand for more sophisticated graphics, to name only one area, unless we can address more than 64 K bytes of memory? How will we be able to access the staggering amounts of information in future memory banks without an increase in word size? And then there are the exciting new languages like Smalltalk that demand 16 bits for their operation. Simply put, 16 bits is the only way to go. The 16-bit operating system, therefore, becomes a critical link in the computing chain.

## Doing It Right the Second Time

The *operating system* is the "master controller" of the computer: it gets us going when we turn on our computers, keeps track of files, lets programs talk to one another, performs input/output tasks, and so on. Put charitably, most operating systems in the 8-bit world have been afterthoughts or compromises in design. Even CP/M, a de facto standard in our field, has been criticized as being awkward for nontechnical users. But CP/M's ubiquitousness is responsible for the development of a lot of valuable software that would otherwise probably not have been written.

The sin of inefficiency is venial compared to the mortal sin of "user-unfriendliness." I'd buy an operating system any day that takes a long time to run a given program but which makes me more productive by communicating with me in useful ways. Let's face it: most of us don't have to worry about real-time process control and its inherent time constraints. And the cost of a line of code is becoming astronomical.

**KEVIN COHAN** *1956-1981*
*Kevin Cohan, BYTE technical editor, died April 22nd when the car he was driving left the road, striking a tree. He was 24 years old. Kevin joined the BYTE staff in November, 1980, after attending Dartmouth College, and was a valuable and well-liked member of our "family." He will be missed.*

Percom Mini-Disk Drive Systems for TRS-80* Computers...

# Now! Add-On *and* Add-In Mini-Disk Storage for your Model III.

**The industry leader in microcomputer peripherals, Percom not only gives you better design, better quality and first-rate service, but you pay less to *boot*.**

## New for the TRS-80* Model III

Patterned after our fast-selling TFD Model I drives. And subjected to the same reliability controls. These new TFD mini-disk systems for the Model III provide more features than Tandy drives, yet cost far less.

- **Flippy Capability:** Both internal (add-in) and external (add-on) drives permit recording on either side of a diskette.
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- **1.5 Mbyte On-line:** The Percom drive controller (included with the initial drive) handles up to four drives. With four 80-track mini-disk drives you can access over 1.5 million bytes of on-line file data.

  Moreover, the initial drive may be **either** an internal add-in drive or an external add-on drive. And whichever configuration you get, the initial drive kit comes complete with our advanced 4-drive controller, interconnecting cables, power supplies, installation hardware, a DOS and of course the drive mechanism itself.
- **First Drive Includes DOS:** OS-80™, Percom's fast extendable BASIC-language disk operating system, is included on diskette when you purchase an initial drive kit. Originally called MicroDOS, OS-80 was favorably reviewed in the June 1980 issue of Creative Computing magazine.
- **Works with Model III TRSDOS:** Besides being fully hardware compatible, Percom's Model III 40-track drive systems may be operated with Tandy's Model III TRSDOS — without any modifications whatsoever. And, TRSDOS may be easily upgraded with simple software patches for operating 80-track drives.

**Percom TFD add-on drives start at only $399. Model III Drive kits start at only $749.95.**

**Quality Percom products are available at authorized dealers. Call *toll free 1-800-527-1592* for the address of your nearest dealer or to order direct from Percom.**

## Still #1 for Model I

As if greater storage capacities, exceptional quality control measures and lower prices aren't reasons enough to make Percom your first choice for Model I add-on drives, **all** Percom Model I drives are also rated for double-density operation.

Add our innovative DOUBLER™ adapter to your Model I Expansion Interface, and with Percom drive systems you can enjoy the same double-density storage capability as Model III owners.

The DOUBLER includes a TRSDOS*-like double-density disk operating system called DBLDOS™

We also offer a double-density Model I version of OS-80 as well as DOUBLEZAP programs for modifying NEWDOS/80 and VTOS 4.0† for DOUBLER compatibility.

Of course you don't have to upgrade your computer for double-density operation to use Percom mini-disk drive systems. In single-density operation, our TRS-80* Model I compatible 40-track drives store 102 Kbytes of formatted data on one side of a diskette, and our 80-track drives store 205 Kbytes. By comparison, Tandy's standard drive for the Model I stores just 86 Kbytes.

And like our Model III drives, Model I add-on drives are optionally available with "flippy" storage capability.

### System Requirements:

**Model III:** 16-Kbyte system (min) and Model III BASIC. The second internal drive may be installed after the first internal drive kit is installed, and external drives #2, #3 and #4 may be added if either an internal or external first-drive kit has been installed. External drives #3 and #4 require an optional interconnecting cable.

**Model I:** 16-Kbyte system (min), Level II BASIC, Expansion Interface, disk operating system and an interconnecting cable. For double-density storage, a Percom DOUBLER must be installed in the Expansion Interface and DBLDOS (comes with the DOUBLER) or other double-density DOS must be used. For single-density operation, a Percom SEPARATOR™ adapter, installed in the Expansion Interface, will virtually eliminate "CRC ERROR — TRACK LOCKED OUT" read errors. Prices and specifications subject to change without notice.

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We work with the serious systems integrator . . . on terms that make sense to you. That means giving you a set of products which expand your limits, not reduce them.

We manufacture the most complete family of high quality IEEE/696 S-100 mainframes on the market. Choices include three mainframes in rack-mount or table-top packages with complete board sets, to serve as the building blocks for your 8 or 16 bit system. We also provide other options ranging from complete floppy disk systems right up to our proven Pascal development system.

**The ∫ factor: one source.**

No matter which option you choose, you get the benefit of working with completely integrated products . . . fully assembled and tested . . . under one warranty and one price structure . . . leaving you free to concentrate on value-added application development and sales.

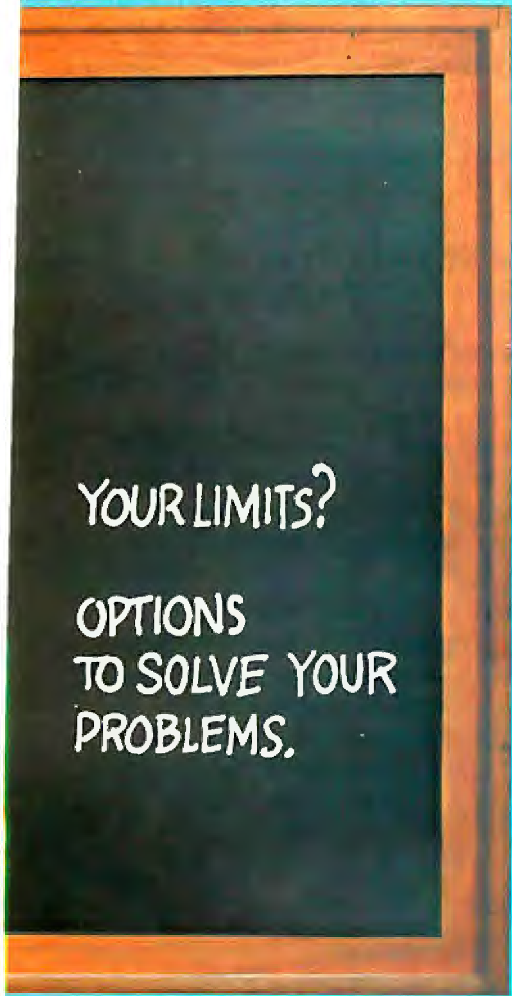
**Choose from mainframe options . . .**

Select from three packaging options: Rack-mount, table-top or front panel models. All three feature our 20 slot S-100 motherboard with 25 amp power supply and are delivered fully assembled and tested with our Series II™ board sets. Any board configuration you choose works with any DPS-1 version, allowing you to vary your package offering, or develop on one version and market another.

- Front Panel model — a powerful development and diagnostic tool for Z-80† systems, which can be used for prototyping, servicing, debugging, and software or hardware development. Use its features to set breakpoints, trigger scopes, single step, slow step and more.
- Front Panelless desk top model—a lower cost option for OEM or other turnkey operations which do not require the extra capability of our Front Panel.
- Rack Mount version — features a heavy gauge frame designed to fit into standard 19" racks. CVT power supply for brown out immunity is standard.

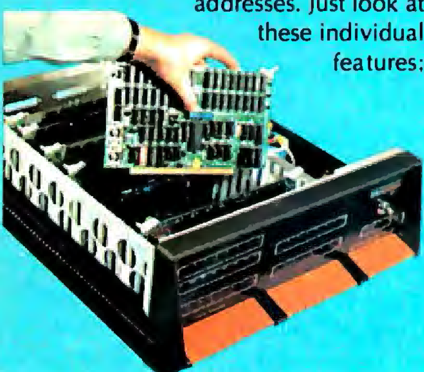
*In Calculus, a fundamental statement in the definition of limit; interpreted here to imply: "For your integration problem, Intersystems has a solution."

† Registered trademark of Zilog, Inc.




**Board level options...**

Intersystems mainframe packages, equipped with Series II boards, are operational in both 8 and 16 bit settings and support extended addressing in both I/O and memory space, recognizing 16 bit I/O addresses and 24 bit memory addresses. Just look at these individual features:



- MPU-80—uses a Z-80, 8 vectored interrupt lines and two 4K windows to address up to 1 Megabyte of RAM without bank select.
- 64KDR—sophisticated refresh circuitry allows unlimited DMA and absolutely reliable operation without wait states.
- 6 SI/O — six individually software-controllable serial I/O ports with optional interrupts. Each can run RS 232 at up to 19,200 BAUD, as can our VI/O board.
- VI/O—has two serial ports; two 8-bit parallel output and two 8-bit parallel input ports plus 8 individually controllable command lines and 16 levels of vectored interrupts.
- FDC II—can DMA up to a full track into 16 Megabytes of memory. Optionally generates interrupts and handles up to four 8" floppies.
- MPU-8000 — available with the non-segmented Z-8002†, which directly addresses 64K, or the segmented Z-8001†, which can directly address 8 Megabytes.

**Extended systems options...**

Interfacing disk drives is not a trivial matter, so when your objectives and resources dictate you spend your energy elsewhere, use our resources to perform the service for you. We can add our disk drive package to any Z-80 or Z-8000 configuration we provide ... again, fully assembled and tested and covered under one warranty.

**Or our complete Pascal Development System.**

We use it for our own hardware and software development. It includes either table-top mainframe, two 8" floppy disks, 128K RAM, CP/M#, and Intersystems Pascal/Z™ compiler and Cache BIOS™.

THIS SYSTEM IS FAST! Why? Because our ultra-fast Cache BIOS automatically buffers whole tracks, eliminating most disk accesses. This delivers up to three times the throughput of any other floppy-based system we know and is equal to many small hard disk systems.

The system is versatile, too. SET program allows you to change many BIOS parameters and specify control characters to enable special features such as diagnostic output to trace program execution. It can also provide remote I/O to link your system to almost any other computer, large or small.

And it's reliable. The Cache BIOS System runs continuous memory tests when idle, and verifies with a Read after Write and Read after Read.

And the system also includes our Pascal/Z, a true native compiler producing ROMable and Re-entrant code. It features a minimum of extensions chosen for the development of your scientific and business applications. And it's compatible with our native code Pascal for Z-8000, providing a graceful upward path to 16 bit applications. So what you write now is right later.

**One choice you won't have to make...**

We don't believe you should ever have to sacrifice good technical support to find a good product. We'll back you to the hilt with services like free technical consultation, board-swapping, diagnostic packages, and documentation that gives you all you need to integrate, operate and maintain your system ... right down to schematics of the boards.

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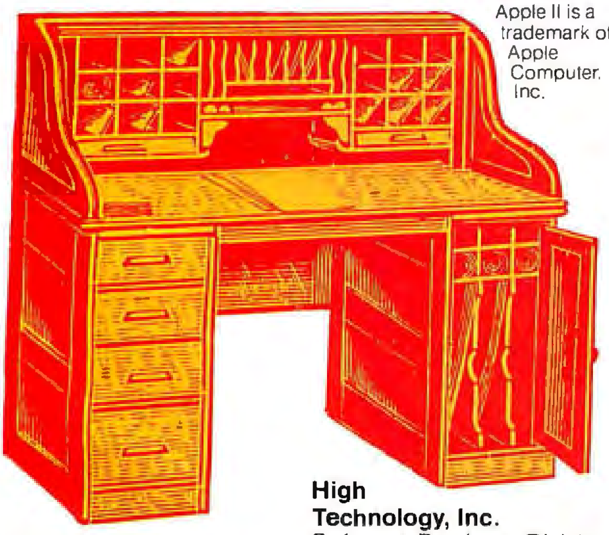



## Editorial

Now we have a chance to start with a clean slate. Software manufacturers are filling their 16-bit tabula rasas with offsprings of UNIX, an operating system developed at Bell Labs in 1969 by Kenneth Thompson and Dennis Ritchie. (See Robert Greenberg's article, "The UNIX Operating System and the XENIX Standard Operating Environment," page 248.) A software engineer was quoted in a recent issue of *Electronics* magazine (March 24, 1981, page 119) as saying that UNIX is "like sitting behind the wheel of a well-tuned sports car—when you press the gas, it goes, and when you hit the brakes, it stops. It's the ultimate in responsiveness, and yet all the while you are riding in comfort." UNIX deserves such accolades. Its hierarchical file structure lends much needed order to the chaotic approaches found in many personal computer operating systems; it is designed for truly efficient multiuser operation; the elegant idea of the *pipe* allows data to flow from program to program efficiently; and the *shell* program acts as a user-friendly interface to the rest of the operating system. An excellent example of UNIX's versatility, described in Greenberg's article, shows how the user can add a simple spelling correction program to a system, with just one line of code.

### New Programs

Several software vendors have taken out licenses to adapt UNIX to 16-bit personal computer systems. These include Microsoft, Whitesmiths, Zilog, and Onyx, the developers of XENIX, Idris, Zeus, and Onix, respectively. Among non-UNIX-related 16-bit operating systems, OASIS, developed by Phase One Systems Inc, has received high marks from many professional programmers. And judging from its past track record with CP/M, Digital Research's new CP/M-86 should also become a major factor in the market. (See "CP/M: A Family of 8- and 16-Bit Operating Systems," by Gary Kildall, page 216.)

Despite the recent relaxation of UNIX licensing fee conditions by Western Electric, the UNIX offspring will not be cheap. Operating system software could sell for more than $2000. However, Lifeboat Associates' version of XENIX will probably retail for less than $1000 by the end of the year.

The 8-bit computer is far from dead. There is too much good 8-bit software around for this to happen. And, for many applications, it's hard to beat the price-performance ratio of the 8-bit machine—at least by today's prices. Sixteen-bit and 8-bit machines will coexist for many years to come. I don't believe in the "mutually exclusive" school of computer punditry. Just as no high-level language has ever supplanted another (can readers give me an example of this?), 8-, 16-, 32-, (etc) bit microcomputers will coexist in the future.

In our field, the future becomes the present overnight. You don't need a crystal ball to state emphatically that we have not seen the end of the 8-bit versus 16-bit debate. But the new operating systems do add a welcomed layer of professionalism to personal computing. ■

## OSI Still in Personal-Computer Business

As a result of "Ohio Scientific Sold" ("BYTELINES," March 1981 BYTE, page 246), we have had several telephone calls from dealers who were disturbed by BYTE's report that "In all likelihood OSI will move away from personal computing and into the small-business market." This statement is a false and damaging "projecture."

When Ohio Scientific was founded in 1975, our first products were designed for, and directed to, the personal-computer market. In 1977, when other small-computer manufacturers were entering the "fun and games" computer market, OSI introduced the Challenger C3B Business Systems, featuring a three-processor system with 74-megabyte Winchester hard-disk storage.

As a pioneer in small business-computer systems, we feel we moved into the small-business market some time ago. Our first business-system advertisements appeared in BYTE in 1978!

As for our personal-computer systems, now and for the future—in May 1980, we announced an enhanced version of our Challenger C1P and introduced our Challenger C1P Series 2. In total units and dollar volume, we are counting heavily on our personal-computer line to carry a full share of Ohio Scientific's continued success.

**W Paul Warren**
**Coordinator, Marketing Communications**
**Ohio Scientific**
**1333 S Chillicothe Rd**
**Aurora OH 44202**

*We are sorry for any misinterpretations of Sol Libes's speculation on the future of OSI's marketing strategy. We were not implying that OSI will drop its personal-computer line, but that we feel that there may be a shift in its marketing emphasis. . . .* **MH**



## BYTELINES Makes Waves

I have always enjoyed reading Sol Libes's "BYTELINES," and consider him to be a good source of information on the personal-computer industry, except for one annoying trait. Because Mr Libes is professionally associated with products that use the S-100 bus, his information is strongly biased toward Intel and S-100 products. For example, I recently counted six issues in a row where he discussed UNIX-like software to be introduced for Intel and S-100 users. At no time did he mention that the Motorola/S-50 users have had UNIX-like systems available for some time. Certainly he has seen the advertisments in BYTE for UNIFLEX for the 6809 by TSC (Technical Systems Consultants). If Mr Libes hasn't heard of the UNIX-like OS-9 by Microware, it is only because he looks at the world through S-100 blinders. Perhaps "BYTELINES" should be expanded to include associate editors who would supply information on other computer buses and the popular "no-bus" systems.

**Leo Taylor**
**18 Ridge Ct W**
**West Haven CT 06516**

**Sol Libes Replies:**

*I am pleased that Leo Taylor enjoys reading my column and considers it "a good source of information." There is no doubt that I have a bias toward S-100-based systems—I guess it's my upbringing. I try to control it and present a balanced picture of the personal-computing field. I feel that I am successful 99% of the time, and that no one can be 100% unbiased.*

*When I wrote the UNIX items for "BYTELINES" during the spring and summer of 1980, TSC had not yet announced UNIFLEX, so I was not aware that it was coming. Additionally, nowhere in TSC's advertisements is it specifically stated that UNIFLEX is "UNIX-like," although the description sure sounds like it is.*

*The OS-9 operating system fell into the same category as UNIFLEX. Despite the fact that its advertisements refer to OS-9 as UNIX-like, a product review, in the December 1980 issue of 68'* Micro Journal, *stated that "the similarity [to UNIX] is mostly superficial."*

# The One Printer Solution for the Two Printer Problem.


## HIGH SPEED DATA PROCESSING

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## Treasure on Disk

I enjoyed the reviews and comments on the Adventure-like games in the December 1980 BYTE, especially Jerry Pournelle's "User's Column." (See "BASIC, Computer Languages, and Computer Adventures," page 222.) I would, however, like to point out for the benefit of BYTE's readers that the original version of Adventure ("The Colossal Cave") has been available from the Heath Users' Group for over two years, for a mere $10.

This version comes on a 5-inch disk that runs on the Heath H-8 (with disk drive) or the H-89 computers. A minimum of 32 K bytes of memory is required, and the game plays very fast. Unlike other issues, Heath's version (written by Gordon Letwin before he left to join Microsoft) can be easily copied for backup and safe keeping—a distinct plus.

I'd also like to point out that while there are several maps and guides available to the Colossal Cave, none help that much. They may assist in reducing the search for treasures, but they won't help in avoiding some of the more subtle pitfalls, and certainly won't help in the Final Adventure.

**D C Shoemaker**
**2000 A Foxridge**
**Blacksburg VA 24060**

## More GOTOs Changing

In David Carew's article "Change Your GOTOS into FOR...NEXT Loops" (January 1981 BYTE, page 334), a better approach to the problem would have been (if step 0 not allowed):

```
510 FOR I = 1 TO 2
520 READ X
530 I = 1
535 IF X = K THEN I = 2
540 NEXT I
```

However, the best way, for systems that allow it, is:

```
510 FOR I = 0 TO -1 STEP -1
520 READ X
530 I = X = K
540 NEXT I
```

For the TRS-80 (and, I think, all Microsoft BASICs), line 530 treats the second equals sign as a logical operation, giving a −1 (true condition) if equal, and a 0 (false condition) if not equal. Some BASICs have a different convention for true and false (some represent true as 1 and false as 0) so the statement would be FOR I=0 TO 1. Another advantage of this form is that it can be embedded in the middle of a long line as follows:

```
500 ..... : FOR I = 0 TO -1 STEP -1
          : READ X : I = X = K : NEXT : ....
```

Both of these examples are faster than the published counterparts—always setting I to 1 is faster than the test (even if false), because there are fewer characters to interpret, and the same goes for the other example. Also, both of these examples use less memory for the program.

**Carey Tyler Schug**
**POB 585**
**Chicago IL 60690**

## CMOS Is Boss

A few important points need to be made in connection with Larry Malakoff's article "Memory: Making an Intelligent Decision." (See the February 1981 BYTE, page 142.) Mr Malakoff generalizes that dynamic memories are superior in the areas of packing density, power consumption, and cost. Unfortunately, he has overlooked one of the most exciting memory techniques currently available: CMOS (complementary metal-oxide semiconductor) *static* memories.

While we at Hitachi are active in the dynamic memory business (especially the 4816-type 16 K by 1-bit and the 4864-type 64 K by 1-bit devices), we recognize that, for many reasons, static memory is often desirable. This approach is typified by our CMOS 6116-type fully static 2 K by 8-bit memory.

Responding to each of Mr Malakoff's points:

- Density: Using the 6116, a 64 K-byte static memory board is not only feasible, but Godbout Electronics will soon release an S-100-compatible board, called RAM 17. The increased size of the 6116's package (24 pins versus 16 pins for the 4116-type dynamic device) is easily offset by the total lack of "tricky" refresh logic required by dynamic memory.
- Power Consumption: The 6116's power requirements (operating *and* standby) are equal to or less than most 16 K-bit dynamic devices. The power supply to Godbout's 64 K-byte static board is con-

servatively overregulated using one 7805 5 V, 1 A voltage regulator.

- Price: Expect the price of Godbout's RAM 17 to be competitive ($1400) with the $895 to $1195 figures quoted by Mr Malakoff.

A few other points:

- Compatibility: The 6116 is easy to interface and is fully compatible with all processors, DMA (direct memory access) controllers, front panels, etc. Boards like those mentioned in the article may not work with faster processors (eg: 6809, 8088) now available for the S-100 bus.
- Versatility: The 6116 is pin-compatible with the 2716 EPROM (erasable programmable read-only memory) and Hitachi's new 48016 EEPROM (electrically erasable PROM), and so the user can configure a board to contain the best combination of memory types for a given application.
- Speed: The 6116 is available for speeds rated as fast as 120 ns (more than fast enough for microprocessor applications). Godbout's board will work with Z80 microprocessors running at 6 MHz with no wait states. I do not believe that there is a dynamic board that can do the same.
- Design Simplicity: No "black art" transparent refresh or special circuitry (eg: DMA, Reset) is needed; consequently, the time and the cost of the design process have been reduced. (For systems with more than 64 K bytes of memory, the best solution is to adopt the IEEE 696 Extended Addressing Standard, not the cumbersome nonstandard bank-select scheme.)

As CMOS manufacturing processes continue to approach NMOS in density, cost, and performance, companies like Hitachi have the capability to bring their CMOS expertise to bear on applications like memory devices and peripheral controllers. As devices become more complex, and applications more demanding, CMOS technology will be *required* to overcome thermal dissipation problems.

**Thomas Cantrell**
**Microprocessor Product Marketing**
**Hitachi America Inc**
**1800 Bering Dr**
**San Jose CA 95112**

## Hand-Held Computer Algorithm Improvement

I read with interest Gregg Williams's description of the Panasonic and Quasar hand-held computers, especially the data-compression techniques. (See "The Panasonic and Quasar Hand-Held Computers," January 1981 BYTE, page 34.) Reading the text box that describes the mapping algorithm, however, I noticed a possible improvement.

In figure 3, page 41, a permutation of four elements encoded with 6 bits (001010, by rows) is demonstrated. However, according to the text, the first box will always be unswitched. Since it is constant, the first box (or first bit) need not be stored explicitly. This leaves 5 bits instead of 6 to encode the permutation (01010 for the example). The recursive nature of the algorithm should compound the savings significantly for larger permutations. In table 1, I have reproduced Mr Williams's table 2 with an additional column.

| Table Rank (N) | Number of Elements in Table ($2^N$) | Williams's Algorithm $F(N)=2^N+2F(N-1)$ | Modified Algorithm $F'(N)=2^N+2F'(N-1)-1$ | Ordinary Lookup $N2^N$ |
|---|---|---|---|---|
| 1 | 2 | 1 | 1 | 2 |
| 2 | 4 | 6 | $4+2(1)-1=$ 5 | 8 |
| 3 | 8 | 20 | $8+2(5)-1=$ 17 | 24 |
| 4 | 16 | 56 | $16+2(17)-1=$ 49 | 64 |
| 5 | 32 | 144 | $32+2(49)-1=129$ | 160 |
| 6 | 64 | 352 | $64+2(129)-1=321$ | 384 |

**Table 1**

**Craig R Ewert**
**400 Raymondale #16**
**South Pasadena CA 91030**

**Gregg Williams Replies:**

*Your analysis of the requirements of the algorithm is completely correct, although this does not necessarily mean that even more space can be saved within the HHC (hand-held computer). I compiled the table of results you referred to based on a description of the algorithm, and I did not realize that the box in the upper-left corner did not need to be encoded. Although I was unable to contact the person who had written the code implementing the algorithm, your interpretation of the algorithm does, in fact, allow permutations to be stored with less memory. My thanks to you (and to Paul E Black, of Oquirrh City, Utah, who wrote a similar letter) for pointing this out.*

## Thermodynamic Flaws

Richard Hetherington's excellent "Programming Quickie" in the February 1981 BYTE contains one flaw that can cause the user of his routine to arrive at some misleading results. (See "Energy-Saving Cost/Benefit Analysis," page 266.)

Table 2 gave the heat value of various fuels, and as far as I can see, it's correct. Unfortunately, the heat values are theoretical maxima, and to compute cost savings you need to make allowances for inefficiencies in extracting that heat. In practice, efficiencies range from (essentially) 100% for electricity to 20% or less for a fireplace. (A small fire in a large fireplace on a cold night can actually run at negative efficiency—losing more heat up the chimney than it contributes to the house.) Efficiencies tend to vary with the quality of the heating hardware, and (I suspect) with whether they are measured in the laboratory or in a more conventional environment. In general, you would not be wrong to expect 100% for electricity; 60% to 70% for gas or oil heat; 40% to 50% for wood or coal stoves; and something pretty dismal for an unaugmented fireplace.

The conventional means of accounting for this are either to reevaluate the fuel's heat value by the efficiency, or to alter the equation C=Z*Q/H to read C=Z*Q*E/(100*H), where E is the efficiency in percent. In this case, I would modify the routine to use the latter method, because it lets you evaluate the effect of switching to a more efficient heat source.

Anyone seriously planning to tackle his or her home-heating problem should construct a paper-and-pencil thermodynamic model of his or her house. This is nowhere near as difficult as it sounds. Any public library has some books (mostly those dealing with solar heating) that can help.

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Mr Hetherington's routine is only as good as the data you put into it, and if you don't know how much heat you are putting into your house, and where it is going out, you may not recognize bad data when you use it.

**Donald Kenney**
**291 S Main St**
**Andover MA 01810**

## Computers Can Help People

I read Mark Dahmke's editorial and would like to share with BYTE readers an interest of mine. (See "Computer Speech: An Update," February 1981 BYTE, page 6.)

I'm an academic adviser at Michigan State University and work with students in the Lower Division. Among our many academic services, we try to assist students in selecting majors that will help them attain their individual goals in life. I have very realistic concern and at the same time very optimistic hope for one student in particular.

Kelly Watson is a quadriplegic and has a combination of athetoid and spastic cerebral palsy. She is a delightful young lady—bright, pretty, and her sparkling sense of humor helps her overcome frustration. Kelly, although just 20, became a sophomore at the end of this winter term. She has gotten this far in her academic career out of sheer determination, and I'm sure someday she will be the newspaper editor she plans to become.

Kelly uses a joystick-operated electric wheelchair and types with a headstick on an IBM electric typewriter. MSU's Artificial Language Laboratory hopes to be able to provide her with a word-processing system. With financial assistance from concerned communities, technologists such as Mark Dahmke and John Eulenberg will soon be able to make accessible to persons such as Bill Rush and Kelly Watson those opportunities we all enjoy. I foresee a great advancement in human concern.

**Jane E Linnell**
**Michigan State University**
**Undergraduate University Division**
**Student Academic Affairs Office**
**East Lansing MI 48824**

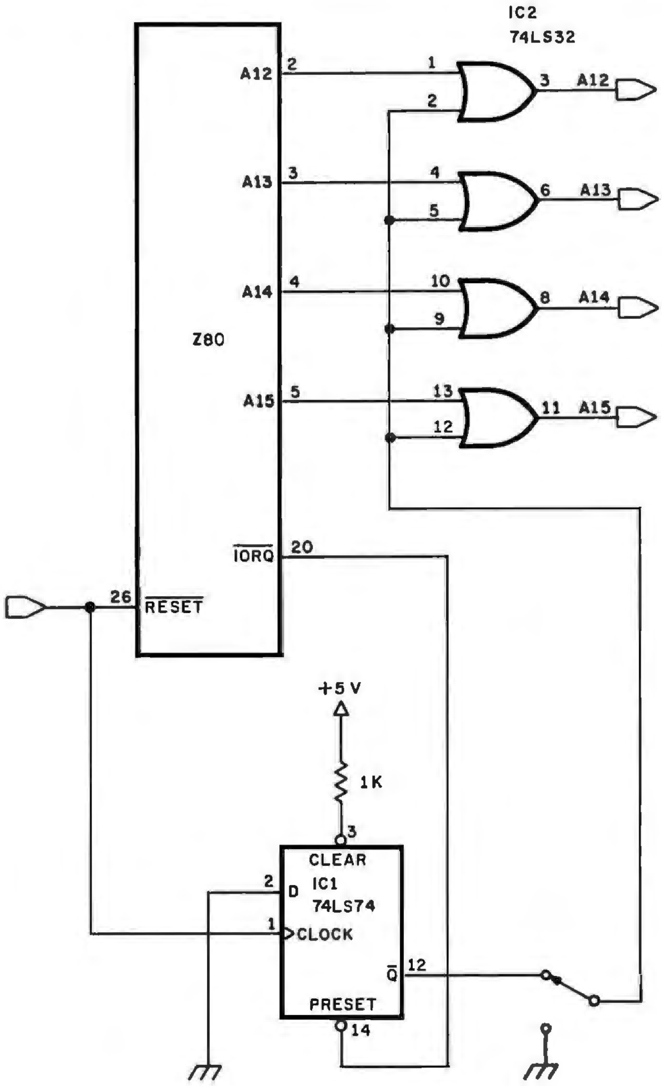



**Figure 1**

## Simpler Starting Solution

Although Randy Soderstrom's approach to the problem of forcing the Z80 starting address was interesting, it is not the simplest solution. (See "Forcing the Z80 Starting Address," February 1981 BYTE, page 288.) His suggestion requires four integrated circuits, and an initial time delay is introduced. The circuit in figure 1 uses only two devices.

Upon reset of the system, the D flip-flop (IC1) is clocked, causing $\overline{Q}$ to go high. Although the processor's address bus and program counter contain all 0s, the memory addressed is hexadecimal F000. The 74LS32 quad OR gate (IC2) accomplishes this with one input per gate high. The system monitor can be stored at hexadecimal address F000 and can now handle its high-priority housekeeping without worrying about the address. A JP (jump immediate) to the next instruction will set the program counter correctly. The first OUT or IN instruction will activate the IORQ (input/output request), and then preset the D flip-flop, allowing signals on the address bus to pass freely through the 74LS32, and restoring the system to normal operation. As in Randy's circuit, there is no interference with memory refresh.

This technique is used on MOSTEK's STD Bus-based CPU-1 card. We feel this is the best and most economical approach to take.

**Mitchell A Russo**
**MOSTEK**
**29 Cummings Pk, Suite 426**
**Woburn MA 01801**



Circle 247 on inquiry card.

## BASIC Problems

Samuel Bates's "Rotation Algorithm" was fascinating but frustrating for two reasons. (See the January 1981 BYTE, page 328.) First, there are many terms used from Hewlett-Packard's HP 3000 BASIC that are not common to other versions of BASIC. I can figure out what MAT R=ZER does (it puts 0 in every element of the array R) and duplicate it with a subroutine, and I can determine from context that # means < > (not equal). However, I'm stymied by FILES*, ASSIGN, ENTER, and READ#1,1. Please, BYTE, return to the old policy of inserting a box with explanations of uncommon terms! A flowchart would have been useful, too.

"Whose BASIC Does What?" by Teri Li was also welcome. (See the January 1981 BYTE, page 318.) I hope its idea will be extended both to cover more computers and to be more complete in terms. I hope that BYTE will eventually publish it as a separate reference booklet. There were, however, some errors in the article. For the Commodore PET, the major errors of significance are:

HOME and CLS should be checked.

COLOR=n, FRE(x$), SPC(expr), and RANDOMIZE should not be checked.

CALL address should have SYS entered.

TI(expr) should be TI or TI= expr.

TI$, a different real-time clock function, should be listed.

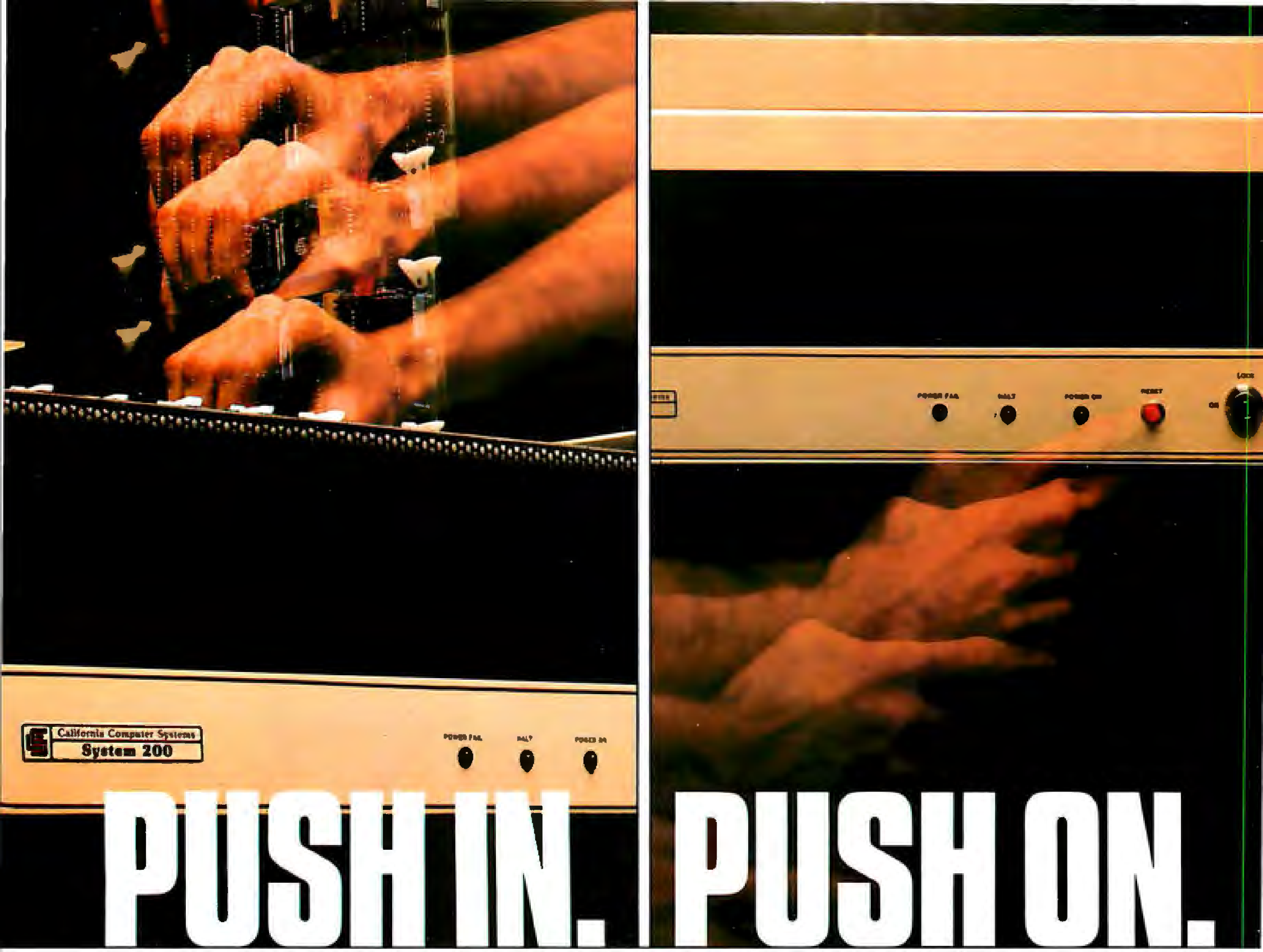
I don't need to say that BYTE is the best (I read six other journals regularly as well), so I'll just say "thanks and keep it up."

**Frank Chambers**
**Rock House**
**Ballyoroy, Westport**
**County Mayo, Ireland**

*The Hewlett-Packard 3000 is correctly classified as a minicomputer, so only a small percentage of our readers will have access to a system similar to the one used by Mr Bates. The BASIC statements that may be unfamiliar are defined in table 2.* ■

| | |
|---|---|
| 10 FILES * | tells the interpreter that file names will be provided in a later ASSIGN statement |
| 120 ASSIGN A$,1,S | assigns A$ as file number 1, a sequential file |
| 160 ENTER 255,A9,A$ | allows 255 seconds for the values A9 and A$ to be input |
| 1130 READ #1,1 | sets the pointer for file number 1 to the first record |
| 1140 IF END #1 THEN 1190 | transfers control to statement 1190 if end-of-file number 1 is encountered |
| 1150 READ #1,B$ | reads the next value from file number into the variable B$ |

**Table 2**

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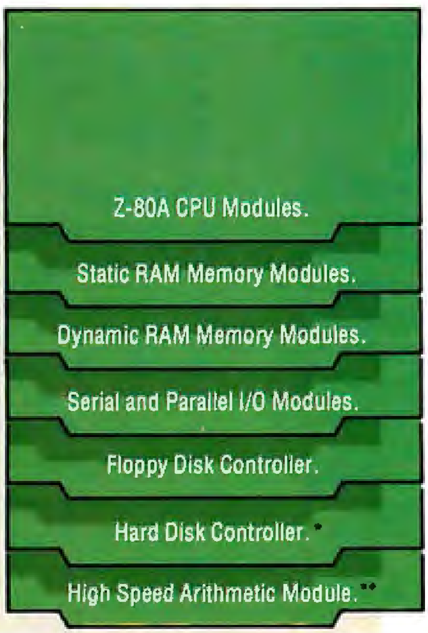


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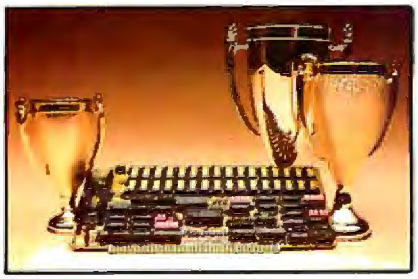

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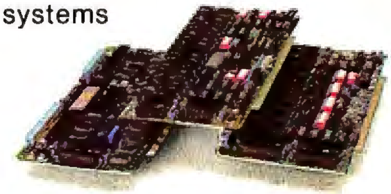

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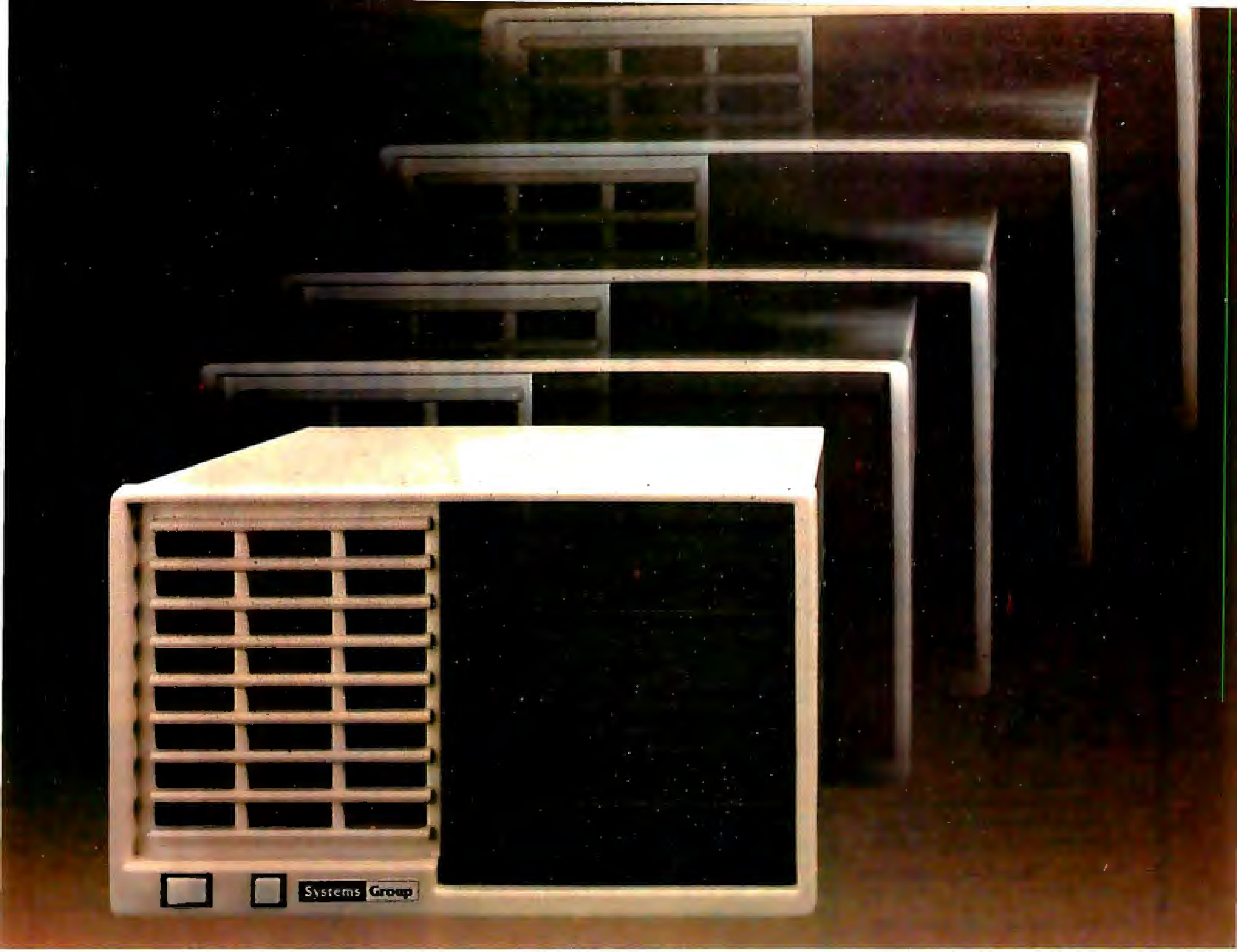
Systems Group

## Hardware Review

# RAMCRAM Memory Module for the Atari

Mark Pelczarski
1206 Kings Circle
West Chicago IL 60185

Axlon Inc has released an alternative for add-on memory for the Atari computers that might save some money for Atari 800 owners. RAMCRAM will also offer more memory for the Atari 400 than you may have thought possible.

For $320 you can buy a single module that contains 32 K bytes of programmable memory. The unit plugs into the middle memory slot of an Atari 800, and with the 16 K-byte module provided with your system, gives a full 48 K bytes of memory (it will not work with only an 8 K-byte module ahead of it).

In an Atari 400, the module can replace the built-in 8 K bytes of memory to give a 32 K-byte system. The Atari 400 would then be able to use any software for Atari 800 32 K-byte systems, plus it would contain enough memory to handle a DOS (disk operating system) and, therefore, a floppy-disk drive. With RAMCRAM, Personal Software's 17 K-byte VisiCalc will run on the Atari 400.

In an Atari 800, the top 8 K bytes of memory-address space are preempted if you have a cartridge in the left slot, such as BASIC, the Editor/Assembler, or Star Raiders. With a left cartridge installed you can use

Photo 1: *The Axlon RAMCRAM memory cartridge for the Atari 400 or 800.*

only 40 K bytes. Without a cartridge, but with RAMCRAM installed, you have 48 K bytes of memory which can be used for copying disks faster on a one-drive system. (DOS does not require a cartridge, and more programmable memory means swapping disks fewer times while copying.) You also have 48 K bytes for machine-language programs that do not need cartridges, such as VisiCalc, and languages could be loaded from disk without using cartridges.

Axlon also provides its dealers with a memory-diagnostic program that will analyze the memory of an Atari


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800, checking that the full 48 K bytes are functional. It performs three tests: the first tries to zero every bit in memory, the second checks for memory uniqueness by turning on bits and testing whether other bits were affected, and the third rolls a 1 bit through each location, checking that every bit can be turned on. The diagnostic program is available to customers for $15.

If you own an Atari computer and you're the type of person that thinks ahead more than a year, it seems as though RAMCRAM is the way to go for memory expansion. If you own an Atari 400, it gives you memory that you couldn't get otherwise. If you own an Atari 800, it gives you all the memory it can now hold *and* leaves one expansion slot open for future use. Given Axlon's plans for additional Atari-compatible products, that slot may be valuable. ■

## At a Glance

**Name**
RAMCRAM

**Use**
Increases programmable-memory capacity of Atari computers

**Manufacturer**
Axlon Inc
170 Wolfe Rd
Sunnyvale CA 94086
(408) 730-0216

**Dimensions**
7.5 by 15.5 by 1.5 cm (3 by 6 by 5/8 inches)

**Price**
$320

**Features**
Expands Atari 800 to 48 K bytes, replaces existing memory in Atari 400 to give a total of 32 K bytes

**Hardware needed**
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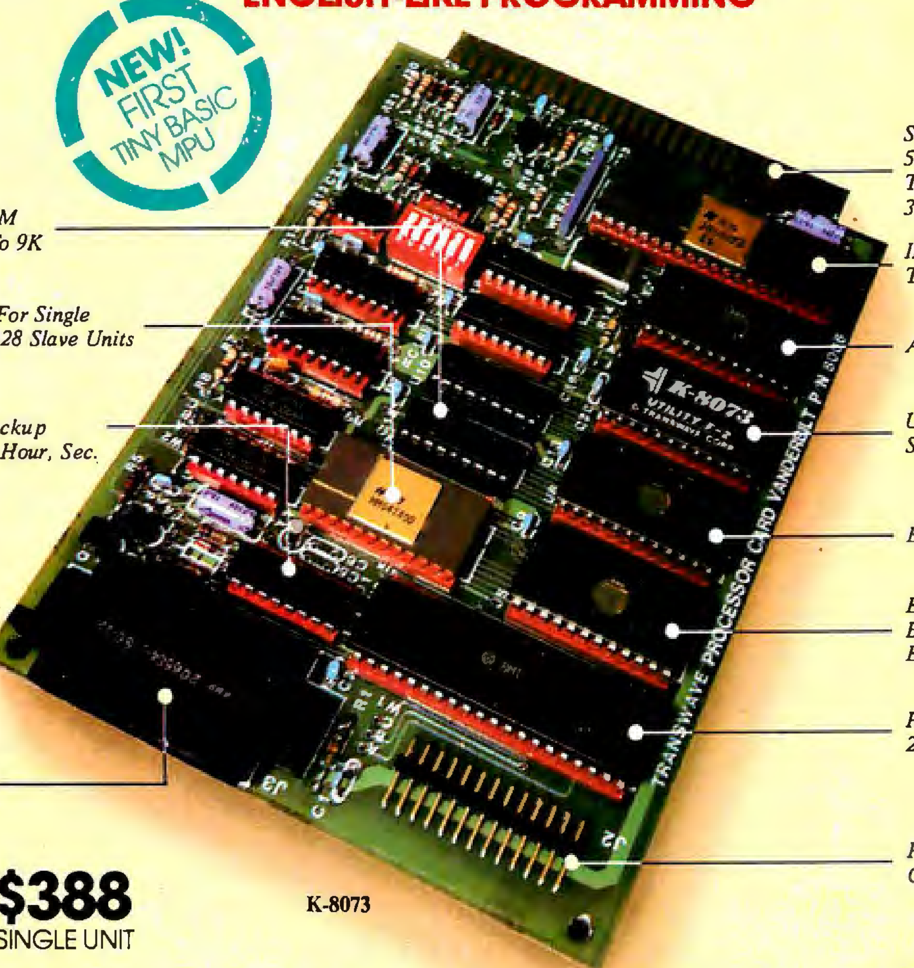


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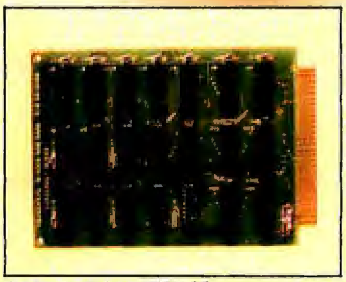

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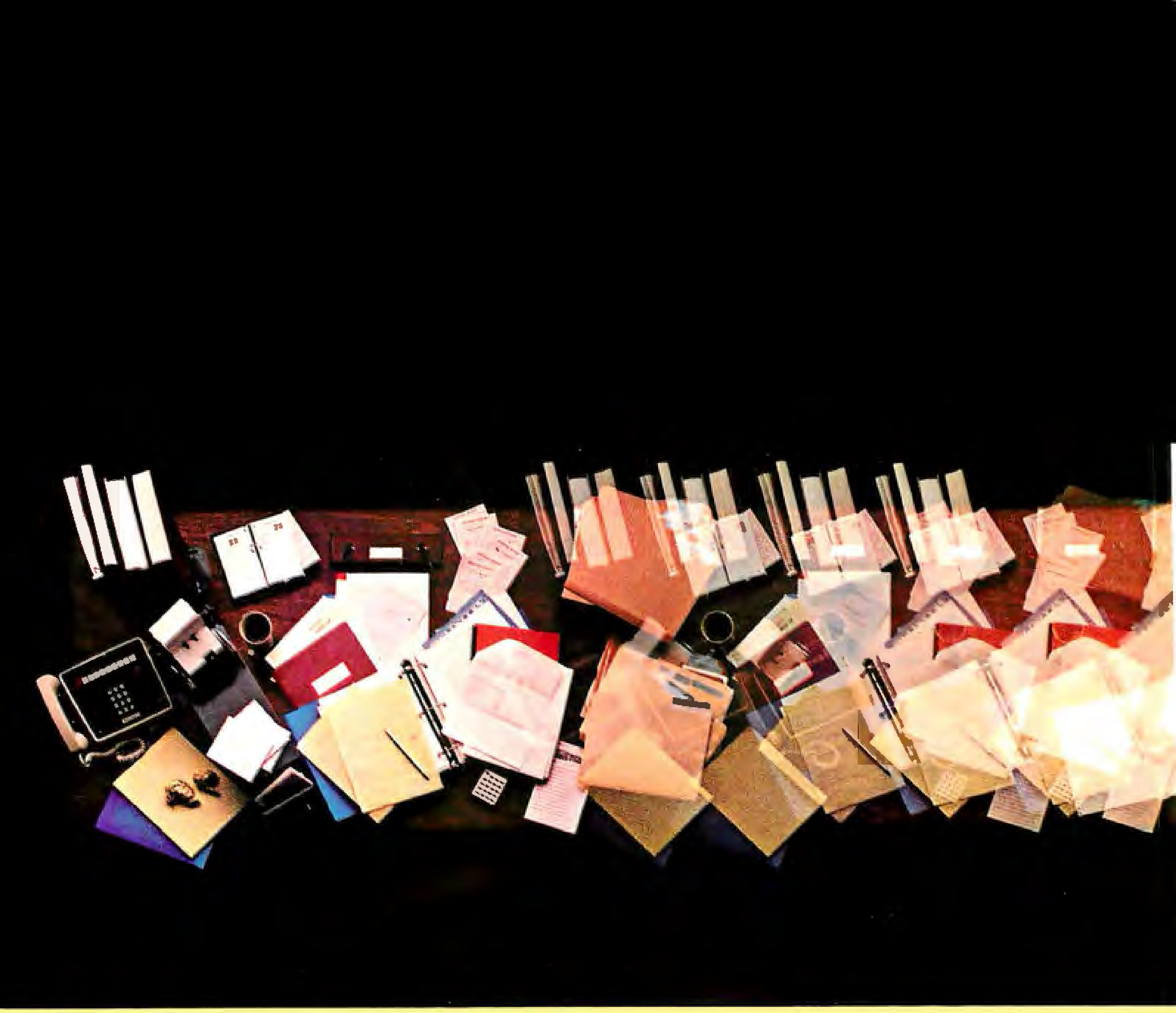

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## Technical Forum

# LISP vs FORTRAN

## A Fantasy

Laurie Rocheleau
c/o David Clay
Florida Institute of Technology
Melbourne FL 32901

**Editor's Note:** *David Clay, an instructor of computer science at the Florida Institute of Technology, sent us an interesting short story written by one of his students. In his cover letter, he wrote:*

*"I assigned a short term paper recently on the comparison of two programming languages, LISP and FORTRAN. Most papers were written in an expected style, outline of topics, and format—until I came to Laurie Rocheleau's. I was surprised, entertained, and impressed. After reading it, I felt that others might find it a novel approach to a somewhat mundane academic chore—writing term papers."*

*We, too, were surprised, entertained, and impressed, so we decided to publish this short story/term paper. We also want to thank Clay for rewarding such creativity: the cover letter of Rocheleau's paper is marked "A++". . .* **GW**

As they wheeled her into the room her hopes began to fade. She had been praying that this place would be different from all the others. The last room had been so cold. Not only in temperature; no one had even attempted a conversation the entire eight months she had been there. This new room seemed to be a copy of the last, and all the others she had been in.

They placed her in a corner, and after plugging in all of her tubes and wires, they left. It was terribly quiet and dark.

Suddenly she began to receive something from someone across the room. She was absolutely ecstatic. Someone was trying to communicate with her. The language was a bit strange, it was some form of output statement:

PRINT*,'What is your name?'

It was sort of hard to understand yet they were characters, her specialty, and after a bit of interpretation, she decided upon a method of replying. She had no PRINT statement in her memory, but she did have a trick up her circuit board. She sent her interpreter the instruction:

(CONS('(My name is LISP. What is yours?)))

As the other received her message, she could almost sense a chuckle. Soon she received his reply:

PRINT*,'My name is FORTRAN. Why must you com-

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municate in such a strange way? Don't you have input and output commands?'

She felt a bit embarrassed, yet she knew that she had many advantages over this FORTRAN fellow. She replied:

(CONS('(No, I don't have input or output commands. I have to use this CONS instruction with quotes to get something printed out. And I have other instructions to use as input instructions.)))

His reply upset her greatly:

PRINT*,'Ha, how cumbersome. I bet you can't even handle a simple addition without some complicated function call. Well anyway, I'll grace you with a little knowledge about myself. I was one of the world's first high-level programming languages. And today I am probably the most widely used language for programming of scientific and engineering computations.'

She sat for a few nanoseconds, organizing her cutdown:

(CONS('(All right, blowhard, listen to this; I and my various dialects are the primary languages in at least two areas of computer science: symbolic computation and artificial intelligence, which are concerned with programs that perform tasks that humans say require intelligence. Has anyone ever said you have intelligence? I bet not!)))

PRINT*,'Intelligent! How can you even consider yourself intelligent if you can't deal with numbers. I mean numbers make the world go around. Look, even your insides are numbers—all zeros and ones, and you don't even understand them. I bet you can't deal with decimals, or even take the square root of a number—real or integer. You're useless.'

Quickly she replied:

(CONS('(No, I can't take the square root of a number, but I can do quite a bit with numbers. Just take a look at this, these are some more of my functions:

| | |
|---|---|
| (PLUS $X_1 . . . . X_n$) | $= X_1 + . . . + X_n$ |
| (DIFFERENCE X Y) | $= X - Y$ |
| (MINUS X) | $= -X$ |
| (TIMES $X_1 . . . X_n$) | $= X_1 \times . . . \times X_n$ |
| (ADD1 X) | $= X + 1$ |
| (SUB1 X) | $= X - 1$ |
| (QUOTIENT X Y) | $= X \div Y$ |
| (LESSP X Y) | = T if X < Y else NIL |
| (GREATERP X Y) | = T if X > Y else NIL |
| (ZEROP X) | = T if X = 0 else NIL |
| (NUMBERP X) | = T if X is a number else NIL |
| (LENGTH X) | = Length of list X |

They may not be as simple to understand as your method of manipulating numbers, but remember this: numbers are just a minor part of my abilities. Why, unlike you, I can even distinguish between a character and a number with my NUMBER function.

I realize that you are very graceful when it comes to dealing with numbers, but when it comes to character manipulation, a programmer would be crazy to use you. With me, the programmer can easily deal with characters and do a little with numbers if need be. You see, I'm not quite so one-sided as you are.)))

PRINT*,'OK Miss LISP, how about subroutines? They're simple. All I have to do after the END statement (I do hope you understand everything so far) of the main body is have the programmer write SUBROUTINE Name (parameter list). Below this all he has to do is write a subprogram that will be executed just like a regular program, when, in the calling program, the instruction CALL Name (argument list) is encountered. When the execution of the subroutine is finished, a RETURN statement returns control to the statement following the CALL statement in the calling program. The parameters in the parameter list are reference parameters, using the chaining, the copying, or the value/result method. Why, my subroutines can even call other subroutines if they want to. . . . I'm waiting for your response!'

(CONS('(I love the way you quickly changed the subject—away from letters and numbers. But, OK, here's my response: I will add to my argument of input and output while describing my "subroutines," which I call Procedures. I don't need explicit input and output statements




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because "data" is provided in the form of arguments in procedure calls and because the value produced by a procedure called at the top level is automatically output by my interpreter.

I have taken a good look at your basic structure—Blah! At my top level, your main program, I have no need for variable declaration, assignments, loops, tests, etc. This is so because usually the first environment where such things are meaningful is the environment established by a procedure called from my top level.

To show you how I "call" a procedure, I must first say that nearly all of my commands are procedure-related. And all of my procedures return a value—thus, they are function procedures.

First I define a procedure, then I call it—just the opposite of your goofy subroutines. To define a procedure, I merely say:

LISP PROCEDURE Name(parameter list)
*Body*

where the body is much like the body of your subroutines. It is simply instructions to perform the task of the procedure. Some of the instructions can even be Procedures themselves.

As far as calling goes, I don't even have to say Call. All I have to do is write the name of the procedure along with its parameter list, for in essence my procedures are functions.

Name(parameter list)

This is all that is needed. The parameters are usually values. But I can pass arguments in the unevaluated form—Name Parameters. And my procedures can call themselves: this is called recursion, the all-important function that you can't even handle. You're nothing but an old man that's constantly being updated. They'll soon phase you out. No recursion—ha ha!)))

PRINT*,'OK, so I am old, but you ain't no spring chicken yourself. I have been doing a bit of research while you were babbling. We were both invented in the late '50s. So don't talk to me about old.

Oh, and there's one little thing you left out—how about Global Variables? You don't even have such a thing. Why, when I call a subroutine, I can have a COMMON statement in both the calling and the called routines, in which there are variables which are global to the called routine. They can be changed if need be by the called routine, or they can just be used in evaluations. These changes, if any, affect the values in the calling routine. Why, I can even name my common statements, like this:

COMMON / Name / variables

This way, different subroutines can have different globals with their calling routines. Can you top that????'

(CONS('(I sure can . . .)))

Suddenly the lights came on. The humans were back. Oh well, their talk would have to wait. Maybe this place wouldn't be so bad after all. ■

 

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# Logo for Personal Computers

Harold Nelson, Technical Editor

The imminent release of not one but *two* versions of the Logo language for personal computers may be one of the most exciting software developments of the year.

The Logo programming language was developed at the Artificial Intelligence Laboratory at MIT (Massachusetts Institute of Technology). According to the Logo Project's originator and driving force, MIT Professor Seymour Papert, "Logo is the name of a philosophy of education in a growing family of computer languages...."

In the same passage, Professor Papert is quick to point out that Logo is not merely a children's language, although since its development over twelve years ago it has always been intended to facilitate discovery learning by young children. In fact, it represents a kind of "Copernican revolution." Rather than the child being programmed by the computer (as with computer-aided instruction), the child learns by *teaching* the computer—and has a good deal of fun in the process. In the past, this has been the overriding purpose of the Logo Project. However, Professor Papert states: "An example of a powerful use of list structure is the representation of Logo procedures themselves as lists of lists so that Logo procedures can construct, modify, and run other Logo procedures." (*Mindstorms: Children, Computers and Powerful Ideas.* New York: Basic Books Inc, 1980, page 217.)

Apple Logo and TI Logo are the first versions of this language that are intended for use with personal computers. TI Logo was developed for the Texas Instruments 99/4 computer, while Apple Logo runs on the Apple II or Apple II Plus computer. Each is a descendant of earlier implementations written in LISP and Pascal for larger computers, and this heritage is evident in both versions of the language.

## TI Logo

The first "draft" of Logo for the TI 99/4 was prepared by the Logo Project at MIT. Texas Instruments modified this draft according to its priorities and has done some impressive code compression in order to increase available memory for the production version of TI Logo.

## Hardware for TI Logo

In addition to the TI 99/4 computer and a color monitor, memory expansion (from 16 K bytes up to 48 K bytes) and the language in EPROM (erasable programmable read-only memory) are the only requirements for running the prototype of TI Logo. In the prototype, both memory expansion and the language are contained in an actual black box (see photo 1, inset).

TI Logo has two production versions. The currently available version requires a disk controller, a 5-inch floppy-disk drive, a 32 K-byte memory expansion unit, and a TI Logo command module or ROM (read-only memory) cartridge. The second version, scheduled for release later this year, will require only the memory expansion unit and the command module (see photo 1).

## Features

TI Logo can perform arithmetic operations on integers from −32,768 thru 32,767, and can generate random integers from 0 thru 9, perform basic logical operations, and evaluate logical relationships. It can also assign numerical values to words (values to variables), assign names to numbers (so that something can be called by name instead of number), and it has functions for structuring and modifying lists. In addition, there is a fine program editor for writing and modifying procedures (Logo programs).

Other Logo features in Texas In-

**Photo 1:** *The TI Logo prototype (inset), including memory expansion, is contained in the black box under the monitor and behind the TI 99/4 computer. The final production version of TI Logo, which should be available later this year, will consist of a 32 K-byte memory expansion unit and a solid-state command module. (Photo courtesy of Texas Instruments.)*

struments' version include powerful yet easy-to-use graphics capabilities that employ a *turtle* for drawing and thirty *sprites* for creating dynamic displays.

### The Turtle

One of the best-known features of Logo is turtle graphics, or the line-drawing turtle—a small triangle on the video display (see photos 2 and 3). A variety of simple instructions move the turtle, tell it to face a certain direction, move it a given distance, and instruct it to draw, not draw, or erase a line.

Early MIT versions of Logo actually controlled a floor robot that resembled a turtle. This floor turtle had a pen that could be raised or lowered for tracing the path that the turtle was instructed to follow. Originally, the state of the art made use of a mechanical robot easier than computer graphics When young children were involved, the floor turtle also seemed to facilitate the transition to using the screen turtle. (The significance of turtle graphics has been recognized outside MIT for some time. For example, a subset of Logo, called Turtletalk, has been included in the Smalltalk language designed by Alan Kay for Xerox. Turtlegraphics is also a program in the library of the Apple version of Pascal.)

TI Logo has a screen turtle that can be controlled by simple primitive instructions (see text box on turtle primitives). These *primitives* can be used for immediate turtle instructions or to create *procedures* (sequential lists of instructions) which define new instructions.

An important feature of TI Logo is that while all primitives can be spelled out in full, many can be abbreviated to two-letter instructions (eg: CS can be used anywhere in place of CLEARSCREEN). Such abbreviations can make Logo more accessible to such nontypists as the very young or the handicapped.

### Sprites

The inclusion of thirty sprites and

**Photo 2:** *The turtle, shown at the top of the rightmost circle, has just completed a series of slightly displaced circles in order to produce this coil, or slinky-type, figure.*

**Photo 3:** *This equilateral triangle is produced by lifting the turtle's pen, moving the turtle seventy steps forward (toward the top of the display), and then lowering the pen. At this point the turtle stops and waits for further instructions. It is instructed to turn 150° to the right and move forward seventy-five steps—this produces the right leg of the triangle. The turtle waits again. It is told to repeat the following sequence twice: turn right 120° and go forward seventy-five steps. This causes the turtle to draw the base and left leg of the triangle. The turtle is then told to raise its pen, return home (to the center of the drawing pad), and put its pen down. Since these instructions are not written in a procedure, it is necessary to reenter the entire sequence each time the triangle is to be reproduced.*

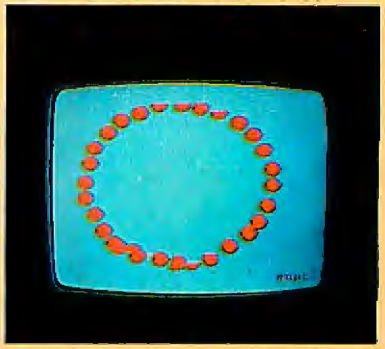


**Photo 4:** *In this demonstration procedure provided by Texas Instruments, all thirty sprites have been told to carry the ball shape and move away from the center (home) position, each in a different direction.*

dynamic sprite graphics is unique to TI Logo. As shown in photos 4 and 5a, sprites are TI Logo "beings" (software constructs) that assume various shapes and colors and move in a number of directions at different speeds. (See also listing 1.) Of themselves, sprites possess none of these "physical" characteristics—these must be given to them, once again, by use of simple primitives (see text box on sprite primitives).

Sprites can assume (carry) any one of twenty-eight possible shapes. The first six shapes (turtle, truck, plane, rocket, ball, and box) are predefined in TI Logo (see photo 6). The remaining twenty-two shapes must be user-defined.

A new shape can be created, or an existing one modified (you can change the six predefined shapes), by calling a 16 by 16 square MAKESHAPE grid (see photo 5b) and blacking out the desired shape. Each square of the grid represents one pixel (picture element) on the video display. The shape is formed (blacked out) by moving the cursor from square to square within the grid. Once a shape has been defined, any or all of the sprites can carry that shape.

(Displaying sprites seems to be a major capability of Texas Instruments' TMS9918A Video Display Processor. TI has released the TMS9918A, and the unit is beginning to appear in products from independent manufacturers. See "Video Display Processor Simulates Three Dimensions," by Karl Guttag and John Hayn, *Electronics*, November 20, 1980, page 123.)

## Characters

TI Logo also allows you to define (or redefine) alphanumeric characters and static designs by using any of the 256 8 by 8 square grids, called *tiles*. Letters, numbers, and other keyboard characters are predefined tiles, but they can be changed. If the predefined keyboard characters are modified (eg: made lowercase), the modified character appears when the appropriate key is typed.

New characters or designs can be defined and placed anywhere on the display screen (see photo 5c). While tiles can be located anywhere on the screen, they cannot move about as can shapes that are carried by sprites.

You can assign colors to tiles and use them in either the turtle or sprite modes to form titles, explanations, or parts of "pictures."

## Procedures

Procedures can be considered as either Logo programs or definitions of words that, once defined, can be used like primitives. Procedures are lists of instructions made of primitives and/or the names of previously defined procedures (see photos 7a and 7b, and listings 1, 2, and 3). Resident or defined shapes, colors, and movements can be assigned to sprites in procedures. The turtle can be instructed to draw figures by simply entering the name of a procedure.

It is often easier to define procedures, whether they contain instructions for the turtle, the sprites, or nongraphic operations, rather than enter the individual instructions needed to carry out such tasks. One reason is that several sophisticated programming techniques become quite simple in Logo. It's possible to *nest* level upon level of procedures by having one procedure call another which, in turn, can call another, and so on. A nested procedure is called by entering its name as an instruction in the procedure being written. *Iteration* is accomplished by merely having the procedure repeat a list of instructions a certain number of times. *Recursion*

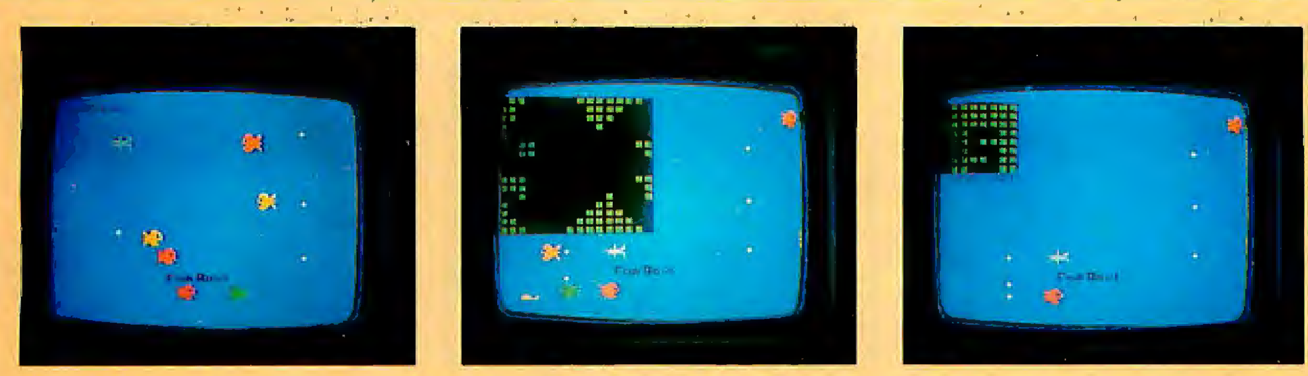


**Photo 5:** *The shapes and characters used in the FISHBOWL (photo 5a) were specifically defined (see listing 1 for the procedures). Shapes are defined by blacking out the desired shape on a 16 by 16 square grid (photo 5b). Characters are similarly defined on an 8 by 8 grid (photo 5c).*

is a simple matter of using the name of the procedure being defined as an instruction in that procedure—the procedure then calls itself from within itself.

It is also possible to construct a procedure so that it modifies itself. This can be done by having the procedure change the values of local variables and/or by having it define new, or modify already-nested procedures. This type of recursion causes the procedure to produce a different effect at each recursive level—the procedure performs its task, changes itself, performs its modified task, etc. Listing 2 demonstrates how these powerful concepts and techniques become virtual child's play with Logo.

In addition to the ease of writing procedures and all that can be learned in the process, there is another advantage to working with procedures rather than immediate instructions. After entering all of the individual instructions for the turtle or sprites, it would then be necessary to enter the entire sequence each time that activity was to be performed. If the instructions are included in a procedure, it's simply a matter of entering the procedure's name to have the activity performed. In addition, procedures, along with user-defined shapes and characters, can be saved for future recall. In the TI Logo prototype this is done on cassette. In the production versions it will be possible to do this on disk—a preferable method with regard to both speed and reliability. The production versions of TI Logo have hard-copy capability via a thermal printer. In some settings this can be extremely useful.

## The Editor

TI Logo has a full-screen, real-time edit mode that is extremely helpful for writing, modifying, and debugging procedures. While in the edit mode, the cursor can be moved anywhere in the displayed text to

**Listing 1:** *The FISHBOWL procedure turns the video display into a simulated aquarium (see photo 5a) with fish swimming in various directions and bubbles rising to the surface. FISHBOWL first calls TITLE, which places the tiles (see photo 5c) containing the specially designed letters of "Fish Bowl" at the center bottom of the display. The FISHBOWL procedure then tells the background (BG) to set its color (SC) to dark blue (4), and calls the procedures FISHRIGHT, FISHLEFT, BUBBLES, and SHARK. These four procedures assign shapes, colors, and motion to various sprites. For example, FISHLEFT tells three sprites (4, 5, and 6) to carry the shape (7) of a fish swimming to the left (see photo 5b), and sets different colors, headings (SH), and speeds (SS) for each sprite. In BUBBLES, the SETX primitive is used to horizontally fix the two columns of bubbles. The numbers input are the x coordinates of the desired columns.*

```
TO FISHBOWL
TITLE
TELL BG SC 4
FISHRIGHT
FISHLEFT
BUBBLES
SHARK
END

TO TITLE
CS
PUTTILE 12 20 100
PUTTILE 13 20 101
PUTTILE 14 20 102
PUTTILE 15 20 103
PUTTILE 16 20 104
PUTTILE 17 20 105
END

TO FISHRIGHT
TELL [1 2 3] CARRY 6
TELL 1 SC :RED SH 95 SS 20
TELL 2 SC 8 SH 75 SS 18
TELL 3 SC :YELLOW SH 105 SS 16
END

TO FISHLEFT
TELL [4 5 6] CARRY 7
TELL 4 SC :ORANGE SH 273 SS 19
TELL 5 SC :GREEN SH 265 SS 21
TELL 6 SC :LEMON SH 279 SS 17
END

TO BUBBLES
TELL [7 8 9] CARRY 8
EACH [SC :WHITE SETX -50]
EACH [SH 0 SS 3*YN]
TELL [10 11 12 13] CARRY 8
EACH [SC :WHITE SETX 70]
EACH [SH 0 SS 2*YN]
END

TO SHARK
TELL 14 CARRY 10
SC :GRAY SH 271 SS 40
END
```

**Photo 6:** *In addition to these six predefined shapes in TI Logo, the user can define as many as twenty-two additional shapes. Each of these can be carried by any or all of the sprites.*

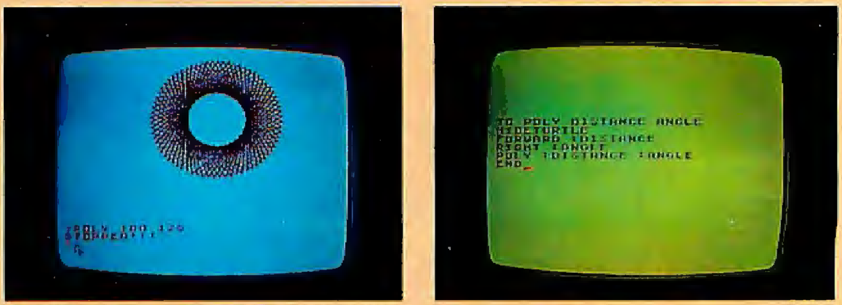



**Photo 7:** *The pattern in photo 7a is produced by stopping the procedure, shown in the edit mode in photo 7b.*

**Turtle Primitives**

*The basic turtle primitives are virtually identical in TI and Apple Logo. Differences are noted in parentheses, as are acceptable abbreviations. All primitives can be fully spelled out and most can be entered as two-letter abbreviations.*

*The turtle mode is entered by the instruction TELL TURTLE (DRAW in Apple Logo). This places the triangular-shaped turtle at the center of the "drawing pad." In TI Logo this position is the origin of a coordinate system whose horizontal (x) axis goes from −128 to 128, whose vertical (y) axis ranges from −96 to 96.*

*There are four text lines under the pad for entering instructions and receiving messages. The Apple version is almost the same in the split-screen turtle mode (actually the horizontal axis goes from −140 to 138). This is normal turtle mode. Apple Logo, however, also offers a full-screen turtle mode that allows the turtle to draw on the entire pad but eliminates the text lines (see photos 9 and 10a).*

*Both versions employ the following instructions for moving the turtle:*

| | |
|---|---|
| *FORWARD (FD)* number<br>*BACK (BK)* number | *The* number *represents the number of turtle steps that the turtle is to move.* |
| *RIGHT (RT)* angle<br>*LEFT (LT)* angle | *The* angle *represents the angle, in degrees, that the turtle is to turn.* |

*It is possible to move the turtle anywhere on the drawing pad and trace virtually any shape with these instructions.*

*More interesting figures can be obtained by having the turtle draw only part of the time. The following commands, in both versions, control the turtle's pen:*

*PENDOWN (PD): Causes the pen to leave a trace of the turtle's path (the pen is down when the turtle mode is entered).*

*PENUP (PU): Allows the turtle to move about without leaving a trace.*

*PENERASE: Causes the turtle to erase a line it has drawn if the original path is retraced.*

*PENREVERSE: Instructs the turtle to draw lines where there are none and erase lines where they are present.*

*HOME sends the turtle back to the center of the drawing pad. CLEARSCREEN (CS) in TI Logo erases all drawing and text and returns the turtle to the home position. DRAW does almost the same thing in Apple Logo but it does not erase text.*

*In order to exit the turtle mode, enter the instruction NOTURTLE (NODRAW in Apple Logo). This will return you to the Logo monitor.*

change, delete, or insert characters, words, or entire lines. It's also possible to move lines up or down and merge them with other lines.

The editor in the production version of TI Logo is automatically activated for writing procedures. (The prototype does not have this feature.) Several features can be written in the edit mode and all of them entered into memory by exiting the edit mode. One advantage to writing procedures in the edit mode is the ease with which you can change and correct the procedure as it is being written.

You can also use the editor's capabilities as a basic text editor. This is an important feature, since learning to write with a text editor relieves the tedium of making pencil-and-paper corrections and revisions.

## Limiting Features

The video hardware of the TI 99/4 does not allow more than four sprites carrying shapes to be displayed on a horizontal row at one time (see photos 8a and 8b). If a fifth sprite is placed on the same row, the first one disappears, and so on. The process is reversible, so as soon as the newcomers move on, the original residents begin to reappear. Once you are aware of this problem, you can work around it.

An annoying occurrence in TI Logo is that the turtle sometimes runs out

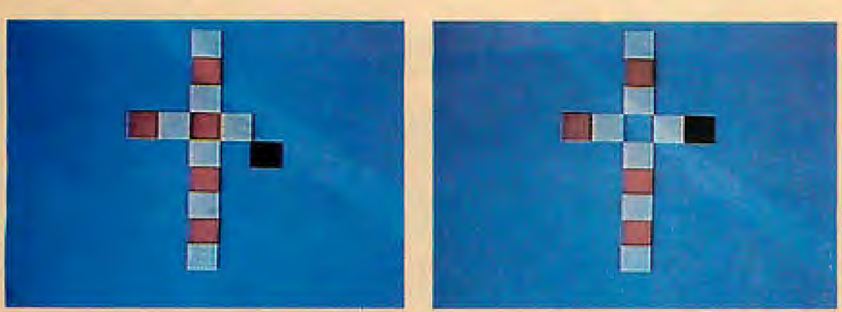


**Photo 8:** *These photos illustrate a slight problem caused by the TI 99/4's video hardware when running Logo. As long as there are no more than four shapes in a horizontal row, there is no difficulty (photo 8a), but as soon as a fifth shape is moved onto a row (the black square in photo 8b), the first shape in that row disappears (the red square that was at the center in photo 8a is gone in photo 8b). The first shape reappears when the fifth shape is moved to another row, so there can never be more than four visible shapes in a row at one time.*

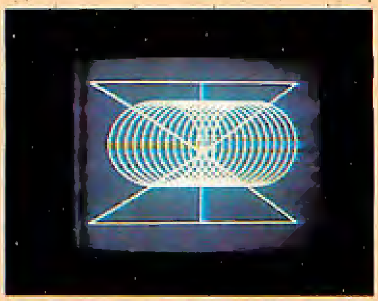


**Photo 9:** *Apple Logo's turtle graphics can produce interesting figures from simple procedures. Straight lines can be drawn by setting the x and y coordinates. The turtle will draw a straight line from its present point to the point you have set. This photo and photo 10a show the full-screen graphics feature of Apple Logo.*

of lines. At this point, the turtle stops in its tracks, the procedure halts, and the following message is printed:

NO MORE LINES

Apparently, workspace allocations have to accommodate both sprite and turtle graphics modes. Some tradeoff was necessary, and this message appears to inform you that the workspace (memory) allocated for graphics in the turtle mode has been used up.

## Apple Logo

At present, the 5-inch disk version of Logo for the Apple II and Apple II Plus computers is still under development at MIT. (For convenience, we refer to this version as "Apple Logo,"as does the Logo Project staff. To our knowledge there is no connection with Apple Computer Inc.) Representatives of MIT and the National Science Foundation, which funded portions of the Logo Project, are involved in discussions concerning distribution rights for Apple Logo. This issue should be resolved soon, and Apple Logo will, it is hoped, be available this summer.

This review is based on a preproduction prototype, and in fact, an updated prototype that will include color is being completed. This feature will allow you to choose the color of the display background and the lines drawn by the turtle.

Apple Logo has three modes: a nongraphics mode, a graphics (turtle) mode, and an edit mode—but no sprites. However, the Apple version does have much more power in the other modes than TI Logo.

## Hardware for Apple Logo

An Apple II or Apple II Plus computer with 48 K bytes of memory, one disk drive, and an Apple Language Card are all that is needed to run the Apple version of Logo.

## Nongraphic Features

Apple Logo can handle *floating-point* as well as integer arithmetic. It also accepts and outputs numbers (when large or small enough), in exponential notation. For example, 2.7E3 can be used in place of $2.7 \times 10^3 = 2700$, and $-4.3N4$ can

**Sprite Primitives**

*Some of the primitives used to instruct the sprites (available only in TI Logo) are as follows:*

*TELL* sprite number(s): *Gets the attention of the sprite(s) that you wish to address. You can address one or any combination of sprites from 0 thru 29. To talk to all thirty sprites, the phrase :ALL (read "dots ALL" in Logo jargon) is used in place of a number.*
*CARRY* shape: *Tells the sprite(s) which shape to assume. Shapes can be identified either by name or number.*
*SETCOLOR (SC)* color: *Identifies, either by name or number, the color of the shape being carried.*
*SETHEADING (SH)* number: *Gives the sprite(s) the direction to travel. The* number *entered corresponds to a compass heading.*
*SETSPEED (SS)* number: *Tells the sprite(s) how fast to move.*

*The displays produced with these five instructions can be amazing, especially when multiple instructions are combined in procedures.*

*A few other primitives can also be used in interesting ways. HOME causes all active sprites to go to the center of the display screen but, if they have headings and speed, only momentarily. FREEZE stops all active sprites and holds them in place. They will not resume movement until THAW is entered.*

*Sprites will also respond to the FORWARD (FD), BACK (BK), RIGHT (RT), and LEFT (LT) primitives as used in the turtle mode.*

replace $-4.3\times10^{-4}=-.00043$.

Apple Logo can also return the sine and cosine of an input in degrees. This means, in effect, that it has full trigonometric capability. The other trigonometric functions can be easily defined in terms of the sine and cosine. Apple Logo can return a random integer in the range of 0 to $n-1$, where $n$ is an integer input by the user. There is, in addition, a randomizing feature to ensure that each sequence of random numbers will be unique.

Apple Logo has features for evaluating logical relationships, assigning values to variables, words to numbers, and working with list structures. The Apple version of Logo also has provisions for going from Logo to the Apple monitor, calling machine-language subroutines, and determining the current amount of free workspace in Logo. (Texas Instruments omitted similar features in order to save memory space.) And it's worth pointing out that the primitives that instruct the turtle are similar in both the Apple and the TI versions of Logo.

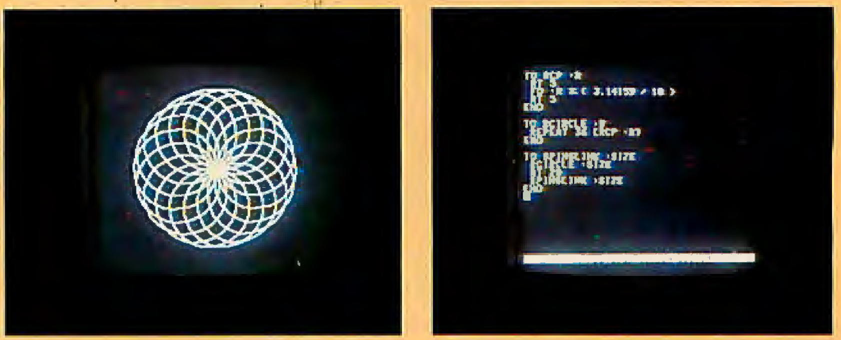


**Photo 10:** *The SPINSLINK figure (photo 10a) is the result of the simple five-line SPINSLINK procedure (shown in the edit mode in photo 10b) that calls the three-line RCIRCLE procedure which, in turn, calls the RCP procedure. Each procedure is nested in the one listed below it. Note the use of floating-point arithmetic in RCP, the use of iteration in RCIRCLE, and the use of recursion in SPINSLINK (it calls itself). (The procedures are taken from the draft of the Apple Logo manual prepared by Harold Abelson.)*

### Turtle Procedures

The draft of the Apple Logo manual, by MIT Professor Harold Abelson, contains over twenty-five pages of turtle geometry projects of rapidly increasing complexity (see photos 9, 10a, and 10b). This manual also contains some interesting discussions of recursion—in fact, the author suggests a level of recursion that can be used to have the turtle draw a "binary tree" (see listing 3).

The additional mathematical capabilities of Apple Logo, as compared with the TI version, can be used to increase the power of turtle procedures, even though these mathematical features are not graphics features *per se*. That is, the floating-point, trigonometric, and randomizing features can be employed to give straightforward instructions to the turtle that will result in figures otherwise difficult, if not impossible, to produce.

### The Editor

The Apple Logo editor functions in essentially the same manner as the production-version TI Logo editor. As soon as you begin to write a procedure, you're automatically in the edit mode. Therefore, all of the editor's features are available whenever procedures are being written. It is also possible, as with TI Logo, to employ these features as a text editor.

There is, however, one confusing sidelight. The command to abort a procedure (rub out what has just been written and exit the edit mode) in Apple Logo is very nearly the same command used in TI Logo to enter the procedure into memory and exit the editor. This could cause considerable confusion if you work with both versions side by side.

### An Annoying Feature

If the turtle tries to draw beyond the drawing pad in the turtle mode of Apple Logo, everything stops and you are told that the turtle just went OUT OF BOUNDS. If you are in the process of modifying a procedure to fit onto the pad, this is quite a nuisance. In the TI version, if the turtle leaves his pad he simply *wraps* around the display, and the procedure continues to execute. This approach seems preferable, because you can visualize the finished product. (In the large-machine versions of Logo you can choose between wrapping and not wrapping—an ideal arrangement.)

### Conclusions

Both personal computer versions of Logo are exciting, valuable products. Seymour Papert has said on more than one occasion that Logo provides easy access to very powerful ideas, but the question remained—would this be true of Logo designed for small personal computers? The answer, relative to both versions, is clearly affirmative, whether the user is a young child, a physically handicapped individual, or an adult who discovers computing for the first time.

It's difficult to find anything to criticize in either product. Given their common background of over ten years of development and testing in the Logo Project at MIT, such a situation is not hard to understand. Still, a few items in each version might have been handled differently.

One such example occurs when you attempt to use the Apple and TI Logo nongraphics instructions in the immediate mode. These functions do not simply return a value. For example, in TI Logo:

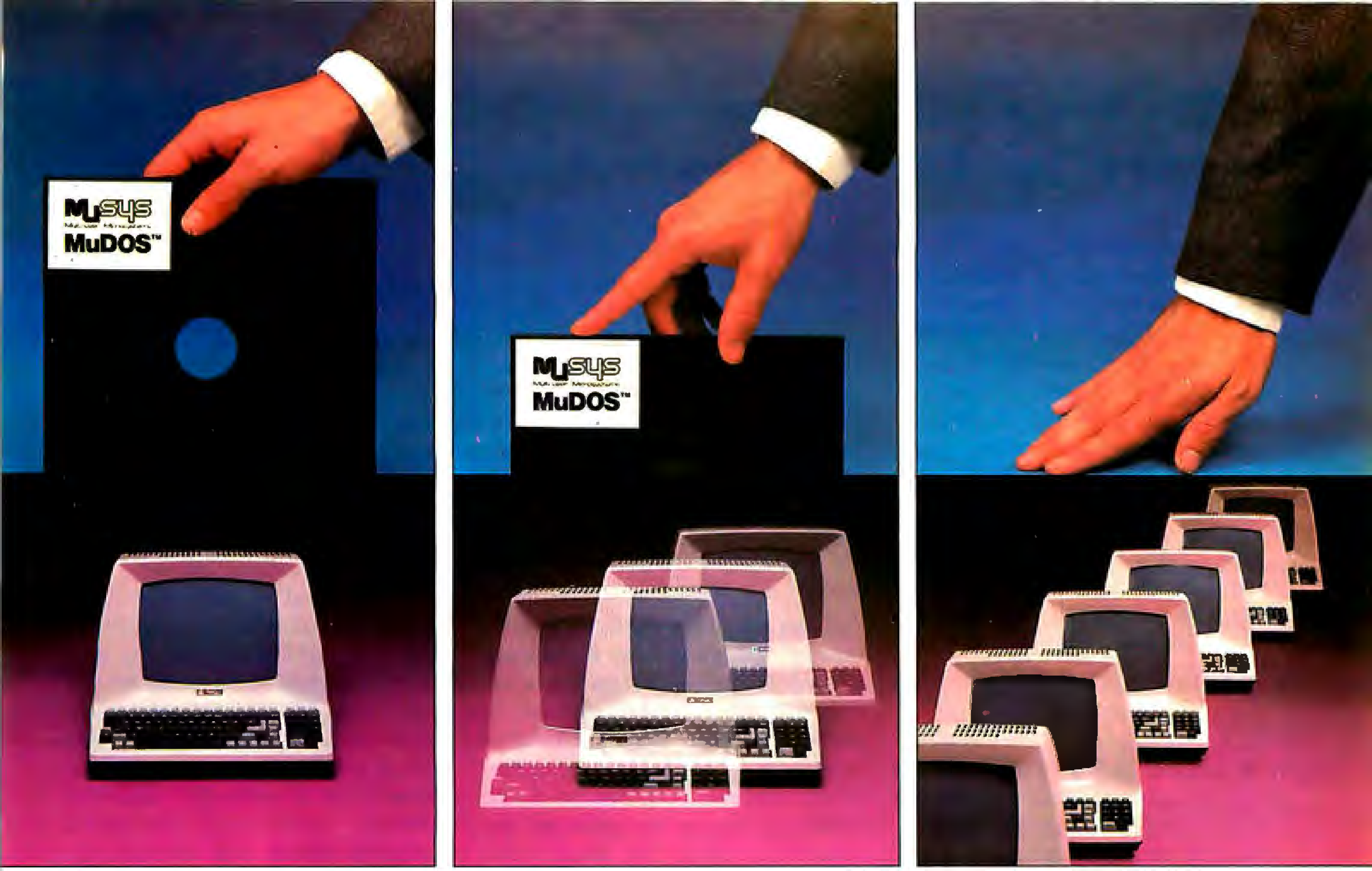
3+4

returns:

TELL ME WHAT TO DO WITH 7

It will not return just the value 7. Similarly, in Apple Logo:

SIN 30

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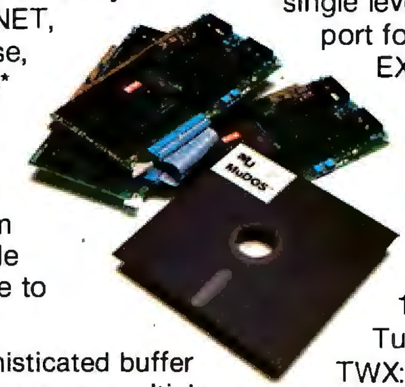


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returns:

YOU DON'T SAY WHAT TO DO WITH .5

The reason for this, apparently, is that these functions are intended for use in instructions in procedures where the value returned will be used for a variable. It would be useful, however, if these functions could be used immediately, and if they returned only the appropriate values: they could then be used more easily for mathematical or logical evaluations, either in planning procedures or for other purposes.

If you type PRINT in front of the statement to be evaluated, only the value is returned. For example:

PRINT 3+4

will return only the value 7. Still, it would be useful to obtain this kind of return without typing PRINT, especially when you are not "talking" to sprites or the turtle.

Another inconvenience occurs in TI Logo when you have active sprites on the screen and want to go to the turtle mode. There is no easy way to get the active sprites off the video display. While you can go from the turtle mode to the sprite mode and remove the turtle with everything it has drawn (by entering NOTURTLE), the reverse is not possible. You can leave the sprites there and work with the turtle, but the moving sprites can be distracting. You can also enter the necessary instructions to remove the colors, shapes, speeds, and headings of the sprites, but this can be time consuming. A third alternative is to leave Logo and then restart it. This is often the quickest solution. In any case, it would be helpful to have a single command that would remove all active sprites from the video screen.

There may be features in the production versions of Logo that are not present in the prototypes—in addition to the possibility of color in Apple Logo, there is discussion of including music capability in both personal computer versions of Logo. Texas Instruments has mentioned this possibility, while the Apple Logo documentation already contains some explanation of how to use the music features, even though they are not present in the prototype.

The prototypes of Apple and TI Logo are currently being used in preschool through high school classrooms (see *onComputing*, Summer 1981, for details) on a "pilot project" basis, and evidence of its value to students is growing rapidly. This evidence deals not only with amount of material learned, but also with a heightened self-awareness and self-esteem derived from the student controlling a powerful machine and thus his or her own learning. It seems inevitable that Logo will become a forceful learning tool, both in the school and in the home.

Having acquired at least a passing familiarity with these two Logo implementations, I see them as complementary, rather than competitive. Anyone who is seriously interested in education and learning on any level should examine both versions. TI Logo easily attracts user interest (the sprites are a definite attention-getter) and it encourages fundamental exploration of a variety of significant concepts. Apple Logo provides a somewhat deeper exploration of the same concepts. The development of Logo for other popular personal computers such as the Radio Shack TRS-80 and Atari will probably not be far behind. ■

**Listing 2:** *The COILGROW procedure has CIRCLEMOVE and CIRCLE nested within it. CIRCLE, in turn, is nested in CIRCLEMOVE. Both COILGROW and CIRCLE employ iteration by repeating the instructions in the brackets. COILGROW is a recursive procedure—it calls itself. COILGROW produces a coil consisting of connected circles of increasing diameter. The procedure is run by entering its name and values for the variables NUMBER, DISTANCE, and ANGLE. (The 360/(:ANGLE) in CIRCLE causes an interesting "bending" of the coil, since it returns an integer that may be slightly more or less than the number of iterations required to produce an exact circle. HIDETURTLE, in the CIRCLE procedure, speeds up drawing since the turtle itself need not be redrawn at each "step." SHOWTURTLE causes the turtle to reappear.)*

```
TO COILGROW :NUMBER :DISTANCE :ANGLE
REPEAT :NUMBER [CIRCLEMOVE :DISTANCE :ANGLE]
CIRCLE :DISTANCE :ANGLE
MAKE "ANGLE :ANGLE-3
COILGROW :NUMBER :DISTANCE :ANGLE
END

TO CIRCLEMOVE :DISTANCE :ANGLE
CIRCLE :DISTANCE :ANGLE
FORWARD :DISTANCE
END

TO CIRCLE :DISTANCE :ANGLE
HIDETURTLE
REPEAT 360/(: ANGLE) [FORWARD :DISTANCE RIGHT :ANGLE]
SHOWTURTLE
END
```

**For More Information**

*To add your name to the Apple Logo mailing list, write: Apple Logo, The Logo Project, 545 Technology Square, Cambridge MA 02139. For $1 they will also send a bibliography of papers produced in conjunction with the project.*

*For information on TI Logo, write: TI Logo, Texas Instruments Inc, Corporate Engineering Ctr, 12860 Hillcrest Wing E M/S 376, Dallas TX 75230.*

**Listing 3:** *MYSTERY requires that an integer be input for the variable NUMBER. It then prints the integers 1 thru NUMBER in an unexpected order: the STOP in the recursive procedure produces the MYSTERY effect; when the technique is used in a V-drawing procedure, the turtle can draw a "binary tree."*

```
TO MYSTERY :NUMBER
IF :NUMBER=0 STOP
MYSTERY : NUMBER-1
PRINT :NUMBER
END
```

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# Build a Low-Cost Speech-Synthesizer Interface

Steve Ciarcia
POB 582
Glastonbury CT 06033

Recently I was at a local electronics store looking at DVMs (digital voltohmmeters). I didn't want to buy one, but, like looking at new cars, I wanted to reestablish the cost-effectiveness of what I already owned.

Most of the meters in the showcase were 3½-digit units with five or more ranges and many ancillary functions. The sales pitch for every one sounded alike.

While not trying to be cute, I stopped the clerk in midsentence and asked if he had any DVMs that "talked." He completely ignored the question. I had to interrupt him twice to get his attention, and even then, he thought I was being difficult.

Eventually, he said that he had no talking DVMs and never expected to see any. Even though I anticipated his answer, I was testing his response to the idea. Considering that we now have talking toys, talking hand-held DVMs shouldn't sound that strange. In fact, such use would be a relatively minor application of synthesized speech. Someday they will be very common.

While I wouldn't consider this salesman a total loss, there are some people who have to go to Missouri to believe the state exists. I trust, however, that you have an open mind to new technology.



## Cost-Effective Speech Synthesis

Advances in the production of high-density LSI (large-scale integrated) circuits and new techniques to synthesize speech have reduced the cost of voice-output systems dramatically. Attaching a speech synthesizer to your computer is now as reasonable financially as adding any other peripheral device.

The cost of a synthesizer is a function of the number of words the synthesizer can speak. Limited-vocabulary synthesizers, such as the TMS0280 unit in the Texas Instruments Speak & Spell toy or any others that have their vocabulary stored totally in ROM (read-only memory), are generally less expensive. Speech interfaces using phoneme synthesis, such as the Votrax SC-01, usually require the help of a computer program running on an external processor to generate extensive voice output. The added complexity makes this type of synthesizer more expensive. Of course, a phoneme synthesizer can have an unlimited vocabulary by using a text-to-speech program running on the external processor.

This article describes the construction of a cost-effective limited-vocabulary voice-synthesis speech-processor board called the Micromouth. It uses the new Digitalker DT1050 integrated circuit set from National Semiconductor, which has a stored vocab-

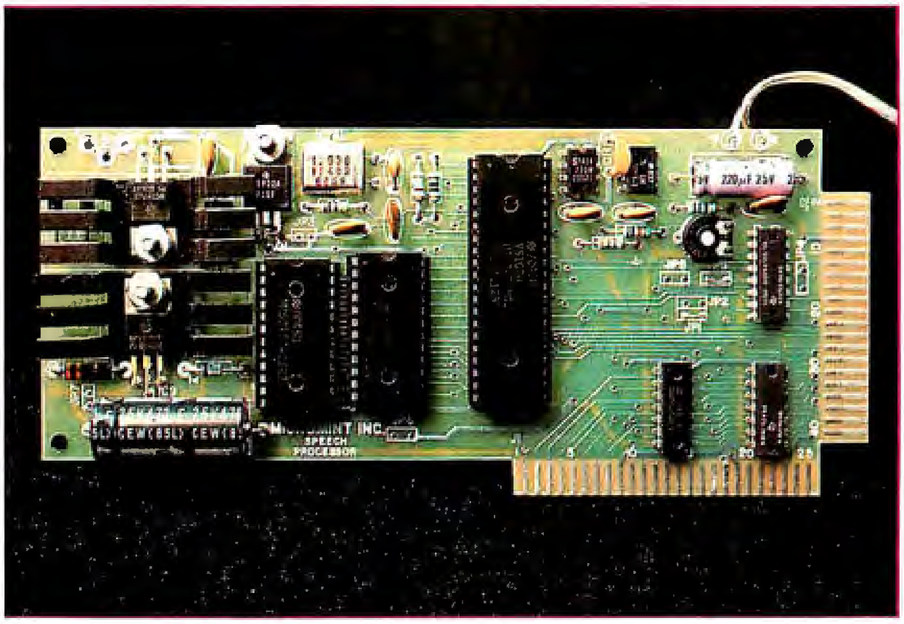

**Photo 1:** *Assembled Micromouth speech-processor board. The 40-pin integrated circuit is the MM54104 speech processor, and the two 24-pin packages are 64 K-bit ROMs, which contain 144 digitized expressions. The 40-pin edge connector on the right is plug-compatible with the Radio Shack TRS-80 Model I, and the 50-pin edge connector on the bottom is plug-compatible with the Apple II. The heat sinks shown in the photo are not generally required but were included on this particular unit for testing.*

Digitalker is a registered trademark of National Semiconductor Corporation.

ulary of 144 expressions. For about $120, you can build this board and add voice output to monitoring functions, computer games, and calculations. It can say "The time is 6:40 pm" and "Number 4 is set at 6.35 volts" just as easily as "Control error..." or "Danger...a star is on the left at 8.2 million meters." While a limited-vocabulary synthesizer may never have appealed to you before, I am sure the low price and simple system integration of this speech interface will spark your interest.

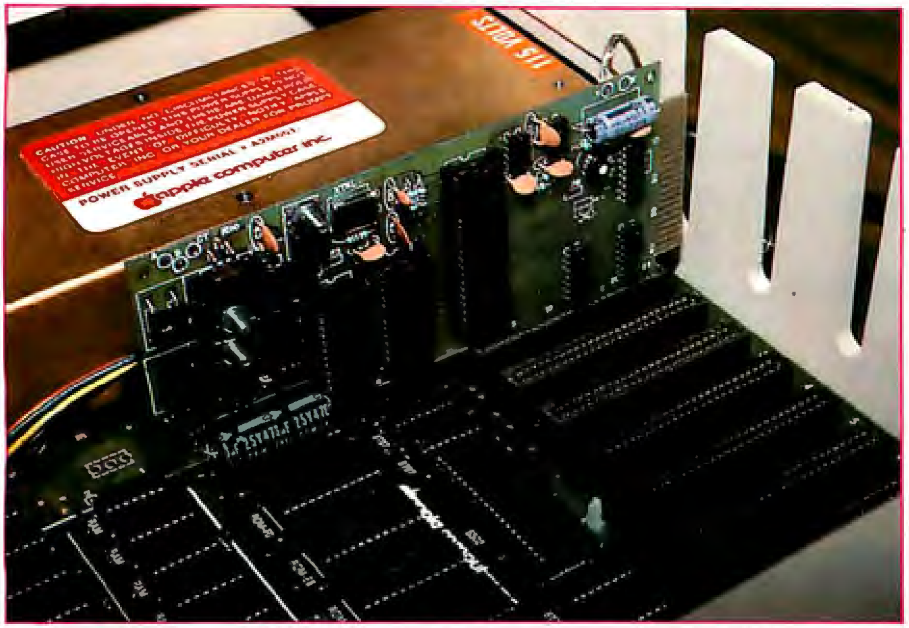

**Photo 2:** *Micromouth speech-processor board shown inserted in peripheral slot 1 of an Apple II computer. Execution of a simple BASIC statement can cause any of the stored vocabulary to be uttered. For example, to make it say "This is Digitalker," a POKE −16001,0 statement would be executed. While the rest of the vocabulary has a male voice, this particular expression has a distinctly female voice.*

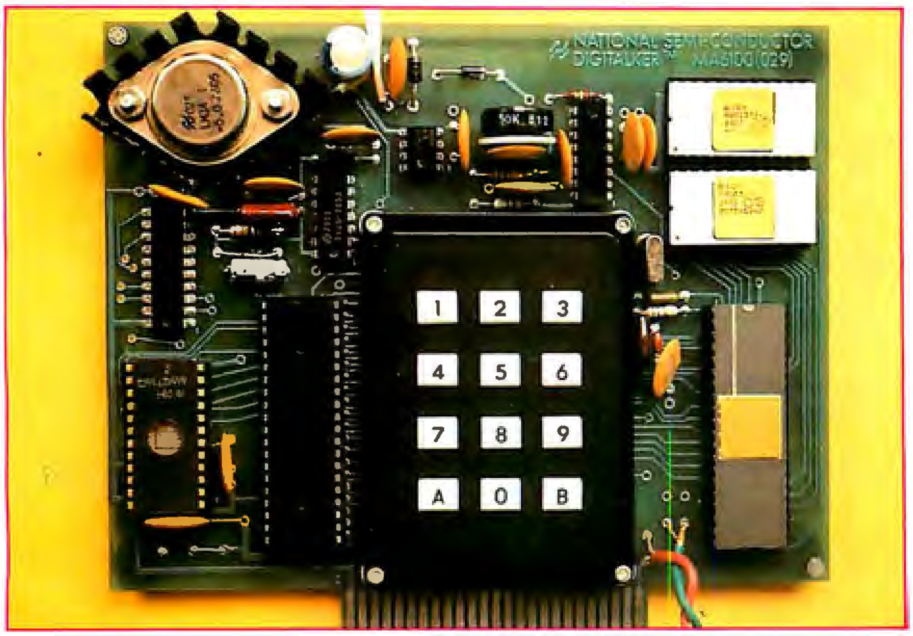


**Photo 3:** *National Semiconductor's DT1000 Speech-Synthesis Evaluation Board. Available from National Semiconductor distributors for $495, the DT1000 contains a microprocessor equipped with a program that allows a user to hear any single expression or a combination of expressions by entering the appropriate decimal code on the keyboard. While all the I/O lines are available on the Evaluation Board connector and it could be used as a general-purpose speech interface, it is more suitable as a sales tool and demonstration device.*

The Micromouth speech-processor board I am presenting is plug-compatible with the Apple II and Radio Shack TRS-80 Model I computers. (It can be used with the TRS-80 Model III with an adapter cable.) It is signal-compatible with other microcomputers, such as the Digital Group product line or the Heath H-8, and can be connected to any computer with an 8-bit parallel I/O (input/output) port, such as a printer port. It requires no external controlling software except a simple BASIC statement to say any expression in its vocabulary. For example, executing OUT 127,120 on the TRS-80 (or POKE −16001,120 on the Apple II) will cause the board to say "Please."

The design and features of the Micromouth speech-processor board are discussed in detail here. But, first, a little background on speech-synthesis techniques, in general, and then details of National Semiconductor's Digitalker system, in particular.

## Speech-Synthesis Techniques

Three techniques are presently used to synthesize the human voice: formant synthesis, linear-predictive coding, and waveform digitization. They differ primarily in the number of bits per second of data required to construct a word.

*Formant synthesis* is essentially a modeling of the natural resonances of the human vocal tract. The bands of resonant frequencies defined are called *formants.* In an electronic synthesizer, these frequencies are generated by excitation sources and are then passed through variable-parameter filters.

One form of the formant technique is called *phoneme synthesis.* In this, the spectral parameters are derived from basic sound units that make up words. A phoneme generator, in turn, reproduces these sounds. In such a circuit, each phoneme has been assigned a code, and the synthesizer module (or chip) utters the corresponding phoneme sound for each code it receives. Creation of continuous speech, therefore, is simply a matter of stringing the phonemes together.

In most cases, the electronic voice generated is quite intelligible, but it may have a mechanical quality about it. Continuous speech using phoneme synthesis can generally be generated with a data rate of less than 400 bps (bits per second). This technique is used by the Votrax Division of Federal Screw Works in the SC-01 Speech Synthesizer Chip and other products.

*Linear-predictive coding* is similar to formant synthesis. Both techniques are based in the frequency domain and use similar hardware to model the vocal tract. Rather than using a simple phoneme code, however, linear-predictive coding stores parameters for filter coefficients, gain, and excitation frequencies. The term "linear-predictive coding" refers to the programmed activities of the multistage lattice filters that produce the desired formants. Adequate-quality speech can generally be achieved with data rates of 1200 to 2400 bps. This synthesis technique is used by Texas Instruments in several products, including the Speak & Spell and the TI 99/4 Text to Speech Translator. It is also used by General Instrument Corporation in its Orator VSM2032 Voice-Synthesis Module.

**The Digitalker speech processor uses a comprehensive data-compression algorithm.**

The third method is *waveform digitization*. This very old technique produces speech by generating a waveform with the time-domain characteristics of voice, in contrast to the previously considered parameter-encoding methods, which represent speech in terms of frequency. The simplest form is uncompressed digital data recording, called PCM, for pulse-code modulation. (In the June 1978 BYTE, my article entitled "Talk to Me: Add a Voice to Your Computer for $35," page 142, discussed how to build a simple digitized speech interface.)

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In simple PCM recording, the analog speech waveform is sampled at a rate twice that of the frequency of the highest voice component and converted to digital format through an A/D (analog-to-digital) converter. Once stored, the digital signal can be played back through a D/A (digital-to-analog) converter and a low-pass filter. One major advantage of digitally encoded speech is its human-like quality. Since it is in essence a recorded voice, the reproduced speech retains the inflections and accents of the original voice. Thus, in addition to male and female voices, it is possible to have a speech synthesizer that reproduces regional or foreign accents. The clarity of the reproduction depends on the speech-compression method used.

Unfortunately, one problem in using PCM alone is that it requires very high data rates. Rates above 100 k bps are not unusual with this method. To reduce the data rate, it is necessary to compress the speech data to remove redundant information. One compression method is called *delta modulation*. As in PCM, the analog speech waveform is sampled, but this time only the *changes* in amplitude (delta values) between samples are stored. Since speech contains many redundant sounds and silences, these changes are much smaller than the absolute amplitude of the waveform, and fewer bits are required to store the smaller values. Delta modulation, therefore, reduces the amount of memory required to store a list of words.

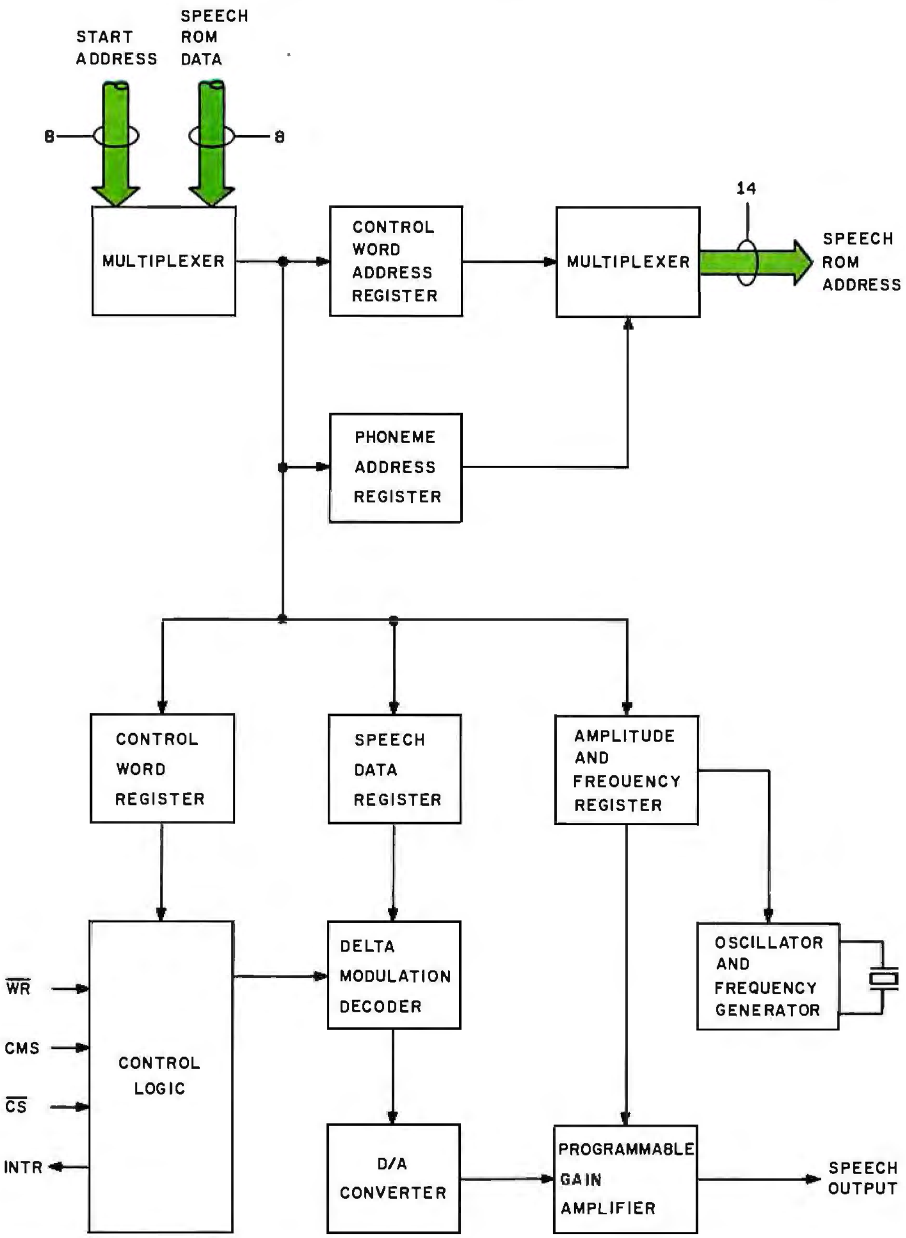



**Figure 1a:** *Block diagram of the National Semiconductor Digitalker MM54104 speech-processor chip. This figure and figure 2 were provided through the courtesy of National Semiconductor Corporation.*

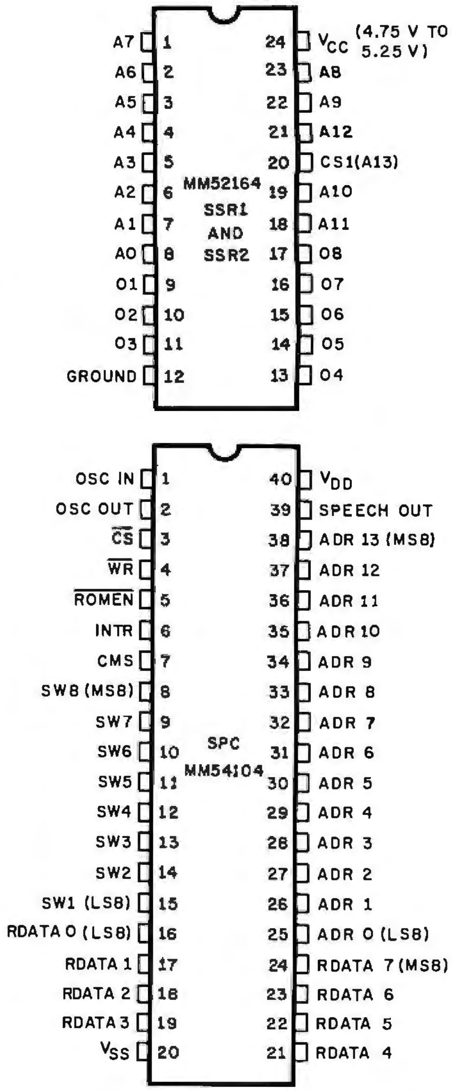



**Figure 1b:** *Pinout specifications of the DT1050 system, which comprises the MM54104 speech-processor chip and the associated MM52164 SSR1 and SSR2 ROMs (read-only memories). The ROMs are designed to be used in sets of two; the chip-select (CS1) signals are set up in complementary fashion.*

Ultimately, the total amount of memory required for continuous speech becomes a function of exotic compression algorithms. Data rates as low as 2400 bps have been achieved. The Digitalker speech-synthesis chip set uses data-compressed digitized speech.

## Digitalker Components

The Micromouth synthesized-speech-processor board is based upon the National Semiconductor Digitalker DT1050 speech-synthesizer chip set, which consists of a speech processor (SPC) and two 64 K-bit ROMs (read-only memories).

The speech processor uses PCM encoding with a comprehensive data-compression algorithm developed by Forest Mozer at the University of California, Berkeley. The primary compression method employed is delta modulation. As previously described, this concept recognizes that speech waveforms are generally smooth and continuous. Rather than storing the absolute amplitude of the voice signal, the differences between successive samples are stored instead. During speech reconstruction, successive amplitudes in the output waveform are obtained by adding these delta values to the previous values, allowing us to avoid using large numbers of bits to store large voltages.

The speech processor also uses phase-angle adjustment and half-

| Word | Decimal Address | Binary Address | Word | Decimal Address | Binary Address | Word | Decimal Address | Binary Address |
|---|---|---|---|---|---|---|---|---|
| This is Digitalker | 000 | 00000000 | P | 047 | 00101111 | it | 097 | 01100001 |
| one | 001 | 00000001 | Q | 048 | 00110000 | kilo | 098 | 01100010 |
| two | 002 | 00000010 | R | 049 | 00110001 | left | 099 | 01100011 |
| three | 003 | 00000011 | S | 050 | 00110010 | less | 100 | 01100100 |
| four | 004 | 00000100 | T | 051 | 00110011 | lesser | 101 | 01100101 |
| five | 005 | 00000101 | U | 052 | 00110100 | limit | 102 | 01100110 |
| six | 006 | 00000110 | V | 053 | 00110101 | low | 103 | 01100111 |
| seven | 007 | 00000111 | W | 054 | 00110110 | lower | 104 | 01101000 |
| eight | 008 | 00001000 | X | 055 | 00110111 | mark | 105 | 01101001 |
| nine | 009 | 00001001 | Y | 056 | 00111000 | meter | 106 | 01101010 |
| ten | 010 | 00001010 | Z | 057 | 00111001 | mile | 107 | 01101011 |
| eleven | 011 | 00001011 | again | 058 | 00111010 | milli | 108 | 01101100 |
| twelve | 012 | 00001100 | ampere | 059 | 00111011 | minus | 109 | 01101101 |
| thirteen | 013 | 00001101 | and | 060 | 00111100 | minute | 110 | 01101110 |
| fourteen | 014 | 00001110 | at | 061 | 00111101 | near | 111 | 01101111 |
| fifteen | 015 | 00001111 | cancel | 062 | 00111110 | number | 112 | 01110000 |
| sixteen | 016 | 00010000 | case | 063 | 00111111 | of | 113 | 01110001 |
| seventeen | 017 | 00010001 | cent | 064 | 01000000 | off | 114 | 01110010 |
| eighteen | 018 | 00010010 | 400 Hz tone | 065 | 01000001 | on | 115 | 01110011 |
| nineteen | 019 | 00010011 | 80 Hz tone | 066 | 01000010 | out | 116 | 01110100 |
| twenty | 020 | 00010100 | 20 ms silence | 067 | 01000011 | over | 117 | 01110101 |
| thirty | 021 | 00010101 | 40 ms silence | 068 | 01000100 | parenthesis | 118 | 01110110 |
| forty | 022 | 00010110 | 80 ms silence | 069 | 01000101 | percent | 119 | 01110111 |
| fifty | 023 | 00010111 | 160 ms silence | 070 | 01000110 | please | 120 | 01111000 |
| sixty | 024 | 00011000 | 320 ms silence | 071 | 01000111 | plus | 121 | 01111001 |
| seventy | 025 | 00011001 | centi | 072 | 01001000 | point | 122 | 01111010 |
| eighty | 026 | 00011010 | check | 073 | 01001001 | pound | 123 | 01111011 |
| ninety | 027 | 00011011 | comma | 074 | 01001010 | pulses | 124 | 01111100 |
| hundred | 028 | 00011100 | control | 075 | 01001011 | rate | 125 | 01111101 |
| thousand | 029 | 00011101 | danger | 076 | 01001100 | re | 126 | 01111110 |
| million | 030 | 00011110 | degree | 077 | 01001101 | ready | 127 | 01111111 |
| zero | 031 | 00011111 | dollar | 078 | 01001110 | right | 128 | 10000000 |
| A | 032 | 00100000 | down | 079 | 01001111 | ss | 129 | 10000001 |
| B | 033 | 00100001 | equal | 080 | 01010000 | second | 130 | 10000010 |
| C | 034 | 00100010 | error | 081 | 01010001 | set | 131 | 10000011 |
| D | 035 | 00100011 | feet | 082 | 01010010 | space | 132 | 10000100 |
| E | 036 | 00100100 | flow | 083 | 01010011 | speed | 133 | 10000101 |
| F | 037 | 00100101 | fuel | 084 | 01010100 | star | 134 | 10000110 |
| G | 038 | 00100110 | gallon | 085 | 01010101 | start | 135 | 10000111 |
| H | 039 | 00100111 | go | 086 | 01010110 | stop | 136 | 10001000 |
| I | 040 | 00101000 | gram | 087 | 01010111 | than | 137 | 10001001 |
| J | 041 | 00101001 | great | 088 | 01011000 | the | 138 | 10001010 |
| K | 042 | 00101010 | greater | 089 | 01011001 | time | 139 | 10001011 |
| L | 043 | 00101011 | have | 090 | 01011010 | try | 140 | 10001100 |
| M | 044 | 00101100 | high | 091 | 01011011 | up | 141 | 10001101 |
| N | 045 | 00101101 | higher | 092 | 01011100 | volt | 142 | 10001110 |
| O | 046 | 00101110 | hour | 093 | 01011101 | weight | 143 | 10001111 |
| | | | in | 094 | 01011110 | | | |
| | | | inches | 095 | 01011111 | | | |
| | | | is | 096 | 01100000 | | | |

**Table 1:** *The 144 spoken expressions in the vocabulary of the standard Digitalker system, with word-access codes in decimal and binary. The "ss" expression is a generalized hissing sound provided to make plurals out of other words in the list. If an address greater than 143 is sent to the speech processor, it "executes data" and nonsense sounds are generated.*

period zeroing compression techniques. Phase-angle adjustment is based on the concept that the intelligibility of speech is not affected by the phase angle of the sine-wave components of the Fourier-transformed waveforms. Therefore, these values can be adjusted to produce a waveform with mirror symmetry; only half the data need be stored.

In half-period zeroing, the low-amplitude portions of a signal are reproduced as silence. For the most part, only the center half of any pitch period needs to be stored since the center half contains most of the energy. The remainder of the waveform is relatively insignificant and can be discarded.

The 144-expression Digitalker vocabulary was initially recorded through a microphone, then differentiated and digitized. A computer program operated on the data to perform phase-angle adjustment, delta modulation, and half-period zeroing. The redundant pitch periods and phonemes were reduced to individual stored periods and a record of the number of times they are repeated (usually 3 to 8 times). The resulting data containing frequency, amplitude, and control information is stored in the two 64 K-bit speech ROMs.

**The Digitalker system introduces low-cost speech output into areas where the expense has not been previously justified.**

Figure 1a is a block diagram of the speech-processor chip. Each block of speech data contains a control word specifying the location in ROM of an audible expression, the type of waveform generated, and the number of

*Text continued on page 58*

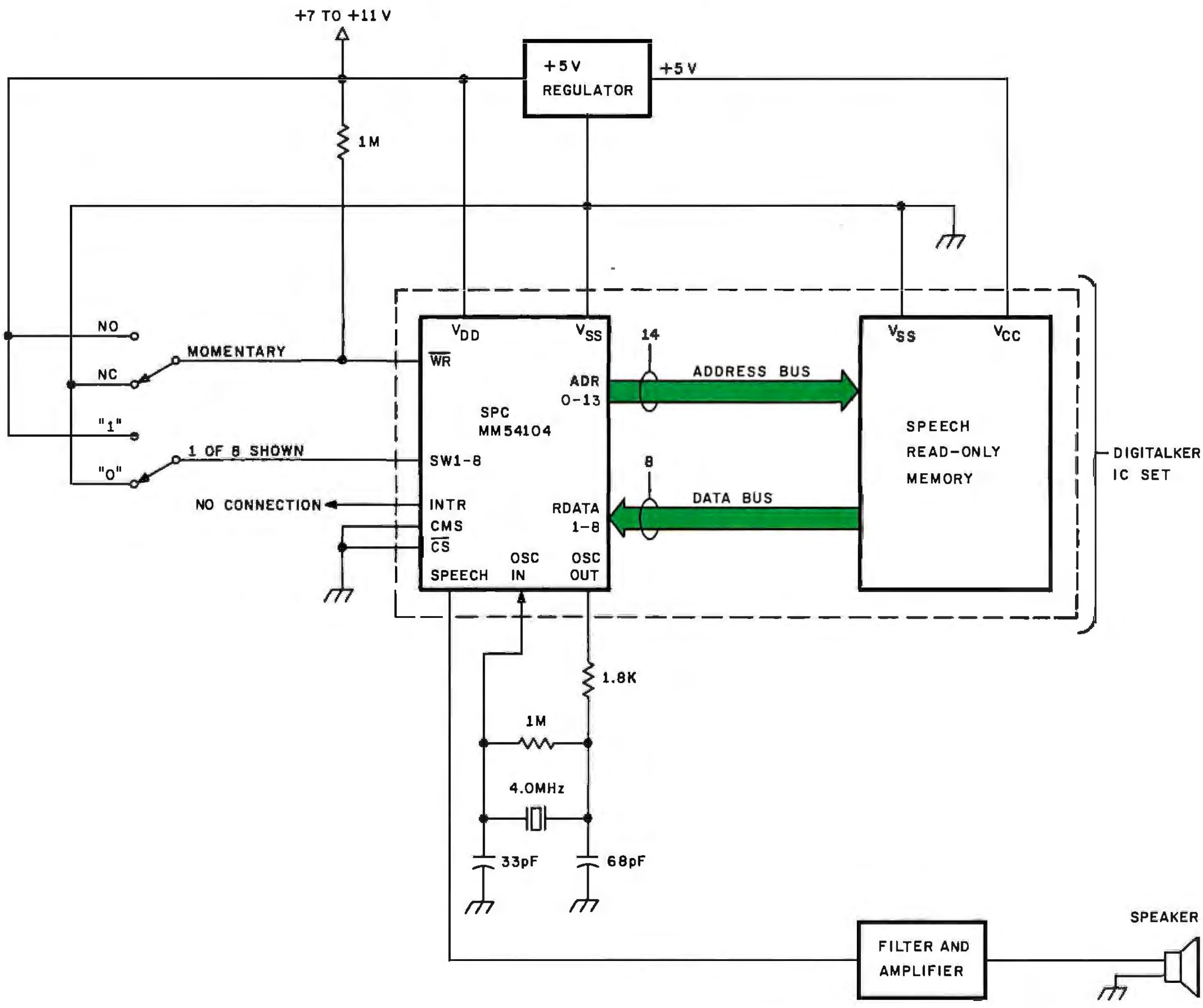



**Figure 2:** *Simplified schematic diagram of a minimum-configuration speech demonstration system, in which mechanical switches are used to set up the desired word. The momentary switch is a single-pole, two-position type. The crystal is a 4.0 MHz Electro Dynamics Corporation HC18 20 pF unit.*

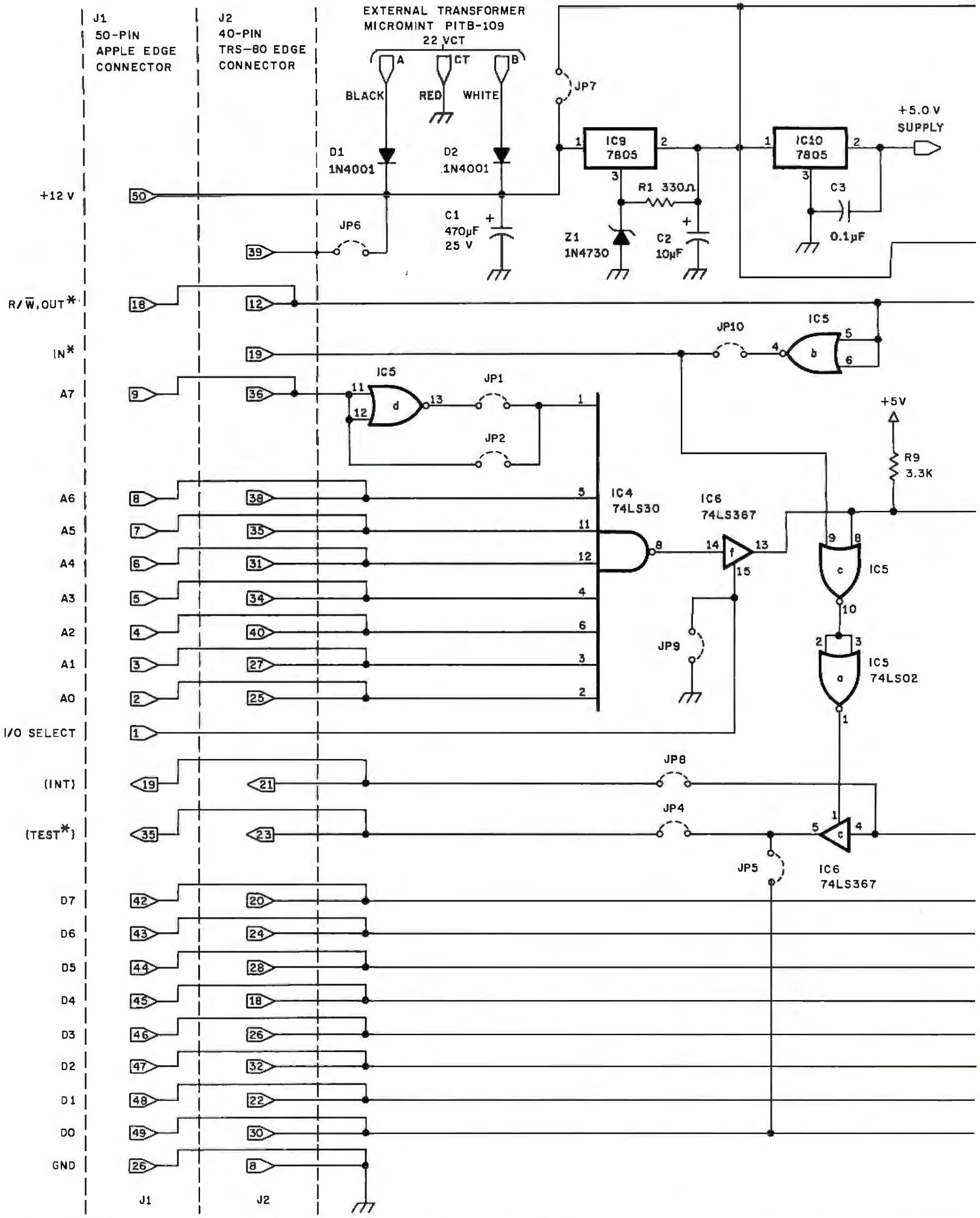
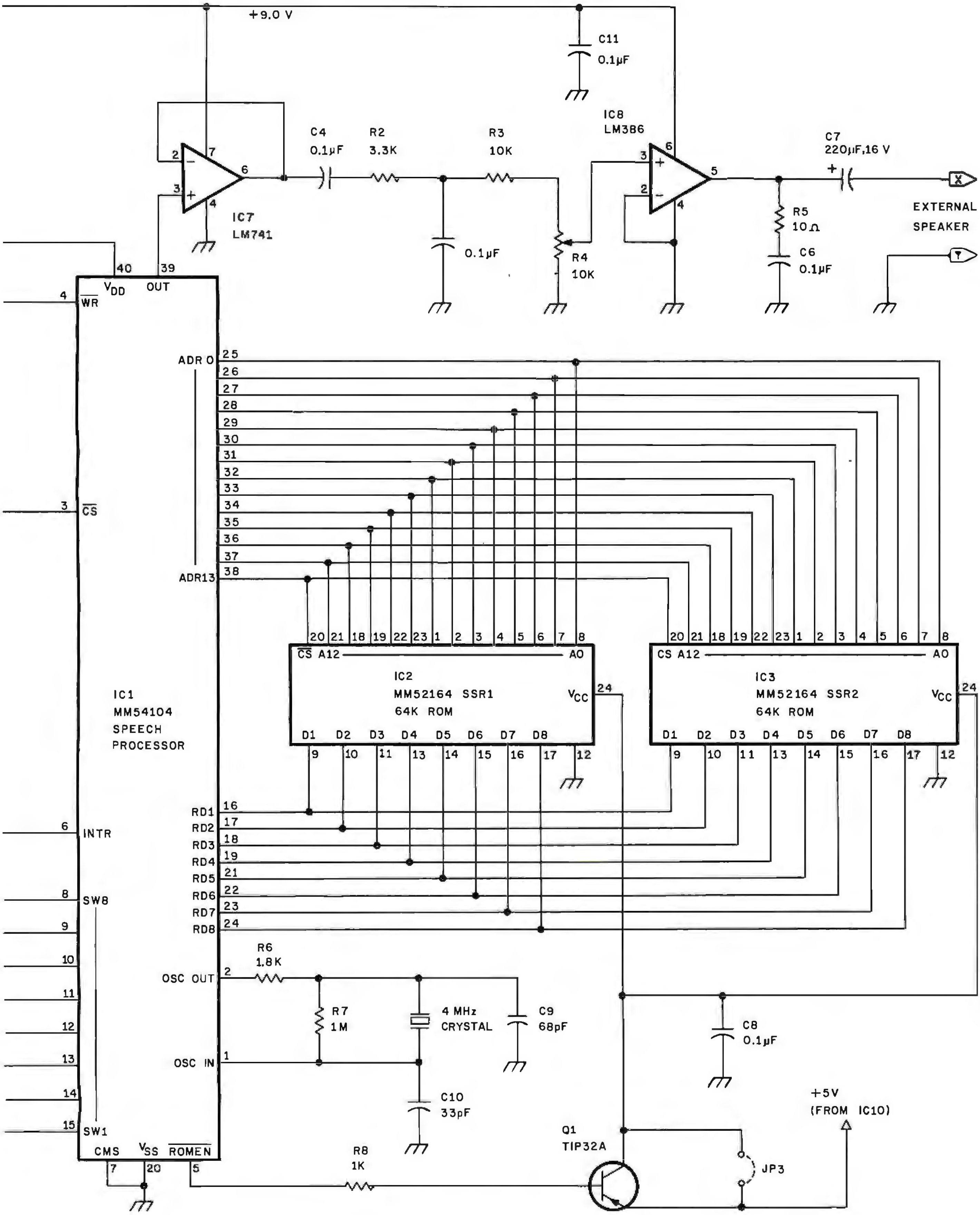



**Figure 3:** *Schematic diagram of the Micromouth speech-processor board. The board is plug-compatible with the Apple II and TRS-80 Model I computers and can be plugged into the TRS-80 Model III with a simple adapter. Several features and options in the circuit are activated by selection of jumper connections; see table 3, on page 58, for a list of jumpers and their purposes. Interface signals are compatible with other microcomputers, including Digital Group, Heath H-8, and S-100-bus systems.*


+9.0 V
C11
0.1µF
IC8
LM386
IC7
LM741
C4
0.1µF
R2
3.3K
R3
10K
C7
220µF,16 V
0.1µF
R4
10K
R5
10Ω
C6
0.1µF
EXTERNAL
SPEAKER
X
Y
VDD
OUT
WR
CS
ADR 0
ADR13
IC1
MM54104
SPEECH
PROCESSOR
IC2
MM52164 SSR1
64K ROM
IC3
MM52164 SSR2
64K ROM
CS A12
A0
VCC
D1 D2 D3 D4 D5 D6 D7 D8
INTR
SW8
SW1
RD1
RD2
RD3
RD4
RD5
RD6
RD7
RD8
OSC OUT
OSC IN
R6
1.8K
R7
1M
4 MHz
CRYSTAL
C9
68pF
C10
33pF
C8
0.1µF
+5V
(FROM IC10)
Q1
TIP32A
JP3
R8
1K
CMS
VSS
ROMEN

*Text continued from page 54:*
times it is repeated. Speech data from the ROM is loaded into the speech processor's data register and passed on to the delta-modulator decoder. This produces a 4-bit number that is applied to the D/A converter. Successive and regressive (remember the mirror waveform) digitizations produce a final waveform that is output in real time. Figure 1b shows the pinout specifications of the speech processor and the associated ROMs.

## Adding a Digitalker Interface

In general, causing any of the 144 stored expressions to be uttered is done by loading a numeric word code into a register in the speech processor. The code, selected from the list in table 1, is latched when the write-enable and chip-select lines are strobed. The speech processor immediately utters the selected expression.

If the input code is 0, the message "This is Digitalker" is spoken, in about 1.3 seconds. To say a word like "at" takes much less time. If another word-selection address is strobed into the speech processor while it is speaking, it will terminate the current output and begin speaking the newly selected expression. To keep the unit from jamming one word on top of another, a handshaking signal (INTR) goes to a low logic condition when the device is talking.

The simplest Digitalker system can consist of as little as the three speech-system integrated circuits, a 4 MHz oscillator, and an amplifier/filter (as shown in figure 2). Different expressions can be accessed by attaching eight switches to the SW1 thru SW8 input lines and a pushbutton switch to momentarily pulse the write-enable line.

Full use of the Digitalker's capabilities, however, can only be achieved when it is connected to a computer and exercised under program control. Figure 3, on pages 56 and 57, is the schematic diagram of the Micromouth speech-synthesizer interface, which incorporates the Digitalker chips. It is designed to be bus-signal-compatible with a number of computers, and it can be operated through a parallel I/O port. Assembled on the printed-circuit board shown in photo 1, it is plug-compatible with the Apple II and TRS-80 Model I personal computers. The pin numbers listed in the figure for connector J2 correspond to the TRS-80 Model I TRS-BUS edge connector, and pin numbers listed for J1 correspond to the Apple II's I/O card slots. A source for the Micromouth speech-processor assembled unit, blank boards, and components is given in the text box on page 68.

| | Address Jumpers | | | |
|---|---|---|---|---|
| | JP1 | | JP2 | |
| Peripheral Slot | Hexadecimal | Decimal | Hexadecimal | Decimal |
| 1 | C17F | −16001 | C1FF | −15873 |
| 2 | C27F | −15745 | C2FF | −15617 |
| 3 | C37F | −15489 | C3FF | −15361 |
| 4 | C47F | −15233 | C4FF | −15105 |
| 5 | C57F | −14977 | C5FF | −14849 |
| 6 | C67F | −14721 | C6FF | −14593 |
| 7 | C77F | −14465 | C7FF | −14337 |

**Table 2:** *I/O addresses used by the Apple II in communicating with the Micromouth speech-processor board. These are addresses in the Apple's peripheral-card ROM address space. The driving software can manipulate these registers using memory-reference instructions; in BASIC, PEEK and POKE are used.*

| Jumper Connection | Purpose |
|---|---|
| JP1 | When connected, sets TRS-80 I/O-port address to decimal 127; mutually exclusive with JP2; see table 2 for Apple II addressing. |
| JP2 | Sets TRS-80 I/O-port address to decimal 255; see table 2 for Apple II addressing. |
| JP3 | To be connected if transistor Q1 is to be omitted and an adequate external power supply is to be used. |
| JP4 | Not for use with either TRS-80 or Apple II computers; provides INTR feedback to computer, gated by the address strobe; see also JP8. |
| JP5 | When connected, enables use of a bidirectional data bus; otherwise a unidirectional bus is assumed. |
| JP6 | Not for use with either TRS-80 or Apple II; when the 40-pin edge connector is used, a + 12 V supply may be provided to the board through pin 39. |
| JP7 | May be connected if an external +9 V or +8 V supply is available. |
| JP8 | Not for use with either TRS-80 or Apple II; provides INTR feedback to computer, although not gated as through JP4. |
| JP9 | Must be connected when board is used with a TRS-80; enables I/O commands to be decoded properly. |
| JP10 | Must be connected when board is used with an Apple II; provides proper I/O-command decoding. |

**Table 3:** *List of jumper connections in the schematic diagram of figure 3. Various features and options of the Micromouth speech-processor board are activated by connecting different jumpers. Some options are not needed when the board is used with an Apple II or a TRS-80. Experimenters with other computers may use the 40-pin and 50-pin edge connectors in nonstandard ways; therefore some connections have been provided that have no obvious use.*

## Micromouth Versatility

The Micromouth board is designed to accommodate bidirectional as well as unidirectional data buses. The data-bus lines are normally attached to pins 8 thru 15 of IC1, the speech-processor component. The bus line from the speech processor, INTR, is jumpered (by either jumper connection JP4 or JP5) to meet the requirements of the particular bus being used. For both the TRS-80 and Apple II, which have bidirectional data buses, jumper JP5 is inserted to connect the INTR output to the D0 bus

*Text continued on page 62*

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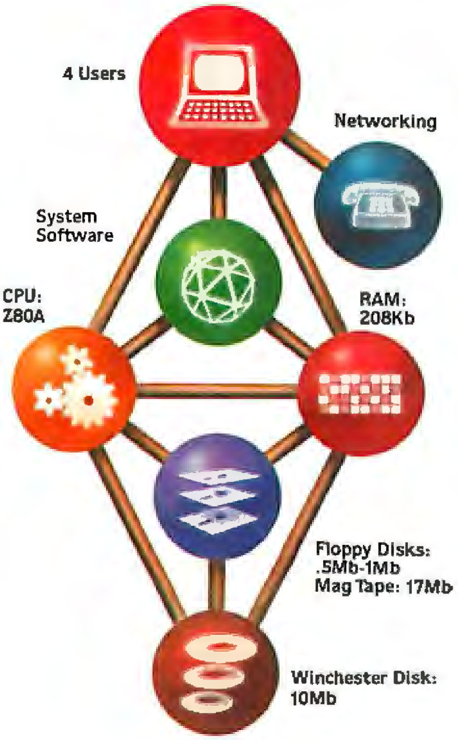


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Circle 16 on inquiry card.

*Text continued from page 58:*
line. The controlling computer can read the status of this line with an input instruction; only the least-significant bit will be affected. For a unidirectional data bus, as in a Digital Group computer, JP4 would be inserted and pin 5 of IC6 connected to the least-significant bit of the input bus.

The logic gates of IC4, IC5, and IC6 perform address decoding and chip selection. The I/O-port address of the board is set by inserting jumper JP1 or JP2. With JP1 installed, the address is port hexadecimal 7F (decimal 127). With JP2 installed, it is port hexadecimal FF (decimal 255). On the Apple II, the port address depends upon the slot in which the board is inserted. Table 2 is an address map for the Micromouth speech-processor board installed in an Apple II.

The speech-processor chip requires +7 to +11 V for normal operation, while the ROMs and other integrated circuits require only a +5 V supply. To accommodate the different ranges, I used two separate voltage regulators. IC9, a 7805 regulator, can safely be fed an input-voltage range of +9 to +24 V. When installed in an Apple II it receives a +12 V supply from the I/O bus. When the board is used with the TRS-80, a separate full-wave power supply using a 22 V center-tapped power transformer supplies approximately +15 V RMS. IC9 and associated components regulate the output to the speech processor to about +9 V. IC10, another 7805, in turn, reduces the +9 V to the +5 V required by the rest of the components.

The typical maximum current requirement of the Micromouth speech-processor circuitry is about 250 mA. Most of this is consumed running the two 64 K-bit ROMs, which are used only a few microseconds at a time. A memory-enable signal, $\overline{\text{ROMEN}}$, can be used with a transistor (Q1) to gate the power on and off to the ROMs. The average current required ends up being about 80 mA.

The final section for consideration is the filter and amplifier, IC7 and IC8. As in any digitized analog-signal output, a low-pass filter is required. For low-pitched male voices, the cutoff frequency should be about 100 Hz; for high-pitched female or children's voices it should be 300 Hz. The filter in figure 3 has a cutoff frequency around 150 Hz. That limit wasn't set mathematically; I simply chose a pleasant-sounding range. The frequency response of the output speaker and its enclosure can also affect sound quality. In my opinion, the sound output by this circuit is quite human-like. Any additional filtering usually serves only to eliminate background noise.

### Using a Parallel Port

The Micromouth board can also be jumpered so that it can be driven by a parallel I/O port. This is accomplished by inserting jumpers JP8 and JP9. With the input lines to IC5 and IC6 left open, a constant chip-select signal will be generated. The 8-bit parallel output from the computer is attached to pins 8 thru 15 on the speech processor. The same signal that latches the bit values into the output port can be used as the $\overline{\text{WR}}$ strobe on IC1 pin 4. The speech-processor-busy status indication is handled by directly reading the INTR line via an input-port line.

### Basic Software Simplicity

The best thing about a fixed vocabulary "canned-speech" synthesizer is the low software overhead. Text-to-speech synthesizers, on the other hand, usually require at least an 8 K-byte driver program, which must be integrated into the existing operating system. With the Micromouth speech-processor board, any or all of the 144 expressions can be spoken using a simple BASIC OUT or POKE statement.

For example, to say "twenty" using the board connected to a TRS-80 system, you would execute an OUT 127,20 statement in BASIC. With the Apple II, the appropriate statement would be POKE −16001,20 if the board were installed in slot 1. As you can see, the control information communicated to the board, a decimal 20,





Circle 106 on inquiry card. →

**Listing 1:** *A BASIC program for the Radio Shack TRS-80 Model I that will cause the Micromouth speech-processor board to say "At the mark the time is 2:45 pm....beep." A program for the Apple II would use the POKE keyword to achieve the same effect as the OUT statement.*

```
100  DIM N(15)
110  DATA 61,138,105,71,138,139,
     96,2,4,5,47,44,71,71,65
120  FOR X=1 TO 15 :READ N(X)
     : NEXT X

150  FOR X=1 TO 15 : OUT 127,N(X)
     : GOSUB 1000 : NEXT X
160  GOTO 1999

1000 IF INP(127)=1 THEN
     GOTO 1000 ELSE RETURN
1999 END
```

**Listing 2:** *A BASIC program that will cause the Micromouth speech-processor board to recite multiplication results for any number between 1 and 10.*

```
100 PRINT "MULTIPLICATION TABLE EXERCISER"
110 OUT 127,0:REM Say This is Digi-Talker
120 PRINT:PRINT"Which table do you want to review (1 to 10)";
130 INPUT N
140 FOR X=0 TO 10
150 PRINT X;"X";N;"=";X*N:J=X*N
160 IF X=0 THEN OUT 127,31:GOSUB 290:GOTO 180
170 OUT 127,X:GOSUB 290
180 GOSUB 310:OUT 127,N:GOSUB 290
190 OUT 127,80:GOSUB 290:OUT 127,129:GOSUB 290
200 J1=INT(J/10)
210 IF J=100 THEN OUT 127,1:GOSUB 290:OUT 127,28:GOSUB 290:GOTO 260
220 IF J=0 THEN OUT 127,31:GOSUB 290:GOTO 260
230 IF J<20 THEN OUT 127,J:GOSUB 290:GOTO 260
240 OUT 127,18+J1:GOSUB 290
250 IF J-J1*10>0 THEN OUT 127,J-J1*10:GOSUB 290:GOTO 260
260 NEXT X
270 PRINT:GOTO 120
280 REM
290 IF INP(127)=1 THEN 290 ELSE RETURN:REM check end of word
300 REM
310 OUT 127,139:GOSUB 290:OUT 127,129:GOSUB 290:RETURN
320 REM say TIMES

READY
```

is the same even though the keywords differ. (Since my program illustrations consistently use OUT statements directed to port 127, I will not bother to restate the conversion in subsequent examples, but you should recognize the direct relationship.)

Having the board speak in a series of words can be handled in one of two ways. One way is to use timing loops or other program-execution steps to allow enough time for a word to be spoken before loading the speech processor with the next word code. The preferred method is to check the busy line (INTR) before loading the next word. In this way, speech can sound continuous regardless of the length of each word. The INTR status bit is read as the least-significant bit of port 127 by the function INP(127). In my examples, while the speech processor is talking, the decimal value returned by INP(127) equals 1; while it is not talking, INP(127) equals 0.

Therefore, saying the number twenty-one, which consists of saying "twenty" and "one" successively, goes as follows:

```
100  OUT 127,20 : GOSUB 1000
     : OUT 127,1
110  STOP
1000 IF INP(127)=1 THEN
     GOTO 1000 ELSE RETURN
1999 END
```

A similar program can be used to demonstrate the entire Digitalker vocabulary:

```
100  FOR N=0 TO 143 : OUT
     127,N : GOSUB 1000
     : NEXT N
110  STOP
1000 IF INP(127)=1 THEN
     GOTO 1000 ELSE RETURN
1999 END
```

Longer utterances are typically





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**Listing 3:** *A BASIC program to demonstrate several different ways of using the speech interface.*

```
50 DIM N(20),M(60)
55 DATA 71,138,139,96,71,12,69,93,129,71
60 DATA 17,69,110,129,71,71,71,71,71,71,71
65 FOR T=1 TO 19: READ N(T):NEXT T
70 DATA 65,71,76,71,71,75,81,71,71,105,71,7,20,47,44,71,71
75 DATA 83,125,96,1,28,21,6,85,129,32,110,71,71,104,133
80 DATA 2,12,28,049,047,044,60,131,83,125,2,1,28,10,85
85 DATA 129,32,110, 71,71,71,71,71
90 FOR T=1 TO 56:READ M(T):NEXT T
100 REM DIGI-TALKER TEST PROGRAM
110 PRINT "DIGI-TALKER TEST PROGRAM"
120 PRINT: PRINT"1. Say entire vocabulary"
130 PRINT"2. Count from 0 to 20"
140 PRINT"3. Tones"
150 PRINT"4. Speech example A"
160 PRINT"5. Speech example B"
165 PRINT"6. Say 'THIS IS DIGI-TALKER'"
170 PRINT:PRINT"Enter choice (1-5) ";:INPUT A
180 IF A=1 THEN GOSUB 250
190 IF A=2 THEN GOSUB 300
200 IF A=3 THEN GOSUB 350
210 IF A=4 THEN GOSUB 400
220 IF A=5 THEN GOSUB 450
225 IF A=6 THEN OUT 127,0:GOSUB 1000
230 GOTO 110
250 REM speak entire word list
260 FOR T=0 TO 143:OUT 127,T:GOSUB 1000
270 NEXT T: RETURN
300 REM speak numbers 0-20
310 OUT 127,31: GOSUB 1000
320 FOR T=1 TO 20: OUT 127,T: GOSUB 1000
330 NEXT T: RETURN
350 REM 80 Hz and 400 Hz tone
360 FOR T=0 TO 5:OUT 127,65:GOSUB 1000
370 OUT 127,66:GOSUB 1000:NEXT T
380 RETURN
400 REM Speak Time
410 FOR B=0 TO 5:OUT 127,65:GOSUB 1000
415 FOR C=0 TO 2:OUT 127,71:GOSUB 1000:NEXT C
420 NEXT B
425 FOR T=1 TO 18 :OUT 127,N(T):GOSUB 1000:NEXT T
430 FOR T=0 TO 5:OUT 127,65:FOR S=0 TO 100:NEXT S:NEXT T
440 RETURN
450 REM example of use as error detector and verbal annunciator
460 FOR T=1 TO 55: OUT 127,M(T):GOSUB 1000:NEXT T
470 RETURN
1000 IF INP(127)=1 THEN 1000 ELSE RETURN
1010 IF INP(127)=1 THEN 1010 ELSE RETURN

READY
```

**Listing 4:** *The printed output of the program in listing 3. Due to the limitations of magazine printing, we cannot reproduce the audible output produced by the program.*

```
run
DIGI-TALKER TEST PROGRAM

1. Say entire vocabulary
2. Count from 0 to 20
3. Tones
4. Speech example A
5. Speech example B
6. Say 'THIS IS DIGI-TALKER'

Enter choice (1-5) ?
```

handled by storing all the word codes in an array. Such a technique can be used to say, "At the mark the time is 2:45 pm....*beep*," using the BASIC statements in listing 1.

I have included a few program examples to demonstrate how the speech-processor board can be used. Listing 2 is a simple program for saying multiplication tables. This program asks the operator to choose a multiplication table for a number between 1 and 10. If 8 were chosen, for example, the program would say:

"Zero times eight equals zero."
"One times eight equals eight."
"Two times eight equals sixteen."

and so on to:

"Ten times eight equals eighty."

This is just a rudimentary example. The program could be modified easily to posit questions such as "Six times nine equals..." and wait for a typed response. Appropriate answers would be "Error...Please try again," or "Right."

Listing 3, on page 66, is a menu-driven program that further exercises the interface and demonstrates a few more applications. Speech example A says, *"beep... beep... beep... beep...* The time is...twelve hours...seventeen minutes...*beep*." It is very much like the time message heard over shortwave radio station CHU Canada.

Speech example B from listing 3 illustrates how process-control applications might be handled. It says, "Control error...Mark seven twenty pm...Flow rate is thirty gallons a minute...Lower speed to twelve hundred rpm and set flow rate to one hundred gallons a minute."

## In Conclusion

Applications that would be enhanced by speech output are limitless. I have demonstrated just a few examples dealing with process control and time.

Many handicapped persons could benefit from speech output. It would be possible, for example, to attach a speech-output device to the user-terminal keyboard of a personal computer. As the keys are pressed, the corresponding letters are spoken aloud. (A simple ROM containing Digitalker equivalents for ASCII [American Standard Code for Information Interchange] characters could be used to interface the speech-processor board.) A similar connection can be made to the printer output (using the INTR-signal handshaking to slow it down) to allow the operator to hear what would otherwise be printed.

I did not attempt to modify any computer games as illustrations. Computer games could easily be made to talk using a few extra BASIC

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The CRT version supports all terminals by allowing you to select during setup which terminal VEDIT will run on. Features such as line insert and delete, reverse scroll, status line and reverse video are used on 'smart' terminals. The memory mapped version supports bank select and a hardware cursor such as on the SSM VB3. Special function keys on terminals such as the H19, Televideo 920C and IBM3101, and keyboards producing 8 bit codes or escape sequences are also supported.

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statements that are independent of the program flow.

What I'd like to leave you with is an appreciation for the price/performance advantages and ease of use inherent in this speech interface. Soon other Digitalker ROMs will be available, containing specialized vocabularies for medical, aeronautical, or even space-war applications. These other ROMs will be available eventually thru the MicroMint.

[**Editor's Note:** *National Semiconductor Corporation is providing a brief telephone demonstration of the Digitalker speech-synthesis system at (408) 737-3939....***RSS**]

The invention of Digitalker does not mean the demise of other approaches to computer-generated speech. Instead, it introduces low-cost speech output into areas that could never have justified the expense previously. Eventually, hand-held talking digital volt-ohmmeters will be mass-produced, and I don't think it will be too far into the future. But that is merely one application. You can expect to see (or rather hear) speech emanating from many commercial products.

Those who work with other speech-synthesis techniques have not been standing still during the development of "canned-speech" chips. Phoneme synthesizers, such as the Votrax SC-01, now accomplish on a single chip what once required a whole circuit board. My investigation of speech synthesis doesn't stop here. In the months ahead I hope to demonstrate other computer-speech techniques, interfaces, and applications.

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*The Apple II version of the Micromouth speech-processor board is suitable for use with parallel-I/O-port and other non-plug-compatible computer connections. The assembly/operation instructions include directions for attaching the board to S-100 bus, Digital Group, and Heath H-8 computers.*

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*The Digitalker integrated circuits are not sold separately by The MicroMint. They can be obtained through National Semiconductor distributors for $85 per set plus shipping charges.*

*New York residents please add 7% sales tax.*

### Bibliography


1. Ahrens, Paul; Klaus Skoge; David Vetter; and John Stork. "Speech Chip Timeshares a 2-Pole Section to Create a 12-Pole Filter," *Electronics*, March 10, 1981, page 177.
2. Ciarcia, Steven A. "Talk to Me: Add a Voice to Your Computer for $35," in *Ciarcia's Circuit Cellar*, Volume 1, BYTE Books, 1979, page 77.
3. Gargagliano, Tim A and Kathryn Fons. "Text Translator Builds Vocabulary for Speech Chip," *Electronics*, February 10, 1981, page 118.
4. Lin, Kun-Shan; Gene A. Frantz; and Kathy Goudie. "Software Rules Give Personal Computer Real Word Power," *Electronics*, February 10, 1981, page 122.
5. Weinrich, David W. "Speech-Synthesis Chip Borrows Human Intonation," *Electronics*, April 10, 1980, page 113.
6. Wiggins, Richard and Larry Brantingham. "Three-Chip System Synthesizes Human Speech," *Electronics*, August 31, 1978, page 109.


**Editor's Note:** *Steve often refers to previous Circuit Cellar articles as reference material for the articles he presents each month. These articles are available in reprint books from BYTE Books, 70 Main St, Peterborough NH 03458.* Ciarcia's Circuit Cellar *covers articles that appeared in BYTE from September 1977 thru November 1978.* Ciarcia's Circuit Cellar, Volume II *presents articles from December 1978 thru June 1980.*

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# Mathematical Modeling:

## A BASIC Program to Simulate Real-World Systems


Randall E Hicks
University of Georgia
Marine Institute
Sapelo Island GA 31327


**Editor's Note:** *The subject of this article, simulating systems by solving a system of differential equations, is difficult, but we feel it is useful to many BYTE readers. In fact, only a rudimentary understanding of the principles involved is needed to use the general-purpose BASIC program of listing 2. The involved mathematics at the end of the article presents the theory on which the program is based. . . .* GW

Many academic disciplines have used computers for modeling biological, physical, economic, and social systems. Modeling complicated systems once was time-consuming, expensive, and cumbersome. Yet, as computer-related technology advanced, the magnitude of these problems has dwindled, and the potential for less-expensive modeling and simulation tasks in all disciplines has increased.

My purpose is to demonstrate how useful microcomputers can be in mathematical simulations. I will introduce you to modeling the behavior of a system by describing it mathematically with a system of time-invariant linear differential equations. I will show how to solve systems of differential equations by two separate numerical methods. As a framework for the simulation tasks, I will use a simple model as an example for you to follow: a hydrologic model of the forested uplands surrounding Okefenokee swamp in Georiga. (See reference 3.)

### The Conceptual Model

To simulate a system, you must be able to conceptualize it into some logical framework. A flow diagram consisting of compartments and connecting flows satisfies this requirement. (See figure 1.) Each compartment in


**Photo 1:** *Zero-input response of the Okefenokee swamp hydrologic model simulated with the program in listing 2.*

the diagram represents a place for the potential accumulation of energy, matter, or information. A *system* is defined as the collection of compartments that have been outlined and the potential interactions among them. The flows between compartments describe how the system interacts with itself through transfers of the compartmental contents.

The boundaries of the system must also be defined. The *environment* of the system is the area outside the system's periphery. If the system does not interact with its environment, it is called a *closed system*, and the model will not receive inputs from or yield losses to its surroundings. In other words, the system is self-contained. In the Okefenokee swamp uplands hydrologic model, the system is said to be *open* because it interacts with its environment. In the conceptual model (figure 1), this is visualized by an input from the environment to the system and by an output from the system to the environment.

The input to the system (**Z**) is the sum of the flows to each compartment ($f_{i0}$) from all environmental inputs. The environment surrounding the system is represented by the numeral 0. In the hydrologic model, there is only

**About the Author**

*Randall E Hicks is a graduate student at the University of Georgia working toward his PhD in Ecology at the Institute of Ecology. He is employed by Ecology Simulations Inc, Athens, Georgia, as a marine systems modeling consultant.*

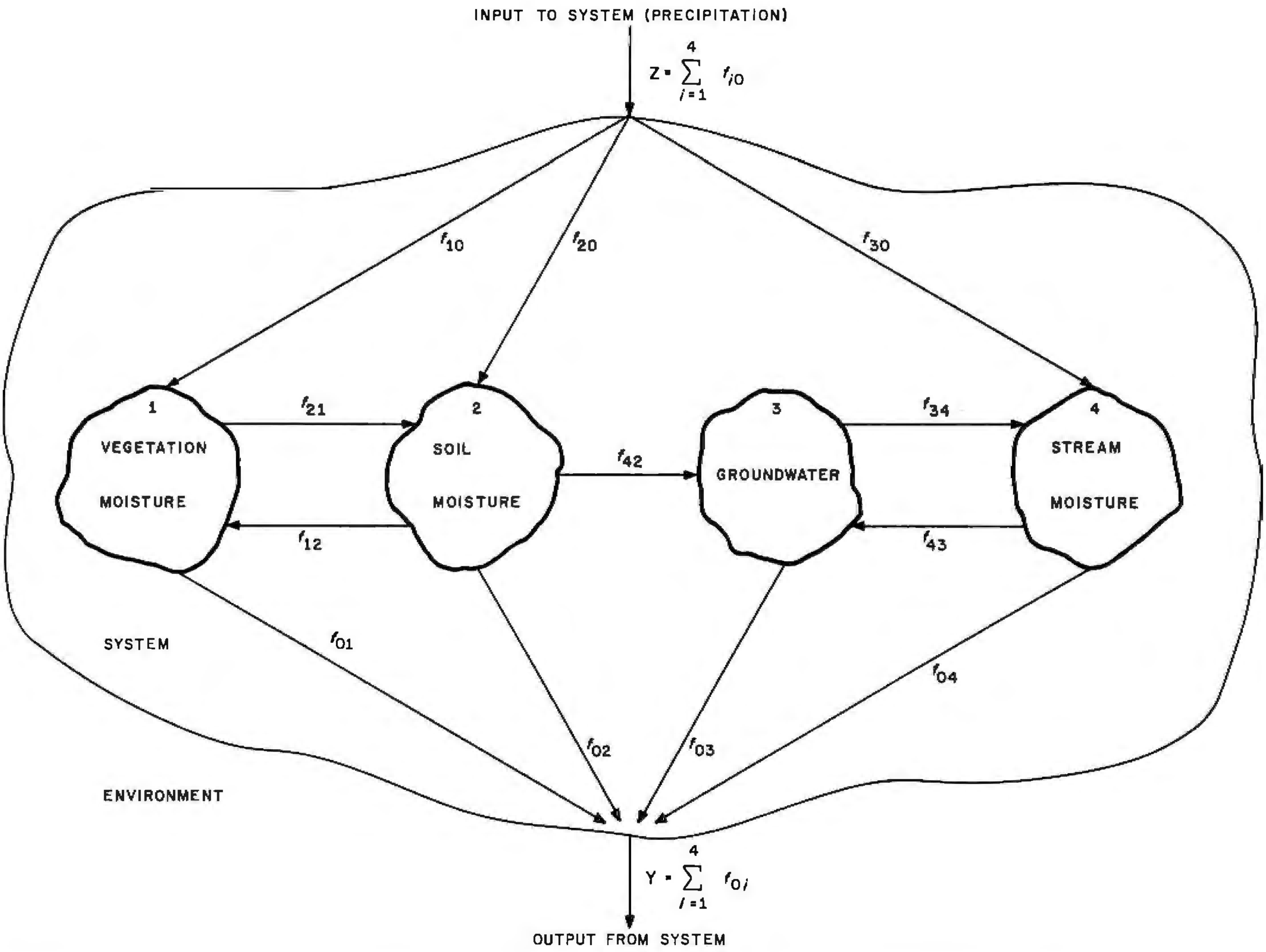



**Figure 1:** *A conceptual model of the hydrology of the forested uplands surrounding Georgia's Okefenokee swamp. The model is subdivided into a* system *and its* environment. *The system receives environmental inputs (**Z**) and yields losses (**Y**) to the environment. Compartments represent areas of potential water accumulation. Flows and their direction are indicated by connecting arrows. Flows within the system are also given numerical designations. The first number represents the recipient-compartment number and the second represents the donor-compartment number.*

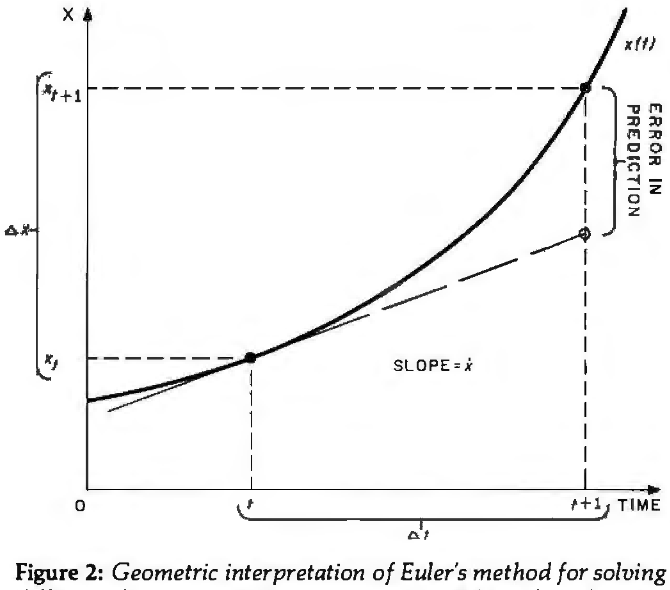
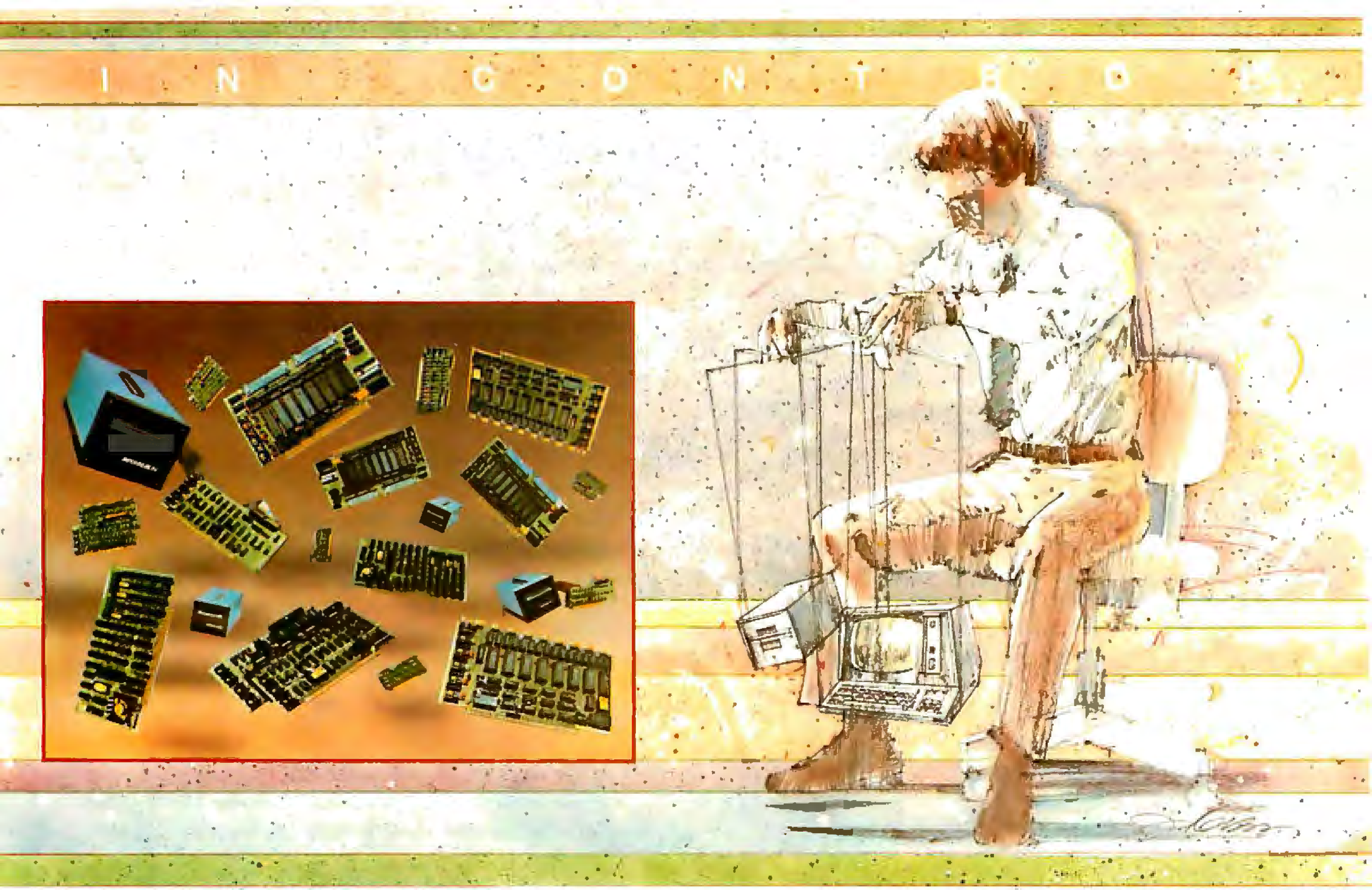



**Figure 2:** *Geometric interpretation of Euler's method for solving differential equations. Compartment size (x) is plotted versus time (t). Actual and predicted compartment sizes are shown.*

one environmental input to the system: precipitation. Hence:

$$\mathbf{Z} = f_{10} + f_{20} + f_{30} = z_1$$

where the numerical designation of $z_k$ represents an input from environmental input $k$ to the system. Flows within the system are represented by lines connecting compartments; arrows show the direction of flow. These flows are classified by two numbers. The first number indicates the compartment that receives the flow, and the second represents the compartment that yields (ie: produces) the flow. In figure 1, $f_{21}$ designates an actual flow of moisture from vegetation moisture (compartment 1) to soil moisture (compartment 2). The output from the system (Y) back to the environment is the sum of the losses from each compartment $i$ ($f_{0i}$). The purpose of the model is to be able to describe the response of each compartment (ie: how much water is present) at all times in the future.

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## The Mathematical Model

The flows into and out of each compartment can be represented by a difference, or a differential, equation. In the model, the flows have been balanced so that no compartment will have a net gain or loss of moisture. The system is said to be at *steady-state*, and the corresponding model will be *static* in nature. The relationships in the flow diagram can be depicted by a system of linear differential equations. In the steady-state example, each differential equation representing a compartment is equal to 0, since inflows and outflows are equal.

For compartment 1 (vegetation moisture), the differential equation would be of the form:

$$\frac{dx_1}{dt} = \dot{x}_1 = f_{10} + f_{12} - f_{21} - f_{01}$$

(**Note**: In this equation, I have used a dot centered over a variable to simplify notation. Henceforth, this will mean the derivative of a variable with respect to time.)

The actual flows ($f_{ij}$) can be divided by the steady-state size of the corresponding donor compartment ($x_j$), or by the environment input ($z_k$), to give two types of coefficients: intercompartmental rate coefficients and environmental input coefficients:

$$a_{ij} = \frac{f_{ij}}{x_j}$$

and:

$$b_{ik} = \frac{f_{i0}}{z_k}$$

where:

$i$ = the recipient compartment
$j$ = the donor compartment

and:

$k$ = an environmental input number

Notice that the intercompartmental coefficients $a_{ij}$ (of matrix **A**) have the same numerical designation as their corresponding flows. Also notice that the environment is represented by a 0 in flows. When environmental input coefficients are formed, you subdivide the total environmental input **Z** into the different types ($k$) of environmental inputs. These coefficients ($b_{ik}$ of matrix **B**) are dimensionless and express the percentage of an environmental input ($z_k$ of vector **Z**) that each compartment receives. These numerical notations define the position of each coefficient in an appropriate coefficient matrix. For compartment 1 (vegetation moisture), the differential equation then becomes:

$$\dot{x}_1 = a_{12}x_2 - a_{11}x_1 + b_{11}z_{11}$$

After redefining all the differential equations into coefficients multiplied by the appropriate donor-compartment size or environmental-input size, you can organize the system of equations into a single matrix equation:

$$\dot{\mathbf{X}}_{n1} = \mathbf{A}_{nn}\mathbf{X}_{n1} + \mathbf{B}_{nm}\mathbf{Z}_{m1}$$

where:

$n$ = the number of compartments
$m$ = the number of environmental inputs to the system
$\dot{\mathbf{X}}_{n1}$ = a column vector of differential equations

$$\begin{bmatrix} \dot{x}_1 \\ \cdot \\ \cdot \\ \cdot \\ \dot{x}_n \end{bmatrix}$$

$\mathbf{A}_{nn}$ = an $n$ by $n$ matrix of intercompartmental rate coefficients

$$\begin{bmatrix} a_{11} & \cdot & \cdot & \cdot & a_{1n} \\ \cdot & \cdot & & & \cdot \\ \cdot & & \cdot & & \cdot \\ \cdot & & & \cdot & \cdot \\ a_{n1} & \cdot & \cdot & \cdot & a_{nn} \end{bmatrix}$$

$\mathbf{X}_{n1}$ = a column vector of initial compartment sizes

$$\begin{bmatrix} \dot{x}_1 \\ \cdot \\ \cdot \\ \cdot \\ \dot{x}_n \end{bmatrix}$$

$\mathbf{B}_{nm}$ = an $n$ by $m$ matrix of input rate coefficients

$$\begin{bmatrix} b_{11} & \cdot & \cdot & \cdot & b_{1m} \\ \cdot & \cdot & & & \cdot \\ \cdot & & \cdot & & \cdot \\ \cdot & & & \cdot & \cdot \\ b_{n1} & \cdot & \cdot & \cdot & b_{nm} \end{bmatrix}$$


**Photo 2:** *Zero-state response of the Okefenokee swamp hydrologic model simulated with the program in listing 2.*

and:

$\mathbf{Z}_{m1}$ = a column vector of environmental input sizes

$$\begin{bmatrix} z_1 \\ \cdot \\ \cdot \\ \cdot \\ z_m \end{bmatrix}$$

The matrices and vectors for the hydrologic model are:

$$\mathbf{A} = \begin{bmatrix} -.369 & .035 & 0.0 & 0.0 \\ .189 & -.0483 & 0.0 & 0.0 \\ 0.0 & 0.0 & -.1632 & .000161 \\ 0.0 & .012 & .000444 & -.000623 \end{bmatrix} \times 1/(10 \text{ years})$$

$$\mathbf{X} = \begin{bmatrix} 0.6500 \\ 2.8940 \\ 0.5250 \\ 55.4400 \end{bmatrix} \times 10^8 \text{m}^3 \text{ water} \qquad \mathbf{B} = \begin{bmatrix} 0.60 \\ 0.07 \\ 0.33 \\ 0.00 \end{bmatrix}$$

and:

$$\mathbf{Z} = [.233] \times 10^8 \text{m}^3 \text{ water / (10 years)}$$

At best, this is a brief treatment of the use of linear differential equations in simulating the behavior of a collection of components. The hydrologic model herein is described by a deterministic general linear model (GLM) of donor-controlled differential equations. This type of model is among the simplest and the most straightforward to use; it has found wide acceptance in many fields. There are many books on general-systems theory and modeling that go into more detail than I can in this article. (For further reading, see references 4 and 5.) Higher-order differential equations can also be used to describe the time-varying changes in flows between compartments in a model. (See reference 2.) A nonlinear model would incorporate higher-order differential equations.

## Numerical Solution of Differential Equations

Now that the model has been described with a system of linear differential equations, a method to solve these equations on a computer is needed. Several numerical methods are available for solving differential equations, but I will discuss only two methods and their implementation on microcomputers: the *Euler* and *Runge-Kutta* methods. I will briefly describe each method and list a corresponding algorithm written in BASIC (Disk BASIC 8001, for the Compucolor II microcomputer) for implementation on a microcomputer. For a more detailed description of these and other methods for solving differential equations, consult a book on numerical analysis or modeling. (See references 1 and 5.)

## Euler's (Rectangular) Method

Euler's method is a simple but computationally inefficient method for solving finite differential equations. First, let's look at a geometric interpretation of this method. (See figure 2.)

Knowing the present value (state) of a compartment ($x_t$), you want to be able to predict the next value ($x_{t+1}$). Your differential equation for the compartment defines the slope of the line at time $t$. You project this slope to the next point in time ($t+1$), and add the change in $x$'s value (called $\Delta x$) to the value of $x$ at time $t$ ($x_t$). In many cases (such as in figure 2), the slope of the actual path of the compartment size may not be equal to the predicted value. In these instances, this algorithm has incorporated some error into the predicted value for the compartment size at the new time. In the Euler method, this error is proportional to the time step ($\Delta t$). This error can be reduced by decreasing the time step; however, that will increase the algorithm execution time on the computer.

The algorithm for the Euler method is:

1. $\dot{\mathbf{X}}_t = f(\mathbf{X}_t, \mathbf{Z}_t, t)$

2. $\mathbf{X}_{t+1} = \mathbf{X}_t + \Delta t(\dot{\mathbf{X}}_t)$

First, compute the slope of the line at $t$, which you assume is the same at $t + 1$. In the hydrologic model, this is already determined by the time-invariant differential equations for each compartment. Second, you compute the new compartment size ($x_{t+1}$). Then you return to step 1 and continue the process for as many times as you wish. If you want to reduce the error in the algorithm, you can decrease your time step and perform the algorithm several times. In this way, you increase the number of iterations of the algorithm before you calculate your final value. Listing 1 is a program for the Euler algorithm written in Disk BASIC 8001.

## Runge-Kutta Method

Runge-Kutta is a multistep, look-forward method for the numerical solution of differential equations. I will

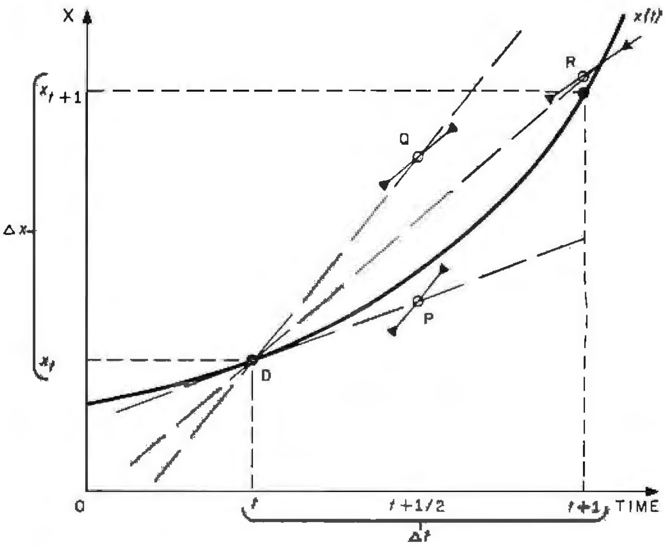
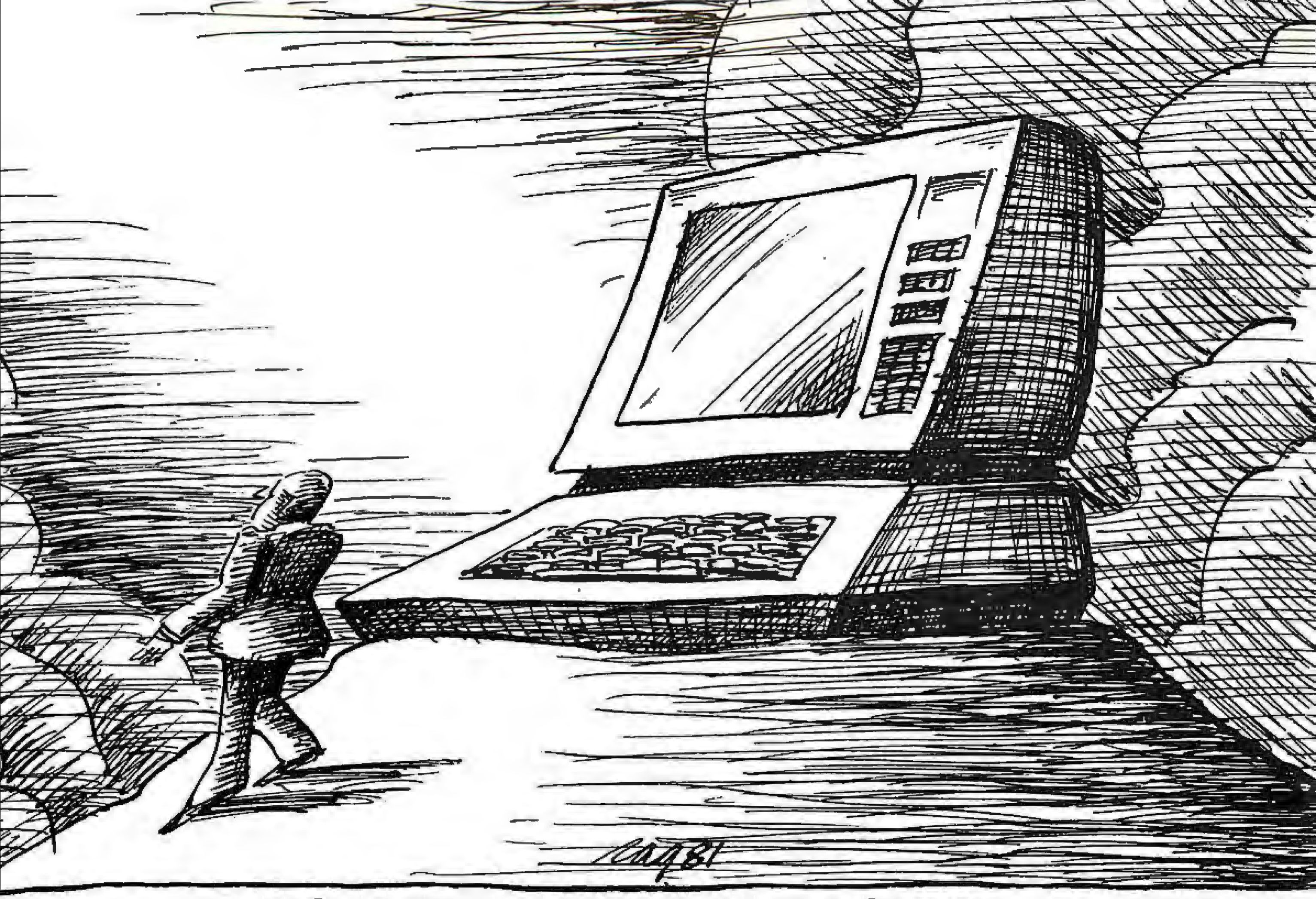



**Figure 3:** *Geometric interpretation of the fourth-order Runge-Kutta method for solving differential equations. Compartment size (x) is plotted versus time (t). Actual and predicted compartment sizes are shown.*



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discuss the fourth-order Runge-Kutta method. It is computationally more involved than Euler's method, but it incorporates less error into the prediction of the next compartment size ($x_{t+1}$). The geometric interpretation of this method is shown in figure 3.

As with the Euler method, knowing the present compartment value ($x_t$), you want to predict the next compartment value ($x_{t+1}$). First, you find the slope ($XD$) of the line at time $t$. Then, as in Euler's method, you calculate the compartment size ($P$), but at time $t+1/2$. After you calculate the slope ($XP$) at $P$, make a second prediction of the compartment size ($Q$) at time $t+1/2$. After you calculate the slope ($XQ$) at $Q$, make a third prediction of the compartment size ($R$), but at time $t+1$. Again, calculate the slope ($XR$). Next, take a weighted average of all the slopes you calculated and determine your final prediction of the compartment size ($x_{t+1}$) at time $t+1$. As with Euler's method, the Runge-Kutta method incorporates some error into your predictions; however, the error is now proportional to the fourth power of the time step ($\Delta t$) and is greatly reduced. The error can be reduced further by decreasing the time step.

The algorithm for the fourth-order Runge-Kutta method is:

1. $\dot{\mathbf{X}}_t^D = f(\mathbf{X}_t, \mathbf{Z}_t, t)$
2. $\mathbf{X}_{t+1/2}^P = \mathbf{X}_t + \Delta t/2(\dot{\mathbf{X}}_t^D)$
3. $\dot{\mathbf{X}}_{t+1/2}^P = f(\mathbf{X}_{t+1/2}^P, \mathbf{Z}_{t+1/2}, t+1/2)$
4. $\mathbf{X}_{t+1/2}^Q = \mathbf{X}_t + \Delta t/2(\dot{\mathbf{X}}_{t+1/2}^P)$
5. $\dot{\mathbf{X}}_{t+1/2}^Q = f(\mathbf{X}_{t+1/2}^Q, \mathbf{Z}_{t+1/2}, t+1/2)$
6. $\mathbf{X}_{t+1}^R = \mathbf{X}_t + \Delta t(\dot{\mathbf{X}}_{t+1/2}^Q)$
7. $\dot{\mathbf{X}}_{t+1}^R = f(\mathbf{X}_{t+1}^R, \mathbf{Z}_{t+1}, t+1)$
8. $\mathbf{X}_{t+1} = \mathbf{X}_t + \Delta t(1/6(\dot{\mathbf{X}}_t^D) + 1/3(\dot{\mathbf{X}}_{t+1/2}^P) + 1/3(\dot{\mathbf{X}}_{t+1/2}^Q) + 1/6(\dot{\mathbf{X}}_{t+1}^R))$

If you wish to reduce the error in the algorithm, you can decrease the time step ($\Delta t$), perform the algorithm several times, and save the last prediction of the compartment size. The Runge-Kutta integration method is incorporated into the GLM program in listing 2.

## General Linear Model Program

So far, I have discussed the general linear model form and two different algorithms for the numerical solution of differential equations. I have combined these two topics and written a general-user program for mathematically modeling a system of components described by linear differential equations, solved for 100 time increments with a Runge-Kutta integration algorithm. This program was written in Disk BASIC and is given in listing 2. To use this program, you enter the number of compartments in and environmental inputs to your system, an intercompartmental rate coefficient matrix (**A**), the initial compartment values, an input coefficient matrix (**B**), and the environmental input values. You must also enter the desired number of iterations of the Runge-Kutta algorithm. This value is the reciprocal of the

*Text continued on page 86*

**Listing 1:** *Compucolor II Disk BASIC 8001 program segment of Euler integration algorithm.*

```
190 REM  ********** START SIMULATION  ******************
195 FOR IJ=1 TO 100
200 DT=1/KK
210 REM  ********** START EULER INTEGRATION LOOP *******
215 FOR JJ=1 TO KK
220 FOR I=0 TO N
230 AX(I)=0
240 FOR J=0 TO N: AX(I)=AX(I)+A(I,J)*X(J): NEXT J
250 FOR K=0 TO NN: AX(I)=AX(I)+B(I,K)*Z(K): NEXT K
260 NEXT I
270 FOR I=0 TO N: X(I)=X(I)+DT*AX(I): NEXT I
275 NEXT JJ
280 FOR I=0 TO N: XX(IJ,I)+X(I): NEXT I
290 NEXT IJ
300 REM  ********** END OF SIMULATION ******************
```

| | |
|---|---|
| PLOT 2 | Enter graph-plotting mode |
| PLOT 2, X, Y | Point at X,Y |
| PLOT 2, 242, X, Y | Vector to X,Y |
| PLOT 2, 250, X0, Y, XM | Horizontal bar at Y from X0 to XM |
| PLOT 2, 246, Y0, X, YM | Vertical bar at X from Y0 to YM |
| PLOT 3, T, L | Cursor to tab T at line L |
| PLOT 6, C | Defines the color of both the foreground and background |
| PLOT 8 | Cursor to home |
| PLOT 9 | Tab 8 spaces |
| PLOT 10 | Line feed (move cursor down one line) |
| PLOT 11 | Erase line |
| PLOT 12 | Erase page |
| PLOT 14 | Double-height text |
| PLOT 15 | Normal-height text, with blink mode off |
| PLOT 16 thru PLOT 23 | Changes color of foreground or background (whichever is active) |
| PLOT 27, 4: PRINT "[disk commands]": | |
| PLOT 27, 27 | Execute floppy-disk command |
| PLOT 27, 10 | Write text vertically |
| PLOT 27, 24 | Write text horizontally |
| PLOT 28 | Cursor up |
| PLOT 29 | Enable background color |
| PLOT 31 | Blink on |
| PLOT 255 | Cancel graph-plotting mode |

**Table 1:** *The use of the PLOT command in Disk BASIC 8001 (for the Compucolor II). This information will help explain certain parts of listing 2, if you convert that program to another microcomputer.*

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**Listing 2:** *A general-user program written in Disk BASIC 8001 for mathematical modeling with a system of time-invariant linear differential equations. The equations are solved for 100 user time increments with a fourth-order Runge-Kutta integration algorithm. As the program is written, the simulation results are scaled and plotted versus time on a video monitor (Compucolor II microcomputer). This section of the program will have to be modified for other microcomputer systems. See table 1 for further information on the PLOT command.*

```
10 REM    **** GENERAL LINEAR MODEL SIMULATION PROGRAM *****
11 REM    ********** WITH RUNGA-KUTTA INTEGRATION **********
20 REM    ************* BY RANDALL E. HICKS ***************
21 REM    **************** COPYRIGHT 1980 *****************
24 PLOT 12
25 PRINT "GIVEN:"
30 PRINT "1) THE NUMBER OF MODEL COMPARTMENTS"
35 PRINT "2) THE NUMBER OF ENVIRONMENTAL INPUTS"
40 PRINT "3) A MATRIX OF INTERCOMPARTMENTAL RATE COEFFICIENTS"
42 PRINT "4) A VECTOR OF INITIAL COMPARTMENT SIZES"
45 PRINT "5) A MATRIX OF ENVIRONMENTAL INPUT COEFFICIENTS"
47 PRINT "6) A VECTOR OF ENVIRONMENTAL INPUT SIZES  AND"
50 PRINT "7) THE NUMBER OF ITERATIVE INTEGRATION STEPS --"
51 PRINT
52 PRINT "THIS PROGRAM WILL USE A SYSTEM OF TRANSITION"
53 PRINT "EQUATIONS TO SIMULATE THE BEHAVIOR OF YOUR SYSTEM"
54 PRINT "USING A RUNGE-KUTTA INTEGRATION ALGORITHM WITH THE"
55 PRINT "OUTPUT PLOTTED AS A GRAPH ON THIS TERMINAL!"
74 PRINT
75 INPUT "HOW MANY COMPARTMENTS IN YOUR MODEL (N=1,7)?";N
80 N= N- 1:PRINT
85 INPUT "HOW MANY INPUT ENVIRONMENTS IN YOUR MODEL (N=1,3)?";NN
90 NN= NN- 1
95 DIM A(N,N),B(N,NN),XX(100,N),X(N),AX(N),XD(N),XP(N),XQ(N),XR(
N),Z(NN)
100 DIM BB(N),S(N),P(N)
110 PRINT "ENTER MATRIX OF INTERCOMPARTMENTAL RATE"
115 PRINT "COEFFICIENTS -- ROW BY ROW, ONE COLUMN AT A TIME."
120 FOR I= 0TO N
125 FOR J= 0TO N:INPUT A(I,J):NEXT J
130 NEXT I
135 PRINT "ENTER INITIAL COMPARTMENT VALUES"
140 FOR I= 0TO N:INPUT XX(0,I):NEXT I
145 PRINT "ENTER YOUR MATRIX OF ENVIRONMENTAL INPUT"
146 PRINT "COEFFICIENTS"
150 FOR I= 0TO N
155 FOR J= 0TO NN:INPUT B(I,J):NEXT J
160 NEXT I
165 PRINT "ENTER THE SIZES OF YOUR ENVIRONMENTAL INPUTS"
170 FOR J= 0TO NN:INPUT Z(J):NEXT J
175 PRINT "ENTER THE NUMBER OF ITERATIONS OF THE ALGORITHM"
176 PRINT "BEFORE INTEGRATION COMPLETION.":INPUT KK
180 REM    ******** STORE INITIAL COMPARTMENT VALUES *********
185 FOR J= 0TO N:X(J)= XX(0,J):NEXT J:PLOT 12
190 REM    *************** START SIMULATION *******************
195 FOR IJ= 1TO 100
200 DT= 1/ KK
205 REM    ******** START ITERATIVE INTEGRATION LOOP *********
210 FOR JJ= 1TO KK
215 REM    ********* START RUNGA-KUTTA INTEGRATION ***********
217 REM    ** COMPUTE DX/DT AT TIME J-1 **
220 FOR I= 0TO N
221 XD(I)= 0
225 FOR J= 0TO N:XD(I)= XD(I)+ A(I,J)* X(J):NEXT J
230 FOR K= 0TO NN:XD(I)= XD(I)+ B(I,K)* Z(K):NEXT K
231 NEXT I
240 REM   ** COMPUTE FIRST ESTIMATE OF STATE(P) AT TIME IJ-1/2 **
245 FOR I= 0TO N:AX(I)= X(I)+ (DT/ 2)* XD(I):NEXT I
250 REM    ** COMPUTE DX/DT AT P **
255 FOR I= 0TO N
256 XP(I)= 0
260 FOR J= 0TO N:XP(I)= XP(I)+ A(I,J)* AX(J):NEXT J
261 FOR K= 0TO NN:XP(I)= XP(I)+ B(I,K)* Z(K):NEXT K
265 NEXT I
270 REM   ** MAKE SECOND ESTIMATE OF STATE(Q) AT TIME IJ-1/2 **
275 FOR I= 0TO N:AX(I)= X(I)+ (DT/ 2)* XP(I):NEXT I
280 REM    ** COMPUTE DX/DT AT Q  **
```

*Listing 2 continued on page 84*

*Listing 2 continued:*

```
285 FOR I= 0TO N
286 XQ(I)= 0
290 FOR J= 0TO N:XQ(I)= XQ(I)+ A(I,J)* AX(J):NEXT J
300 FOR K= 0TO NN:XQ(I)= XQ(I)+ B(I,K)* Z(K):NEXT K
310 NEXT I
320 REM  ** MAKE ESTIMATE OF STATE(R) AT TIME J **
330 FOR I= 0TO N:AX(I)= X(I)+ DT* XQ(I):NEXT I
335 REM   ** COMPUTE DX/DT AT R **
340 FOR I= 0TO N
344 XR(I)= 0
345 FOR J= 0TO N:XR(I)= XR(I)+ A(I,J)* AX(J):NEXT J
350 FOR K= 0TO NN:XR(I)= XR(I)+ B(I,K)* Z(K):NEXT K
355 NEXT I
360 REM  ** COMPUTE FINAL VALUES FOR STATE AT TIME J **
364 FOR I= 0TO N:X(I)= X(I)+ DT* (XD(I)/ 6+ XP(I)/ 3+ XQ(I)/ 3+
XR(I)/ 6):NEXT I
370 NEXT JJ
375 REM  ** STORE COMPARTMENT SIZES AT TIME J IN MATRIX **
380 FOR I= 0TO N:XX(IJ,I)= X(I):NEXT I
385 REM   ******* END OF ITERATIVE INTEGRATION LOOP *********
390 NEXT IJ
395 REM   ************* END OF SIMULATION ********************
405 REM   *************** START OUTPUT **********************
409 PLOT 12
410 PRINT "THE NUMBER OF COMPARTMENTS IN THE MODEL IS:";N+ 1
415 PRINT "THE SIMULATION HAS CONTINUED FOR 100 USER TIME UNITS.
"
420 PRINT "THE NUMBER OF ITERATIONS OF THE ALGORITHM FOR EACH"
421 PRINT "INTEGRATION WAS: ";KK
425 PRINT "THE MATRIX OF INTERCOMPARTMENTAL RATE COEFFICIENTS IS
: "
430 PRINT
435 FOR I= 0TO N
440 FOR J= 0TO N:PRINT TAB( J* 10);A(I,J);:NEXT J:PRINT :PRINT
445 NEXT I
450 PRINT :PRINT
455 PRINT "TO SEE A GRAPH OF THE SIMULATION, ENTER CONT AND"
460 PRINT "HIT THE RETURN KEY."
500 END
610 FOR I= 0TO N:BB(I)= XX(0,I):S(I)= XX(0,I):NEXT I
620 FOR J= 0TO N
630 FOR I= 1TO 100
640 IF BB(J)> XX(I,J)THEN 660
650 BB(J)= XX(I,J)
660 IF S(J)< XX(I,J)THEN 680
670 S(J)= XX(I,J)
680 NEXT I
690 NEXT J
830 REM   *************** END OF SEARCH **********************

860 FOR I= 0TO N:P(I)= 99.0/ (BB(I)- S(I)):NEXT I
870 REM   *********** SCALE VALUES CALCULATED ***************
880 PLOT 12,30,16,29,23
890 PLOT 2,26,25,242,127,25,255
900 PLOT 2,26,26,242,26,127,255
910 FOR I= 0TO N
920 PLOT 15,17+ I,3,(I* 10+ 13),30
930 PRINT "CMPT";SPC( 1);I+ 1
931 NEXT I
950 PLOT 15,23,3,32,28
960 PRINT "TIME (USER UNITS)"
970 PLOT 3,13,27
980 PRINT "0"
990 PLOT 3,36,27
1000 PRINT "50"
1010 PLOT 3,61,27
1020 PRINT "100"
2000 FOR I= 0TO N
2010 PLOT 15,17+ I,3,0,I
2020 PRINT BB(I):NEXT I
2030 FOR I= 0TO N
2040 PLOT 15,17+ I,3,0,I+ 22
2050 PRINT S(I):NEXT I
2060 FOR J= 0TO N
2070 FOR I= 0TO 100:XX(I,J)= (XX(I,J)- S(J))* P(J)+ 1:NEXT I
2080 NEXT J
2105 REM   ******** START PLOT OF OUTPUT MATRIX *************
2110 FOR J= 0TO N
2120 PLOT 17+ J,2,26,XX(0,J)+ 26,255
2130 FOR I= 1TO 100
```

*Listing 2 continued on page 86*

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*Listing 2 continued:*

```
2140 PLOT 2,(I- 1)+ 27,XX((I- 1),J)+ 27,253,(I- 1)+ 27,XX((I- 1)
,J)+ 27,I+ 27,XX(I,J)+ 27,255:NEXT I
2150 NEXT J
9999 END
READY
```

*Text continued from page 80:*

desired time step. The program will then simulate the system of compartments for 100 time units and plot a graph of the compartments versus time. To graph the compartment sizes, you must scale the simulation values and plot them on some output device. I have included code for this in listing 2, which will run unmodified on a Compucolor II microcomputer. If you intend to run this program on another computer, check to see if Disk BASIC 8001 coding is compatible with your system. See table 1 for information on the Compucolor PLOT command.

## Using the GLM Program

When the Okefenokee swamp uplands hydrologic model is simulated with this program on a microcomputer (on an 8080 microprocessor), the execution time of the Runge-Kutta algorithm is 210 seconds. When Euler's method is used, the execution time is reduced to 51 seconds. This time savings can be beneficial, depending upon the computational accuracy of the microprocessor and systems software. It can be cost-effective to use the Euler algorithm if the computer computational error is larger than the difference in the error between the Euler and Runge-Kutta methods. To give you an idea of the memory requirements necessary for a simulation, the hydrologic model can be simulated with the program in listing 2 if your microcomputer has 8 K bytes of programmable memory.

You can solve the system of linear differential equations for the size of any compartment at any time $t$. When inputs ($\mathbf{Z}$), rate ($a_{ij}$) and input ($b_{ik}$) coefficients are constant, and $t$ is initially equal to 0, the solution is:

$$x_i(t) = \underbrace{e^{\lambda_i t}\, x_i(0)}_{\text{zero-input response}} + \underbrace{\left(\sum_{k=1}^{m} b_{ik}\, z_k\right) \int_0^t e^{\lambda_i [t-\zeta]} d\zeta}_{\text{zero-state response}}$$

where:

$\lambda_i$ = eigenvalue of compartment $i$
= $a_{ii}$ + behavior caused by intrasystem coupling

This is the general solution of the ordinary differential equations in the linear model. The solution has two distinct parts, which I call the zero-input response and the zero-state response. If you eliminate the zero-state response, then the solution of the equation will give you the values of each compartment when the system does not receive any environmental input ($\mathbf{Z}$). This can be simulated by changing all the input coefficients ($b_{ik}$) to 0. In the case of the hydrologic model, you would, in effect, be asking, "How is the moisture in each compartment affected if there is no precipitation input?"

You can eliminate the zero-input response from the equation and ask, "How long would it take the system to come to steady-state conditions if there were no moisture within the system to begin with?" This would be simulated by setting the initial compartment values ($x_i$) to 0. Photo 1 shows the zero-input response of the hydrologic model simulated with the program in listing 2. Photo 2 shows the zero-state response of the hydrologic model simulated with the same program.

You can start the simulation with different compartment sizes, a different environmental input size, or change the intercompartmental rate or input coefficients, and see how any or all of these changes will affect the outcome. I suggest that you devise a model that can be described with linear differential equations and simulate it at steady-state conditions. A good domestic simulation would be a model of heat losses, subsidies, and circulation within your home. If you have a slant toward business, you can simulate the flow of material or information into, within, and out of a commercial enterprise. As long as all the compartments and flows can be described in the same units, almost any type of measure can be simulated. Once you have completed the steady-state simulation, you can experiment with the GLM program to suit your taste. If you want to make the model more realistic, you can program the inputs to the system as sine waves, square waves, exponential functions, or an impulse function, instead of being constantly added as they are now. You can also test a compartment's sensitivity to a certain parameter by varying that parameter over its range and noting the differences in the compartment.

One warning: you must always be careful to analyze your simulations and decide if they actually mimic the real-world situation *before* you make sweeping generalizations and claims that you can predict how a system will behave under any given set of circumstances. With a little imagination, interesting and sometimes eye-opening results will be seen in mathematical simulations. ■

### References


1. Atkinson, K E. *An Introduction to Numerical Analysis.* New York: John Wiley & Sons, 1978.
2. Bledsoe, L J. "Linear and Nonlinear Approaches for Ecosystem Dynamic Modeling." In *Systems Analysis and Simulation in Ecology, Volume IV.* Edited by B C Patten. New York: Academic Press Inc, 1976.
3. Blood, E; Haglund, B; Hagner, J; Hicks, R; Rowe, R; and Thomson, S. "A System Simulation and Analysis of an Okefenokee Swamp Hydrologic Model." Unpublished report, Institute of Ecology, University of Georgia, 1977.
4. Mesarovic, M D and Takahara, Y. *General Systems Theory: Mathematical Foundations.* New York: Academic Press Inc, 1975.
5. Padulo, L and Arbib, M A. *System Theory.* Washington DC: Hemisphere Publishing Corporation, 1974.
6. Patten, B C. "A Primer for Ecological Modeling and Simulation with Analog and Digital Computers." In *Systems Analysis and Simulation in Ecology, Volume I.* Edited by B C Patten. New York: Academic Press Inc, 1971.

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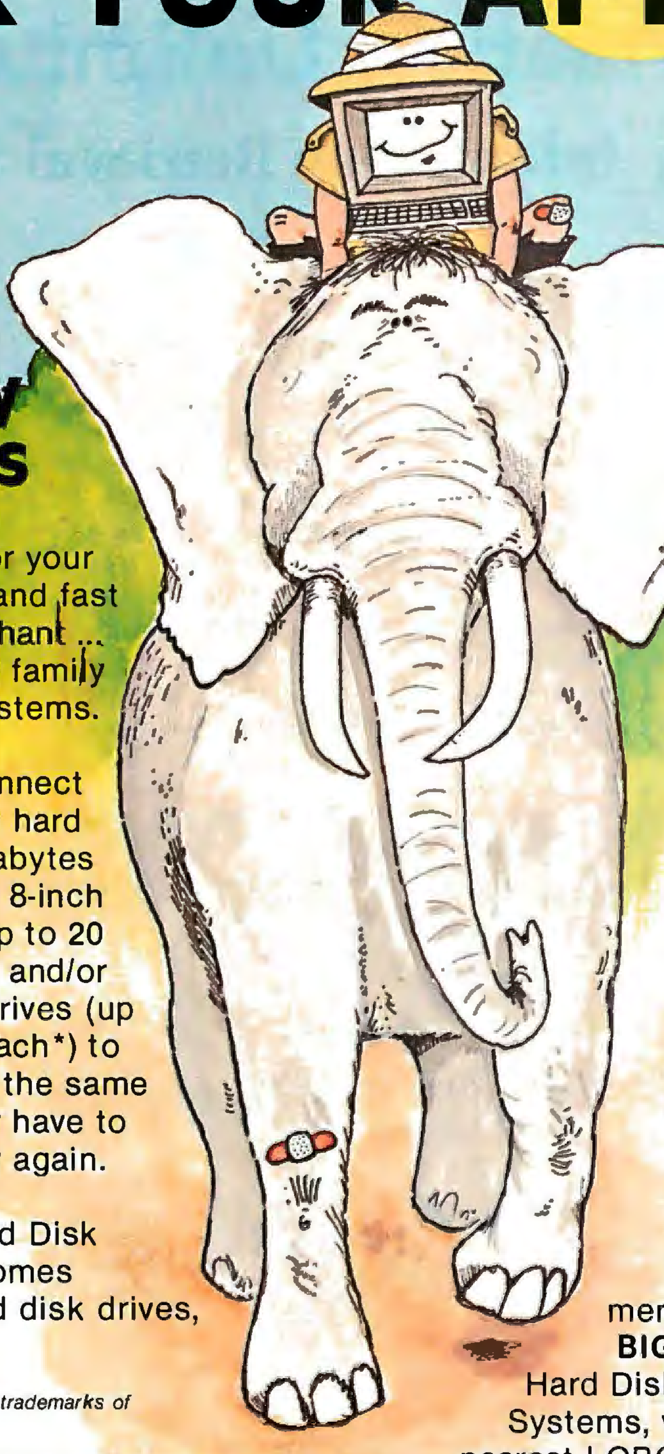

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Stan Miastkowski, Technical Editor

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A much better method is available—if you have access to a modem (modulator-demodulator) and a terminal (or personal computer with communication software). The Dialog Information Retrieval Service (part of the Lockheed Missile and Space Company, Inc) offers on-line interactive access to literally millions of references and abstracts. With Dialog, you can locate information on any subject you can possibly imagine just by typing in words or phrases describing the topic you're interested in. You can search for references by names or companies, authors or publications, dates, product codes, or patent numbers (to name only a few). By combining terms, the information you come up with can be as narrow or as broad as you want it to be. And, reprints of the articles or papers you've found references to can be ordered directly from your terminal.

When speaking of the amount of information available on the Dialog system, the numbers become mind-boggling. Dialog has some *50 billion* bytes of information available on-line in some 130 individual data bases. That works out to a rough total of about forty million individual bibliographic abstracts and references (referred to as *citations*). If all the citations were printed on 8½- by 11-inch paper, the stack would reach higher than the Empire State building.

The newspaper and magazine indexes are among the most popularly oriented data bases—although Dialog also offers a number of specialized data bases for those in education, industry, applied science and technology, and social science and the humanities. Business information and forecasts are also available. Eighteen new data bases were added to the system in 1980, and at least a dozen more will be available by the end of the year. The system is available 110 hours a week in fifty countries, and all data bases are updated regularly. Each day tens of thousands of new citations are added. Also, if you wish to create your own private data bases for use on the system, Dialog provides this service.

**Photo 1:** *The Lockheed Dialog computer room operator station. The system uses two mainframe computers—an IBM 3033 and an AS-9000 (sold in the United States by National Advanced Systems). Each computer contains a complete Dialog operating system; one handles Telenet calls, and the other Tymnet. Direct dial-in calls and leased lines are divided between the computers to even the loads. Because of the large amount of computer power available, the average wait for a response to a query is ten seconds—despite the fact that hundreds of users may be logged in during peak-use periods.*

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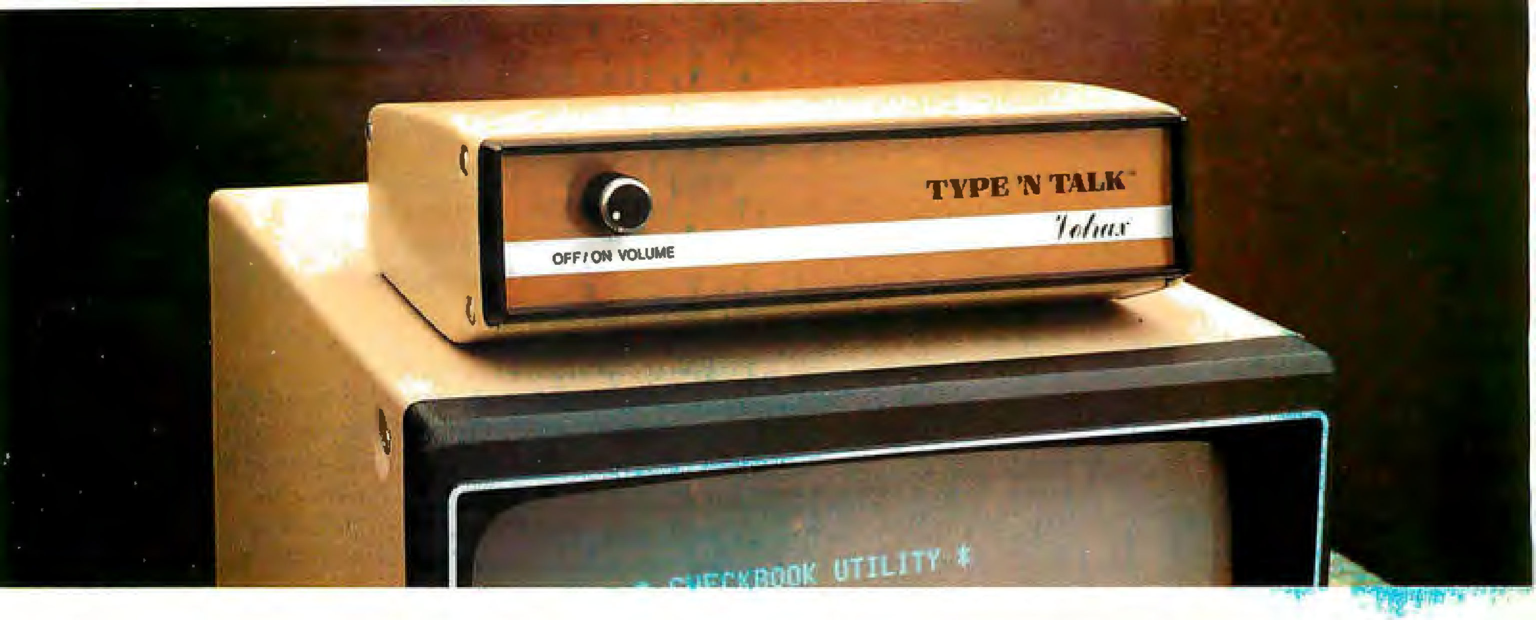


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Type-'N-Talk™ is covered by a limited warranty. Write Votrax for a free copy.

At first glance, Dialog seems expensive. Each data base has an individual charge ranging from $15 to $300 per hour of connect time. (It should be stressed that the most-used data bases cost an average of $50 an hour.) The cost becomes much more reasonable when you realize that an exhaustive search of any subject can be completed in an average of ten minutes. (Simple searches often take only a minute or two.) In addition, Dialog's response time is extremely fast because of the computer power available. Even during peak-use times, there is seldom a wait of more than ten seconds for the system to respond to a query.

It should be stressed that there are dangers inherent in using the Dialog system—especially if you're an "information junkie." It's extremely easy to become so enamored of Dialog's capabilities that you keep on calling up references and lose all track of time. The shock comes at the end of the month, when a very large bill arrives in the mail.

There are two ways to avoid this: the first is to *plan* what you'll be doing when you're logged on the system (explained in more detail below). The second is to keep track of your connect charges. Each time you log off or change data bases, Dialog prints an estimated charge. It's a good idea to keep a pad and a pencil next to your terminal and to keep a running total of charges at the end of every session.

Once you locate what you want, you can have the references and abstracts typed on your printer, although this can get expensive at the normal speed of 300 bps (bits per second). A better way is to have the citations printed by Dialog's off-line high-speed printer. The cost is minimal (normally $0.10 to $0.25 per citation) and they are mailed out the next day. Or, as mentioned above, you can order actual reprints directly from your terminal.

## Dialog History

Dialog started modestly as an in-house research and development project at Lockheed in 1963. At that time, an information sciences laboratory was established to deal with what was then recognized as the coming "information explosion." Two years later, what was essentially the first truly interactive information retrieval system was on-line for internal company use.

In 1968, Lockheed won a contract from NASA to design, program, implement, and maintain a computerized index for the half-million documents produced by the American space program. Called RECON (Remote Console Information Retrieval Service), the development process enabled Lockheed to fine-tune the specialized information retrieval command language, which was called Dialog.

After gaining more experience preparing information retrieval systems for the AEC (Atomic Energy Commission), the US Office of Education, and a number of other organizations, Lockheed, in 1972, decided to offer commercial service and officially named the system Dialog.



**Photo 2:** *Some of the 200 hard-disk drives used by the Dialog system. Most of the CDC (Control Data Corporation) drives hold 637 megabytes of data for a total of more than 50 billion bytes of on-line storage.*

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- English error messages
- user environment control
- disk resident commands
- flexible device I/O
- printer spooling

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Industrial users continue to be Dialog's largest customers since much of the information in the specialized data bases (such as WORLD ALUMINUM ABSTRACTS or SURFACE COATING ABSTRACTS) is virtually unavailable anywhere else. Government agencies are also heavy users of Dialog's services—followed closely by educational institutions and libraries. Although personal computer users currently make up a very small percentage of Dialog customers, Lockheed officials told me they are in the process of adding more general-interest data bases to attract more individuals.

**Photo 3:** *IBM reel-to-reel tape with new and updated data waiting to be placed on the Dialog system. Some twenty tapes arrive at Dialog each day from the outside organizations that prepare the data bases. Each tape contains approximately 20,000 individual references and/or abstracts.*



### A Visit to Dialog

Dialog's facilities are located in Palo Alto, California. As might be expected, the hardware needed to handle the enormous amount of information contained within the Dialog system has taken over a large portion of its building. For those used to working with a personal computer and a floppy disk or two, a visit to Dialog's computer room is a humbling experience. Two mainframe computers (an IBM 3033 and an AS-9000) are both on-line at all times. When I visited Dialog in January, the AS-9000 had just been put on-line. This so-called "super-mainframe" is sold in the United States by National Advanced Systems. Since its claimed speed far exceeds that of any other mainframe, a Dialog spokesman told me he expects it to greatly increase the system's capacity.

The most interesting part of Dialog's facilities are the hard-disk drives—some 200 of them. Most are CDC (Control Data Corporation) units capable of storing 637 megabytes per drive. Although direct dial-up numbers are available, the majority of Dialog users access the system through Tymnet or Telenet (national data-communication networks that have local telephone numbers in many communities).

Lockheed officials term Dialog a value-added *on-line service supplier*. All of the approximately 130 data bases are put together by seventy *data base producers* who have contractual agreements with Dialog. The process of producing and updating each of the data bases is a large one involving literally thousands of people who review publications, journals, and newspapers—many on a daily basis. Many reviewers work at home and transfer their citations to floppy disks, which are sent to the data base producers. The final step is to transfer all the citations to IBM magnetic tape. Between ten and twenty of these tapes, each containing about 20,000 new citations, arrive at Dialog headquarters every day. Before the information is added to the system, *every word* in all citations is indexed. This is one of the most powerful searching features of the system.

### Popular Data Bases

Although many of Dialog's data bases are extremely specialized (such as AQUACULTURE, BHRA FLUID ENGINEERING, or PHARMACEUTICAL NEWS INDEX), a number of the existing data bases are of general interest or of special significance to BYTE readers. Among them are:

- ERIC — One of the first Dialog data bases available, ERIC (Educational Resources Information Center) indexes some 700 publications of interest to every segment of the educational profession. About 3000 citations are added every month.
- COMPENDEX — This data base contains abstracted information from approximately 2000 of the world's

engineering and technical journals since 1969.

- INSPEC — This data base is similar to COMPENDEX except it also abstracts scientific bulletins and contains bibliographic references from scientific indexes. Included is a special section of computer and control abstracts.
- ABI/INFORM — This data base contains management and administration abstracts from some 400 business-related publications.
- SCISEARCH — This is an index to approximately 2600 scientific and technical publications since 1974.

**Photo 4:** *IBM reel-to-reel tape drives used to load new and updated information into the Dialog disk drives.*



This data base contains bibliographic references only.

- MAGAZINE INDEX — Perhaps the most popularly oriented Dialog data base, this is a cover-to-cover index of about 370 popular American magazines since 1976 and contains some 300,000 citations. It's particularly useful for most general-purpose reference questions since it indexes all articles, news reports, editorials, product evaluations, biographical pieces, short stories, poetry, recipes, and reviews. Approximately 5000 citations are added to this data base monthly.
- SSIE CURRENT RESEARCH — Compiled by the Smithsonian Science Information Exchange, this data base lists and summarizes most government-funded research projects either in progress or completed within the past two years.
- GPO MONTHLY CATALOG — This is the catalog (updated monthly) of US government publications.
- ENERGYLINE — This data base contains bibliographical citations as well as abstracts on all aspects of energy.
- CONFERENCE PAPERS INDEX — This is an index to meetings and symposia on all scientific and technical fields. Also included are references to conference papers (many of which have never been published). This is a very large data base to which about 10,000 citations are added each year.
- NATIONAL FOUNDATIONS — This lists all US private foundations that award grants for charitable purposes.
- DISCLOSURE — This data base, updated weekly, provides extracts of reports filed with the SEC (Securities and Exchange Commission) by all publicly owned companies in the United States.
- NATIONAL NEWSPAPER INDEX — This data base contains front-to-back indexing of *The New York Times*, *The Wall Street Journal*, and *The Christian Science Monitor* since January 1, 1979. It contains bibliographical references to everything included in the papers, with the exception of advertisements, weather charts, stock market tables, crossword puzzles, and horoscopes. About 15,000 new citations are added monthly.
- NEWSEARCH — This is a *daily* update of the MAGAZINE INDEX, MANAGEMENT CONTENT, the LEGAL RESOURCE INDEX, and the NATIONAL NEWSPAPER INDEX; it is invaluable for locating references within days of an article's appearance.
- ENCYCLOPEDIA OF ASSOCIATIONS — This data base contains detailed information on approximately 15,000 national nonprofit organizations. Included are listings for professional societies, trade associations, labor unions, and cultural and religious organizations.
- STANDARD AND POOR'S NEWS — Provides extensive news coverage as well as financial reports on

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**Photo 5:** *The Xerox 9700 high-speed printer used by Dialog for off-line printing of references. The printer operates at two pages a second and offers Dialog users a considerable savings over having their references printed out while logged onto the system. The average cost of having references printed off-line and mailed to you is $0.10 to $0.25 per citation.*

**Photo 6:** *Dialog's customer-service area, where specially trained personnel are available to offer advice. They can be reached by calling a toll-free number.*

over 9000 companies. This data base is the equivalent of the Standard and Poor's *Daily News* and *Cumulative News* and often features full-length news stories.

- DIALINDEX — This is perhaps the most useful of the Dialog data bases and contains a collection of the file indexes for *all* data bases. DIALINDEX is a low-cost data base that allows you to ascertain which data bases contain the information you're searching for.
- NTIS — Compiled by the National Technical Information Service of the US Department of Commerce, this data base contains citations to more than 700,000 US reports covering government-sponsored research and development and engineering. Information on almost any subject imaginable is contained within this massive data base.

In addition, there are data bases covering psychology, chemistry, agriculture, medicine, biology, physics, and many other fields and disciplines. Dialog provides a free catalog of all the available data bases.

The Dialog staff and data base producers are continually adding new data bases to the system. By the end of this year, plans call for the addition of a biography index with over five million names, a book review index, an index of the Congressional Record, the Federal Index, a grants index, data from the Bureau of Labor Statistics, and Medline (a medical information data base designed for both physicians and consumers).

### Accessing Dialog

There is no minimum fee or startup charges for the Dialog service. Once you've filled out an application and

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SSIE CURRENT RESEARCH

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TRIS (Transportation)
WELDASEARCH
WORLD ALUMINUM ABSTRACTS
WORLD TEXTILE ABSTRACTS

**Figure 1:** *Available Dialog data bases as of February 1981. Eighteen new data bases were added to the system in 1980; about a dozen more are planned to be operational by the end of 1981.*

have been provided with a password, the easiest means of accessing the system is through either the Tymnet or Telenet networks. Currently, Tymnet charges $8 per hour and Telenet charges $5 per hour. The network connect charges are added to your Dialog monthly statement. (At the present time, Dialog bills monthly, but it is studying the possibility of billing through charge cards.) Dialog provides a list of telephone numbers and passwords/access numbers for both networks. If you have to make a toll call to access the networks, that's an additional charge. This expense is minimized, of course, for subscribers in Dialog's local area or those who have access to WATS (wide-area telephone service) lines. There are also direct-access lines to Dialog and incoming WATS lines are available at $15 per month.

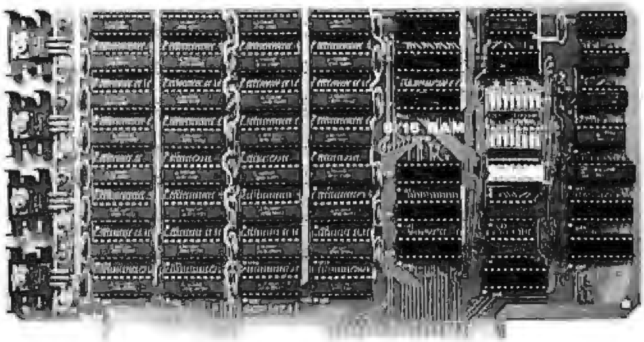
## Using Dialog

There are a number of levels at which the Dialog system can be used. Most of the time, you'll find a simple search with a couple of terms the easiest way to go. A

*Higher production volume and lower chip prices allow us to pass these savings on to you*

# RAM Prices *SLASHED*

## *16K BYTE 8/16 RAM*



This fully static RAM board offers you the best of two worlds. Automatically switches between 8-bit or 16-bit operation, depending upon your CPU. High reliability, low noise design. 200 nsec. chips allow 8 Mhz. 8086 operation. Has extended addressing which can be disabled by a single switch. Prices: 1-9, $280; 10-19, $260.

---

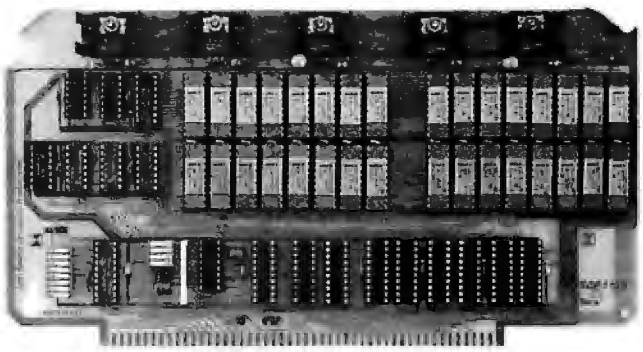
## *OTHER RAM SAVINGS*

16K PLUS RAM—this fully static RAM has become the standard of the industry. It features 200 nsec. chips and Cromemco style bank select using port 40H. Addressable to any continuous 16K on 4K boundaries. Any 4K block may be disabled. High reliability, low noise design. Prices: 1-9, $280; 10-19, $260.

16K STANDARD RAM—this fully static RAM is frequently used by OEMs in systems which do not require bank select. High reliability, low noise circuits. Uses 200 nsec. chips. Addressable to any continuous 16K on 4K boundaries. Any 4K block may be disabled. Prices: 1-9, $265; 10-19, $245.

---

## *64K STATIC 8/16 RAM*



AVAILABLE JULY 6—This state-of-the art board uses 2167 16K static 70/100 nsec. chips in a "power down" mode. This means you can expect the first 64K in a system to use 1.6 amps with subsequent boards using about .8 amps each. Built for the same high reliability you have come to expect from using our other boards. Has 24-bit extended addressing which can be disabled. Initial quantities will be limited—reserve yours now to ensure early delivery. Prices: 1-9, $1295; 10-19, $1195.

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*To obtain an OEM price list for the above memory boards, our 8086 and Interface product lines, write to us on your letterhead. Substantial additional savings for volume purchases.*

TO ORDER: Many of your local computer stores have or can order these boards for you. They may also be ordered direct from the factory. Personal checks, CODs, VISA and MC accepted. Shipping paid by SCP for prepaid orders.

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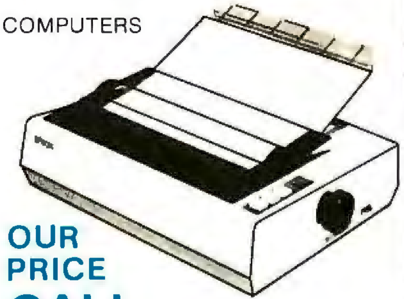

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|---|---|
| Assembler/Editor | 45 |
| Atari 400 Computer | 439 |
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| Atari 810 Disk Drive | 499 |
| Atari 410 Program Recorder | 69 |
| Atari 16K RAM Module | 149 |
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## PRINTERS, MONITORS, DISCS

| | |
|---|---|
| Anadex DP8000 | 850 |
| Anadex DP8000AP | 850 |
| Color Monitor | 375 |
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| MPI 88T | 595 |
| NEC Spinwriter #5510 | 2595 |
| Paper Tiger 445G w/Graphics | 725 |
| Paper Tiger 460 w/Graphics | 1195 |
| Silentype w/interface Cd. | 540 |
| Sanyo 9" B&W | 169 |
| Sanyo 15" B&W | 259 |
| NEC Green Screen 12" | 239 |
| Dysan disks (pkg. 10) | 50 |
| Memorex disks (pkg. 10) | 40 |
| Opus disks (pkg. 10) | 35 |
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| Verbatim disks (pkg. 10) | 30 |

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**CENTRONICS 737**
cable extra
**$737**

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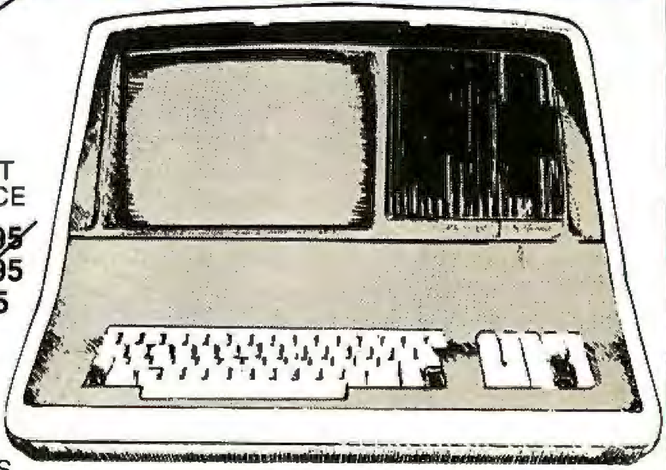

| | LIST PRICE |
|---|---|
| 32K Double Density | ~~2995~~ |
| 64K Double Density | ~~3495~~ |
| 64K Quad. Density | ~~3995~~ |

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| | |
|---|---|
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| Applesoft II Firmware Cd. | 149 |
| Centronics Interface Cd. | 179 |
| Apple Clock/Calendar Cd. by Mtn. Comp. | 225 |
| Comm. Cd. & DB25 Cable | 179 |
| Integer Basic Firmware Cd. | 149 |
| Parallel Printer Cd. | 139 |
| CCS Parallel Print Cd. 7720A | 155 |
| ROMPLUS w/keyboard filter | 165 |
| ROMPLUS (keyboard filter extra) | 159 |
| SSM AIO Serial/Parallel I/O Assembled & Tested | 189 |
| Serial Interface Cd. | 139 |
| CCS Asynchronous 7710A | 139 |

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| | |
|---|---|
| ALS Smarterm | 324 |
| Adventure by Microsoft | 29 |
| Apple Bowl | 19 |
| Apple Stellar Invaders | 19 |
| Assembler/Disassembler | 69 |
| Applebug Debugger | 29 |
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| Applepost Mailing List Sys. | 44 |
| Applesoft Cassette Demos | 29 |
| Applesoft Util. Prog. — Hayden | 29 |
| Applewriter Word Processor | 65 |
| Asteroids in Space | 19 |
| Autostart ROM Pkg. | 59 |
| Battleship Commander | 19 |
| Bill Budges Space Game Album | 39 |
| Bill Budges 3-D Graphics/Tool | 39 |
| Bill Budges Trilogy of Games | 29 |
| Cashier Retail Mgmt. Sys. | 199 |
| Checkbook Cassette | 19 |
| Contrib. Vols. 1-5 w/man. | 29 |
| Controller Bus. Pkg. | 514 |
| Cosmos Mission/Disk | 25 |
| CCA Data Mgmt. Sftwe. | 84 |
| 3-D Animation Pack | 55 |
| Desktop Plan Sftwe. | 79 |
| DOS Tool Kit | 65 |
| DOS 3.3 Upgrade | 49 |
| Dow Jones Portfolio Evaluator | 45 |
| Fastgammon | 23 |
| Forth II by Softape | 45 |
| Fortran for Language Sys. | 159 |
| Head-on | 25 |
| Integer Basic Cassette Demos | 29 |
| Lazer Systems Lower Case + Plus | 59 |
| Microsoft 16K Ramcard | 179 |
| PASCAL Language Sys. | 459 |
| Sargon II Chess Game disk | 34 |
| Shell Games | 29 |
| Single Disk Copy Routines | 35 |
| Space Invader | 25 |
| Star Cruiser | 24 |
| Stellar Trek | 23 |
| Sub-Logic FS-1 Flt. Sim./disk | 34 |
| Tax Planner | 99 |
| The Correspondent | 35 |
| Tranquility Base | 24 |
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## ACCESSORIES

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|---|---|
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| ABT Numer. Input Keyboard A or B | 114 |
| A/D D/A Board by Mtn. Comp. | 319 |
| Arith. Processor 7811 A or B | 339 |
| Clear Cover for Apple Computer | 25 |
| COPYROM by Mtn. Comp. | 51 |
| Corvus 10MByte Disk w/pwr. supp. | 4395 |
| Dan Paymar L.C. Kit 1 or 2 | 59 |
| Extender Board | 27 |
| GPIB by CCS model 7490A | 259 |
| Graphics Input Tablet | 649 |
| Hayes Micromodem* | 319 |
| Introl X-10 Remote Control Sys. | 239 |
| Introl X-10 Controller Only | 169 |
| M&R Sup-R-Term 80 column board | 329 |
| Microsoft Z-80 Soft Card | 295 |
| Novation Cat Modem | 159 |
| Programmable Timer CCS 7440A | 159 |
| Prototyping Hobby Card | 22 |
| ROMWRITER by Mtn. Comp. | 149 |
| Speechlink 2000/64 Word Vocab. | 215 |
| SuperTalker Speech Synthesizer | 239 |
| Symtec Light Pen | 214 |
| Versa-Writer Digitizer Drawing System | 209 |
| Videx Videoterm | 319 |

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Circle 82 on inquiry card.

number of advanced searching functions are available; however, they probably won't be needed until you have quite a bit of experience on the system. Dialog's searching commands are simple, straightforward, and easy to learn. Dialog representatives do offer formal training classes on a regularly scheduled basis at locations throughout the country. However, they're mainly designed for those with no computer experience and those who will be using Dialog as a regular part of their job (such as librarians). New users are given some free time on the system in order to have an opportunity to get a feel for how Dialog works.

*Text continued on page 106*

**Listing 1:** *A typical search on the Dialog Information Retrieval Service—using the MAGAZINE INDEX data base. For the most efficient use of the system, as well as lower cost to the user, the* search strategy *(steps) should be planned on paper before logging in. See the text box of* Basic Dialog Commands *for a summary of the Dialog language. A SELECT statement can be up to 240 characters (when Boolean operators are used). Each search can create up to 98 sets, and there is a limit of one million citations per search.*

Dialog system prompt

"Wildcard" - looks for any characters after the last letter of the word

```
?SELECT COMPUTER?
          1  4251  COMPUTER?
```

Number of citations

Set number

```
? SELECT MICROCOMPUTER?
          2   308 MICROCOMPUTER?
```

Indicates the two terms must be adjacent to one another in the index

```
? SELECT STEPS PERSONAL(W)COMPUTER? OR MHOME(W)COMPUTER?
          3   122 PERSONAL(W)COMPUTER?
          4    85 HOME(W)COMPUTER?
          5   185  3 OR 4
```

Previously selected set number

```
? SELECT S5 AND JN =BYTE
```

Journal name (special index field)

```
              824 JN=BYTE
          6    20  S5 AND JN=BYTE
```

Set number

Format number

```
? TYPE 6/ 1/ 1
6/1/1
1536795
```

Set item number

Dialog reference number

```
? TYPE 6/2/1
6/2/1
1536795
 FCC regulation of personal- and home-computing devices. (Federal
Communications Commission)
 Mahn, Terry G.
 Byte v5 p180(7) Sept 1980 CODEN: BYTEDJ
 DESCRIPTORS: United States. Federal Communications Commission-rules and
regulations; computers-rules and regulations
 IDENTIFIERS: personal computers-rules and regulations


? TYPE 6/3/1
6/3/1
1536795
 FCC regulation of personal- and home-computing devices. (Federal
Communications Commission)
 Mahn, Terry G.
 Byte v5 p180(7) Sept 1980 CODEN: BYTEDJ


? TYPE 6/4/1
6/4/1
1536795
```

*Listing 1 continued on page 104*

*Listing 1 continued:*

```
  FCC regulation of personal- and home-computing devices. (Federal
Communications Commission)

? TYPE 6/3/1-20
6/3/1
1536795
  FCC regulation of personal- and home-computing devices. (Federal
Communications Commission)
  Mahn, Terry G.
  Byte  v5  p180(7)  Sept 1980  CODEN: BYTEDJ

6/3/2
1522838
  The Heath H-89 computer. (evaluation)
  Dahmke, Mark
  Byte  v5  p46(6)  Aug 1980  CODEN: BYTEDJ
  illustration

6/3/3
1508584
  Bills introduced in Congress. (dealing with personal computers)
  6)
  Byte  v5  p186(6)  June 1980  CODEN: BYTEDJ

6/3/4
1508580
  A personal computer on a student's budget.
  Johnston, J.C.
  Byte  v5  p138(6)  July 1980  CODEN: BYTEDJ
  illustration
          :                :
          :                :
          :                :
6/3/17
1017592
  User's report: the PET 2001. (evaluation)
  Fylstra, Dan
  Byte  v3  p114(9)  March 1978

6/3/18
1017578
  Personal computers in a distributed communications network.
  Steinwedel, Jeff; S
  Byte  v3  p80(8)  Feb 1978

6/3/19
1017469
  Speech recognition for a personal computer system.
  Boddie, James R.
  Byte  v2  p64(7)  July 1977

6/3/20
1017464
  Personal computer network.
  Byte  v2  p59(2)  Sept 1977

? END/SAVE
Serial# 4QDI
```

Serial number of search strategy (steps used)

*Listing 1 continued on page 106*

# POWER-ONE D.C. POWER SUPPLIES

## Our customers select their favorite models

The choice wasn't easy. Not with 105 open frame linears and a full switcher line to choose from. Still, the top models of the past year — proudly pictured below — have been named.

Actually, this is a statement of Power-One's most popular D.C. power supplies — as determined by our customers. Obviously, applications vary widely, from small floppies and micro-computers to large main-frame systems.

But one thing they all have in common. They're built by Power-One. Which means the most reliable power supplies available, at the lowest cost possible.

So take a look at our entire line. Send for our new 1981 Catalog and Facilities Brochure for details.

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- Hi-Tech Design
- High Efficiency - 75% min.
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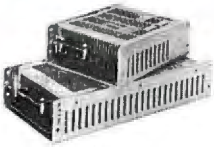
- 115/230 VAC Input
- 20 msec Hold-up
- Totally Enclosed Packaging
- Two Year Warrantee
- 24 Hour Burn-in

### SINGLE OUTPUT

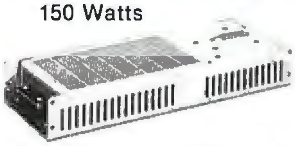


5V to 24V Models

SD, 60W : $115.00
SF, 100W : $170.00
SK, 200W : $250.00

### MULTIPLE OUTPUT

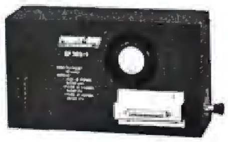
150 Watts



5V @ 20A
12V @ 5A
-12V @ 3A
5V to 24V @ 3.5A
User Selectable

SHQ-150W : $295.00

### QUME PRINTER SUPPLY



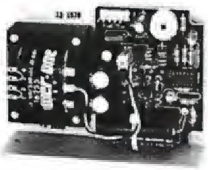
5V @ 10A
± 15V @ 4.5A/16A Peak

SP305 : $345.00

### Disk-Drive

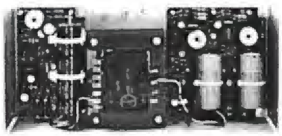
- Powers Most Popular Drives
- 7 "Off the Shelf" Models
- Powers Drives & Controller
- UL & CSA Recognized
- 115/230 VAC Input

### 5¼" FLOPPY SUPPLIES



CP340, 1 Drive : $44.95
CP323, Up to 4 Drivers : $74.95

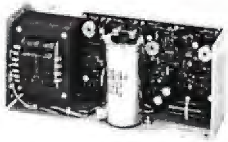
### 8.0" FLOPPY SUPPLIES



CP205, 1 Drive : $69.95
CP206, 2 Drives : $91.95
CP162, Up to 4 Drives : $120.00

### WINCHESTER SUPPLIES

2 Models to Power any Manufacturer's Drive

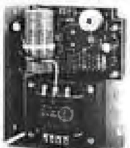


CP379, CP384 : $120.00

### Open-Frame Linear

- Industry Standard Packages
- 115/230 VAC Input
- ±.05% Regulation
- Two Year Warrantee
- UL & CSA Recognized
- Industry's Best Power/Cost Ratio

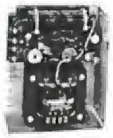
### SINGLE OUTPUT



5V @ 3A
12V @ 1.7A
15V @ 1.5A
24V @ 1.2A
28V @ 1.0A
250V @ 0.1A

HB Series : $24.95

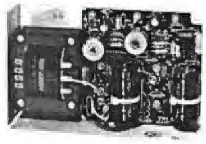
### SINGLE OUTPUT



5V @ 6A
12V @ 3.4A
15V @ 3.0A
24V @ 2.4A
28V @ 2.0A
48V @ 1.0A

HC Series : $44.95 to $49.95

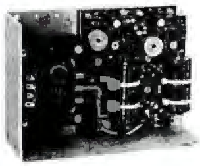
### DUAL OUTPUT



± 12V @ 1.0A or
± 15V @ 0.8A

HAA15-0.8 : $39.95

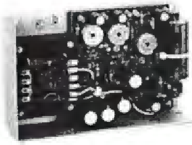
### DUAL OUTPUT



± 12V @ 1.7A or
± 15V @ 1.5A

HBB15-1.5 : $49.95

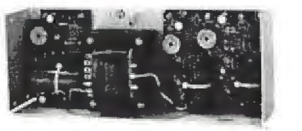
### TRIPLE OUTPUT



5V @ 2A
± 9V to ± 15V @ 0.4A

HTAA-16W : $49.95

### TRIPLE OUTPUT



5V @ 3A
± 12V @ 1A or
± 15V @ 0.8A

HBAA-40W : $69.95

### POWER FAIL MONITORS

- Indicates pending system power loss.
- Monitors AC line and DC outputs.
- Allows for orderly data-save procedures

PFM-1 : $24.95 PFM-2 : $39.95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*Listing 1 continued:*

```
? BEGIN 111                                          Dialog file number
File111:National Newspaper Index
(Copr. IAC)
        Set Items Description (+=OR;*=AND;-=NOT)
        --- ----- --------------------------------

? .EXECUTE 4QDI                                      Execute previous search strategy
                    1588 COMPUTER?
                       7 MICROCOMPUTER?
                      23 PERSONAL(W)COMPUTER?
                      19 HOME(W)COMPUTER?
                      35  3 OR 4
                       0 JN=BYTE

? BEGIN 47
File47*:Magazine Index -
(Copr. IAC)
        Set Items Description (+=OR;*=AND;-=NOT)
        --- ----- --------------------------------

? EXPAND COMPUTER                Find all index terms alphabetically close to specified term
Ref   Index-term                  Type Items RT
E1    COMPUTATIONAL COMPLEXITY            1
E2    COMPUTATIONS-------------           1
E3    COMPUTE------------------           4
E4    COMPUTED-----------------           3
E5    COMPUTEK-----------------           2
E6   -COMPUTER-----------------        3228
E7    COMPUTER AIDED DESIGN----          24
E8    COMPUTER AND BUSINESS
        EQUIPMENT MANUFACTUR--            2
E9    COMPUTER AND COMMUNICATI
        ONS ASSOCIATION--------           1
E10   COMPUTER AND COMMUNICATI
        ONS INDUSTRIES ASS----            1
E11   COMPUTER AND SYSTEMS
        ENGINEERING LTD.-------           1
E12   COMPUTER ANIMATION-------           5
E13   COMPUTER APPLICATIONS
        CORP.------------------           2
E14   COMPUTER ARCHITECTURE----           2
```

*Text continued from page 102:*

## Searching

A Dialog spokesman stressed to me the importance of developing a general search *strategy*. This means sitting down with paper and pencil *before* logging on to the system, organizing questions or topics into logical groups, and then combining the groups through the use of logical (Boolean) relationships. This is an important point since wasting time with an inefficient searching strategy can become very expensive.

Since every word in every citation is indexed, the key to efficient searching is being as specific as possible. For example, the MAGAZINE INDEX contains 1.3 million individual citations; searching for all references to COMPUTER? (the ? is a "wildcard" character that matches any letters at the end of the word) yielded 4251 citations (see listing 1). Obviously, steps must be taken to pare down the number of citations by being much more specific. Searching for MICROCOMPUTER? yielded 308 citations, still a healthy number. HOME(W)COMPUTER? OR PERSONAL(W)COMPUTER? yields 185 citations. (The (W) indicates the two words must be adjacent to one another.)

Besides the every-word indexing, all Dialog data bases contain special indexes that vary from file to file. If I wish to search for all home and personal computer articles in BYTE, I can AND my set of 185 citations with JN=BYTE—giving me a total of twenty citations. There are also special indexes which allow you to specify publication year, author name, article type (such as product review), or a number of other special features. Obviously, sitting down beforehand and planning your search

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**Basic Dialog Commands**

*Although there are many commands available in the Dialog searching language, a small number are the only ones used for the majority of searches. They include:*

- *EXPLAIN — an on-line help file that provides a detailed description of any specified command. The file also contains a list and description of all available data bases and system news.*
- *SELECT — sets aside index terms or groups of terms you specify into numbered sets (up to 98). More than one term can be combined into a single SELECT statement by inserting Boolean operators between terms. For example:*

  *SELECT PETROLEUM AND PRICES AND OPEC AND PY=1979*

  *A command line can contain up to 240 characters.*
- *SELECT STEPS — similar to SELECT, except that each individual item in a single command statement is assigned its own set number.*
- *EXPAND — used to display a listing of index terms that are alphabetically close to the term entered. Each term is given a reference number that can be SELECTed, and the number of individual entries for each term is listed.*
- *TYPE — displays records on-line from the sets you've previously retrieved. A number of different formats and ranges can be entered. For example, the Dialog reference number, the title only, or the full record can be displayed.*
- *PRINT — orders the specified search results to be printed off-line using Dialog's high-speed printer. The printouts are normally received in three to four days. If you've retrieved a large number of references and/or abstracts, having them printed off-line is considerably less expensive than using connect time to dump them to your own printer.*
- *END/SAVETMP — ends a search session and saves the search strategy (individual steps) you've used in an individual data base. The strategy is saved until the end of the calendar day and in that period can be used in other data bases by using the .EXECUTE command.*
- *.EXECUTE — searches a data base using the search strategy saved by the END/SAVETMP command. This eliminates the time and expense of having to enter individual steps every time a different data base is entered.*
- *END/SDI — ends a search session and instructs the Dialog system to run the same search strategy in the specified file each time the file is updated. If new information is found, it is printed off-line and mailed to you. (This service is not available on all Dialog files.)*
- *KEEP — saves the references and/or abstracts you specify in a special set from which documents may be ordered using DialOrder.*
- *.ORDER — automatically orders reprints specified by the KEEP command. The document supplier can be specified from a list supplied by Dialog.*

For more information on Dialog and an application for service, contact:

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California (800) 772-3545, ext 518

makes the process proceed much more quickly, smoothly—and inexpensively.

If you have problems finding the correct search strategy, there is a toll-free hotline number to Dialog's Customer Service Department, which is open twelve hours a day. Besides helping beginning searchers, there is a specialist on each data base available who can help with a particularly complicated search.

### Other Features

Dialog allows you to reconnect to the system within ten minutes of a disconnect (such as being dropped by one of the networks). Up until this time limit, all the set you've created will still be in the user area. Unfortunately, if the disconnect lasts longer, you'll have to start again from the beginning.

Users who wish to keep their own private data bases on the Dialog system can do so through the Private File Service. The cost for storage of data is $12 per million characters per month. Currently, in order to take advantage of the Private File Service, users must supply Dialog with IBM reel-to-reel tapes. However, Dialog's staff is in the process of developing a method that will enable users to build up their personal data bases from their own terminal.

### Summary

Dialog is an invaluable service for anyone who needs to locate information on any imaginable subject from aardvarks to zymurgy. (Remember, the system is *not* designed to be everything to all people. Unlike the Source or Micronet, you can't play games or get the latest news from one of the wire services; not only are those services unavailable, but the cost of just "browsing" adds up very quickly.) Although the cost of the service seems expensive, the system's speed, efficiency, and interactive nature make it a net time and money saver when it's used for its intended purpose—finding references to information.

A Dialog staffer put it this way: "On the system, searching is an adventure." I can add that this adventure is *much* less frustrating than the computer game of the same name. ■

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# A Computer-Based Laboratory Timer

John Gibson
Physics Department
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Accurate time measurement is a fundamental requirement of every elementary physics laboratory. Thanks to modern electronics, most laboratories now use digital timing devices that are activated by photocells or microswitches. This is a great improvement over the hand-operated mechanical stop-clocks that were prevalent only a few years ago, but most electronic timers are still unsatisfactory in one important respect: only the most sophisticated (and expensive) are able to rapidly make and record a succession of elapsed-time measurements.

Data acquisition and logging are natural provinces of the microcomputer. Since small microcomputers and microcomputer trainers are now so widely available, it is only natural to try to adapt them for use in a variety of laboratory measurements. This article will show how a very modest microcomputer can be wired and programmed for use as a sophisticated laboratory timer.

First we will examine the system-independent design considerations for a microcomputer-based, two-channel, data-logging, millisecond timer. Then we will build this design on a Heath ET-3400 microprocessor trainer used with the ETA-3400 expansion accessory.

## The Programmable Timer

The heart of this design is a microcomputer peripheral device called a *programmable timer*. This device connects directly to the microcomputer bus and may be configured (by software) to perform the timing measurements required. When the programmable timer and microcomputer are connected for use as a laboratory timer, there is a clear division of labor: the programmable timer performs the time measurements, and the microcomputer records the results.

Figure 1 is a programming model of a common programmable timer. In addition to its connections to the microcomputer bus, the timer also has a gate input $\overline{G}$, an external clock input $\overline{C}$, and an output O. Inside the timer are three addressable registers:

- An 8-bit, write-only *control register* that is used to establish the timer's operating mode, in much the same way as a control register configures the operation of a common PIA (peripheral interface adapter);
- A 16-bit write-only *latch*. Its contents are divided into two 8-bit bytes, called M, for the more-significant (or high-order) byte, and L, for the less-significant (or low-order) byte. The latch's contents are preset to hexadecimal FFFF on system power-up or $\overline{\text{RESET}}$, and they may be changed at any time by the program running in the microcomputer;
- A 16-bit write-only *counting register*. A momentary logic-0 level at the timer's gate input causes this register to be loaded with bytes M and L from the latch. The counting register then decrements on each cycle of a specified timing signal. Further operating details are dictated by the timer's operating mode.

*Text continued on page 114*

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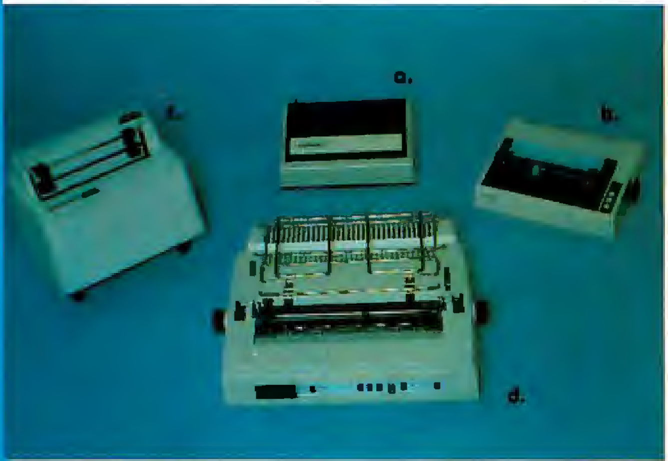


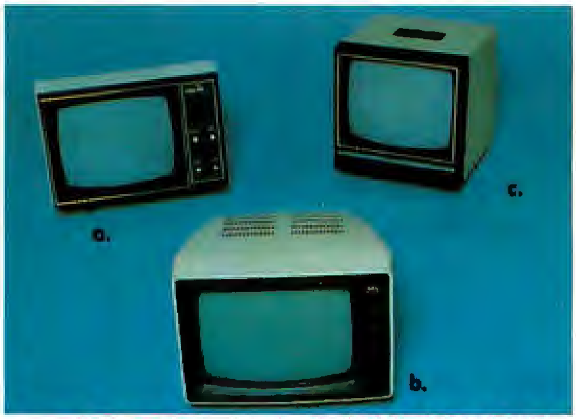


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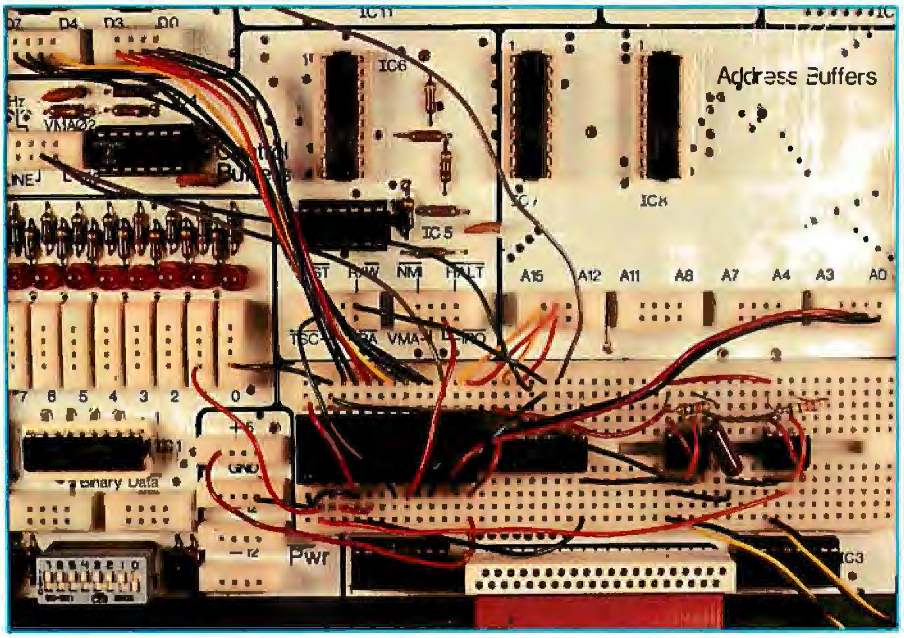


**Photo 1:** *Heath ET-3400 microcomputer trainer wired for use as a two-channel, data-logging, millisecond timer. The picture shows all circuit components except the phototransistors, which are connected to the type-555 integrated circuits (used as input comparators) via the two yellow-black twisted pairs of wires at the lower right.*

**Photo 2:** *Lamp and phototransistor attached to one end of the air track. For best timing resolution, the lamp is mounted so that its filament is vertical.*

*Text continued from page 110:*

The programmable timer is a versatile device with several operating modes, two of which are useful for elapsed-time measurements:

- *Pulse-width-comparison mode,* in which the timer measures the length of time its gate input is held at logic 0;
- *Frequency-comparison mode,* in which the timer measures the time between two successive logic 0s at its gate input.

These two types of time measurement are illustrated in figure 2.

## Time-Interval Measurement

Each elapsed-time measurement consists of six steps. The first three steps are performed by the programmable timer, and the last three are performed by the microcomputer.

The following three measurements are those performed in sequence by a timer programmed for operation in the *pulse-width-comparison mode* (by storing hexadecimal 58 in its control register):

1. The timer's gate input, normally at logic 1, is pulled to logic 0 at the beginning of the timed event. This loads the timer's counting register with bytes M and L from the latch.
2. The counting register then decrements on each cycle of a timing signal applied to the timer's external-clock input and continues to do so while the gate input is held at logic 0.
3. The gate input is driven back to logic 1 at the end of the timed event. If this occurs before the counting register reaches zero, the count stops, and the timer generates a program interrupt by pulling the microcomputer's active-low $\overline{IRQ}$ (interrupt-request) line to logic 0.

The three measurement steps performed by a timer programmed for operation in the *frequency-comparison mode* (by storing hexadecimal 48 in its control register) are as follows:

1. The timer's gate input, normally at

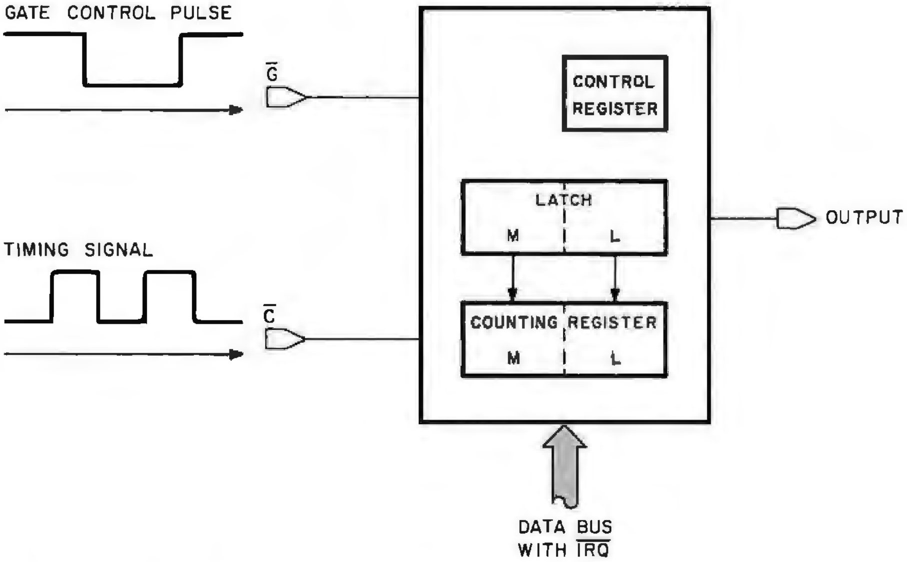


**Figure 1:** *Model of the programmable timer, showing gate input $\overline{G}$, external-clock input $\overline{C}$, output O, the connection to the microcomputer bus, and the addressable registers. The arrows pointing from the latch to the counting register indicate the data transfer that takes place at the beginning of each count. Output O is not used in either the pulse-width-comparison or frequency-comparison modes of operation.*

logic 1, is *momentarily* pulled to logic 0 at the beginning of the timed event. This loads the timer's counting register with bytes M and L from the latch.

2. The counting register then decrements on each cycle of a timing signal applied to the timer's external-clock input and continues to do so, even though the gate input returns to logic 1.

3. The gate input is again momentarily pulled to logic 0 at the end of the timed event. If this occurs before the counting register reaches zero, the count stops, and the timer generates a program interrupt by pulling the microcomputer's $\overline{IRQ}$ line to logic 0.

For either operating mode, the timer ends its three-step sequence by signaling the microcomputer over its $\overline{IRQ}$ line. The microcomputer's task begins when it receives the interrupt signal indicating that the timer has finished a count. The microcomputer then takes over the last three steps and:

4. Reads the timer's counting register.

5. Transforms the count into a useful measurement of elapsed time.

6. Saves the result.

We will now examine all of these

*Text continued on page 118*

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*Text continued from page 115:*
measurement steps in detail.

Step 1 is initiated by the gating device (eg: a photocell) that is connected to the programmable timer's gate input. Figure 3 shows two circuits for coupling phototransistors to the timer.

In figure 3a, the phototransistor is illuminated normally, and the programmable timer's gate input is held at logic 1. An object passing in front of the phototransistor will cause the programmable timer's gate input to be pulled to logic 0 and held there for as long as the light is blocked. If the timer is operating in the pulse-width-comparison mode, it will measure the length of time the light is blocked. If it is operating in the frequency-comparison mode, the timer will measure the elapsed time from the first extinction of the light to the second.

In figure 3b, both phototransistors are normally illuminated, and the timer's gate input is held at logic 1. An object passing in front of either phototransistor produces a momentary logic 0 at the programmable timer's gate input. A second momentary logic 0 occurs as the object passes in front of the second phototransistor. If operated in the frequency-comparison mode, the timer will measure the time from the first extinction of the light (at one phototransistor) to the second (at the other phototransistor).

*Text continued on page 122*

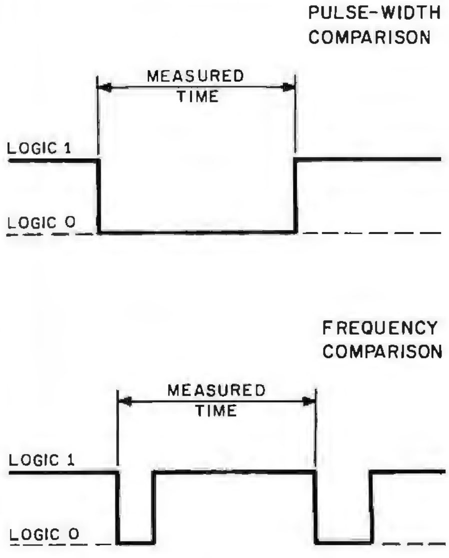


**Figure 2:** *The time intervals measured by the programmable timer for the pulse-width and frequency-comparison modes.*

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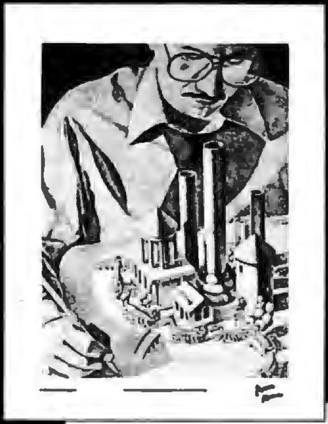
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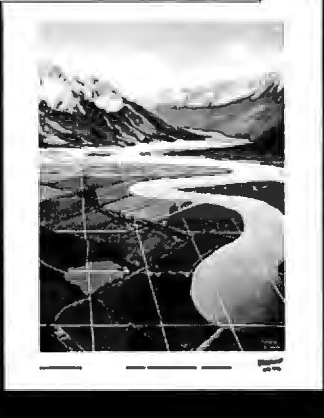

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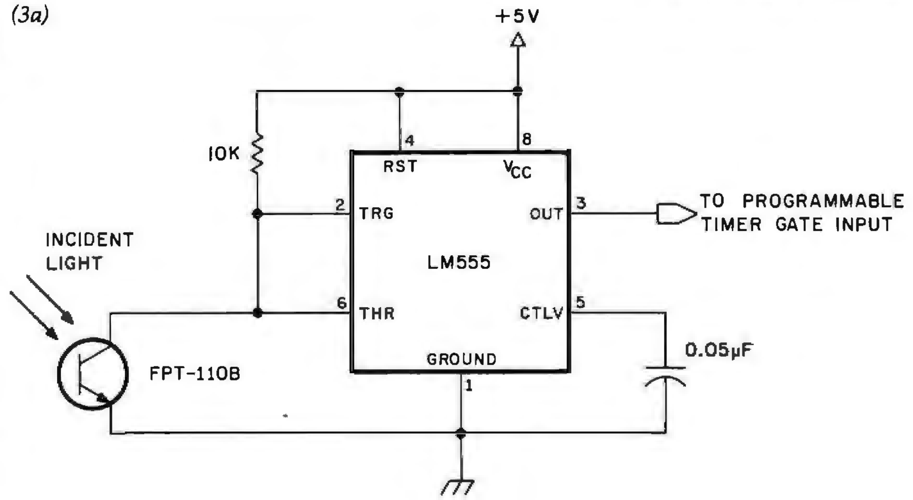
*Text continued from page 118:*

Step 2 states that the counter decrements on each cycle of an external timing signal. The period of this timing signal therefore becomes the *limit of resolution* of any time measurement. My applications required elapsed-time measurements that were accurate to the nearest ms (millisecond). This resolution was achieved by applying a 1 kHz timing signal to the timer's external-clock input. (Later I will describe how this timing signal is produced by using another programmable timer to scale the microprocessor's clock frequency.)

Step 3 says that the count stops, and the microcomputer is signaled, if the timed event ends before the counting register decrements to zero. Recall that the timer's latch is preset to unsigned 65,535 (hexadecimal

*Text continued on page 126*

(3a)




(3b)

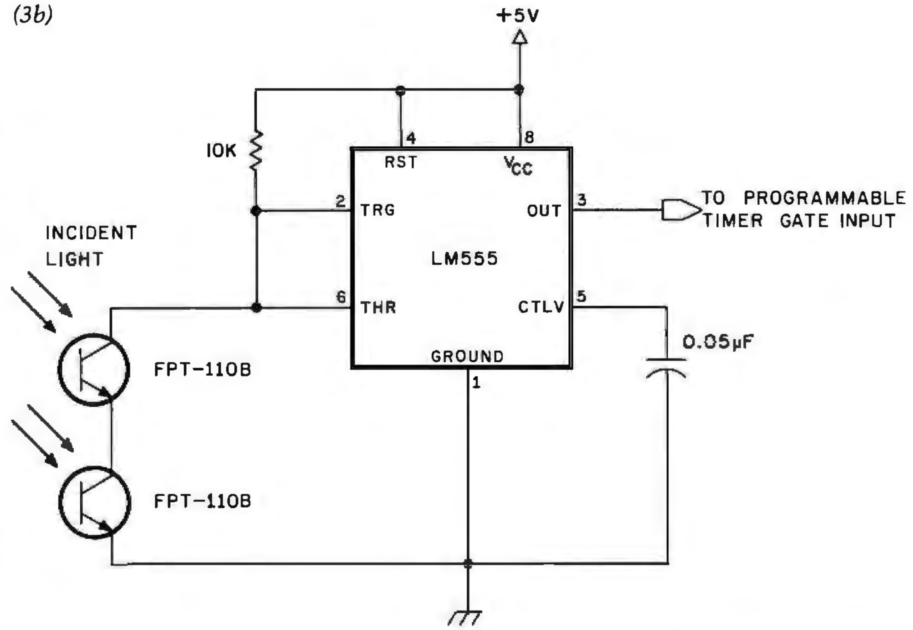



**Figure 3:** *Two circuits for connecting phototransistors to programmable-timer gate inputs. Figure 3a shows control of the timer gate by a single phototransistor; figure 3b shows control by two phototransistors.*

*These type-555 integrated circuits are* **not** *used as timers; instead, they serve as inverting comparators. A 555 component connected in this manner has an input hysteresis in excess of 1.6 V, twice that of a type-7413 Schmitt trigger.*

*The 10 k-ohm resistor is chosen to saturate the phototransistor when illuminated, and hold it near its cutoff point when the light is blocked. The 10 k-ohm resistance is optimal for a 1 W incandescent bulb located 5 cm (approximately 2 inches) in front of the phototransistor. Other setups may require a different resistor.*

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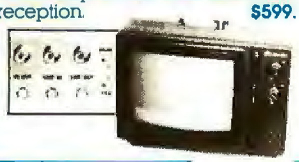

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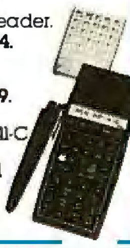

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*Text continued from page 122:*

**Listing 1:** *Interrupt-service routine for reading a programmable timer's counting register, converting the number to a decimal elapsed time and saving the result.*

| Label | Op Code | Comments |
|---|---|---|
| | LDA A M | Read the timer's counting register and clear the timer's |
| | LDA B L | interrupt request. |
| | LDX POINT | Fetch the pointer. |
| | CPX #LAST+3 | Are all memory locations loaded? |
| | BEQ DONE | Branch if all are loaded. |
| | COM A | Complement the count to get the hexadecimal elapsed |
| | COM B | time. |
| | STA A 1,X | Save the hexadecimal elapsed time in this memory loca- |
| | STA B 2,X | tion. |
| | LDA A #$80 | Set bit 7 to show that this memory location has been |
| | STA A 0,X | loaded. |
| | BSR BD | Perform a subroutine that converts the 2-byte hexadecimal number in 1,X and 2,X to a 2½-byte BCD number in 0,X, 1,X and 2,X. |
| | INX | |
| | INX | Advance the pointer to the next 3-byte memory loca- |
| | INX | tion. |
| | STX POINT | Save the new pointer value. |
| DONE | RTI | |



FFFF) on system power-up or $\overline{\text{RESET}}$. Unless changed by the program, this value is automatically loaded into the counting register at the beginning of each timed event. The counting register cannot decrement more than this number of counts. A 1 kHz timing signal will therefore permit a maximum time measurement of 65,535 ms, or 65.535 seconds.

Step 4 begins the program's interrupt-service routine by reading the timer's counting register. Aside from fetching the counting register's contents, this step has another purpose: the read operation causes the programmable timer to release the microcomputer's $\overline{\text{IRQ}}$ line. This is important, because it is the *only* way the timer's interrupt request can be cleared.

Step 5 indicates a need for transforming the count. The quantity read from the timer's counting register (for a 1 kHz timing signal) is the *hexadecimal* number of milliseconds *remaining* until the counter decrements to zero. To be useful, this number should be transformed into the *decimal* number of milliseconds *elapsed* during the timed event. This transformation is a two-step process:

5a. Convert the hexadecimal milliseconds remaining to hexadecimal milliseconds elapsed during the timed event.
5b. Convert the hexadecimal milliseconds to decimal milliseconds.

Step 5a is easily performed. If the timer's counting register is set to hexadecimal FFFF at the beginning of the count, the hexadecimal number of elapsed milliseconds is equal to FFFF—$n_t$, where $n_t$ is the remainder read from the counting register at the end of the timed event. But, since FFFF—$n_t$ is just the one's complement of $n_t$, step 5a simply requires taking the one's complement of the number read from the counting register.

Step 5b is a hexadecimal-to-decimal conversion routine. Any appropriate routine may be used here. Listing 2 contains a fully documented demonstration program that includes a suitable hexadecimal-to-decimal conversion routine.

 

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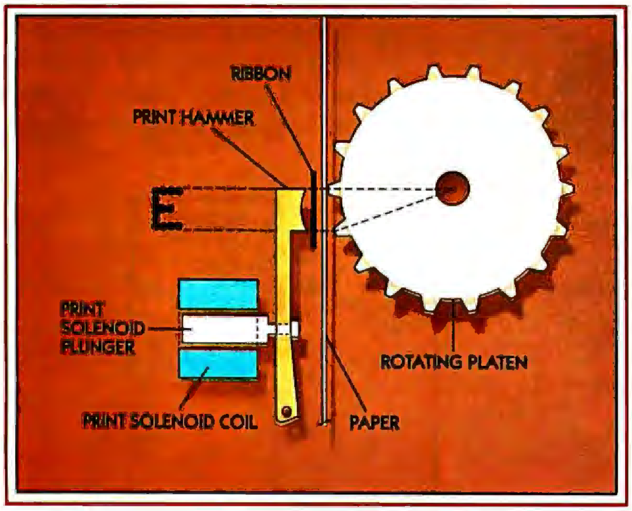


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Step 6 states that the microcomputer must save the result (ie: save the transformed time measurement). If several time measurements are made in rapid succession, the computer must log these results in a manner that permits easy access.

Successive time measurements are saved in successive 3-byte memory locations in a reserved memory block. Why 3 bytes? Although the binary number read from the timer's counting register is contained in only 2 bytes, that number converted to decimal form may require five BCD (binary-coded decimal) digits (for a maximum elapsed time of 65,535 ms). Stored in "packed" BCD form, such a number occupies 2½ bytes of memory. I allow 3 bytes, because I use bit 7 of the most-significant byte as a flag that is set when the memory location has been loaded with a measured time.

Listing 1 is a set of MC6800 instructions for accomplishing steps 4, 5, and 6 of the measurement sequence. This interrupt-service routine reads the timer's counting register, transforms the count into a decimal-radix elapsed time, and saves the result.

Lines 3, 4, and 5 of the listing merit further explanation. POINT always contains the address of the next memory location in which a time measurement will be stored. Line 3 loads the index register with this pointer. Line 4 examines the pointer to see if the allocated memory space has been exceeded. If it has, line 5 causes a skip of the remaining steps.

Notice that the testing of the pointer does not occur until *after* the timer's counting register has been read (lines 1 and 2). The counting register must *always* be read, whether or not the results are to be saved. Otherwise the timer's interrupt request will not be cleared.

### A Programmable-Timer Module

Thus far, I have described how a single programmable timer may be used with a microcomputer to measure and log elapsed times of successive events. I now wish to show how a particular commercial device, the Motorola MC6840 programmable-timer module, may be used in the design of a two-channel event timer.

Figure 4 is a pin-assignment diagram for the MC6840. This integrated circuit contains three independent programmable timers, each with gate input, external-clock input, and output. There are ten addressable registers. Nine of these are the control registers, latches, and counting registers for the three timers; the tenth is a status register containing interrupt flags. (Details of register selection for the MC6840 were described in my earlier article, "A Computer-Controlled Light Dimmer," January 1980 BYTE, page 56.)

A two-channel event timer requires the use of one programmable timer for each channel. If timer 1 is assigned to channel 1 and timer 2 is assigned to channel 2, then timer 3 may be used to scale the microprocessor clock frequency to provide the timing signal required by timers 1 and 2.

To operate as a frequency scaler, timer 3 must be configured for use in the *continuous operating mode*. This is achieved by grounding the timer's gate and loading hexadecimal 82 into its control register. The timer then produces a square wave whose frequency is equal to that of the micro-

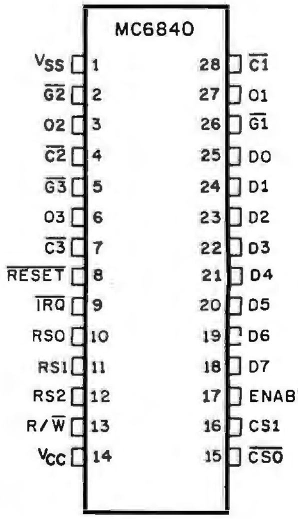


**Figure 4:** *Pin-assignment diagram for the Motorola MC6840 programmable-timer module.*

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Photo 3: *The trainer's six-character LED display is used to indicate which memory locations have been loaded with elapsed-time measurements. This is how the display appears after time measurements have been logged in memory locations A and B (for phototransistor 1) and location D (for phototransistor 2).*


Photo 4: *The trainer's six-character LED display after elapsed-time measurements have been logged in all six memory locations, A thru F.*


Photo 5: *A measured time is read by pressing a letter key on the trainer's hexadecimal keyboard. This is the display's appearance when the A key is pressed to read out the elapsed-time measurement (here 1.581 seconds) stored at memory location A.*

processor clock divided by $2(n+1)$, where $n$ is the 16-bit number stored in the timer's latch. (For example, given a microprocessor clock frequency of 1 MHz, storing decimal 499 [hexadecimal 01F3] in the timer's latch will cause the timer to generate a 1 kHz square wave.) Figure 5 shows the appropriate input and output connections for timer 3.

## Polling the Timers

When timers 1 and 2 are operated in either the pulse-width-comparison mode or the frequency-comparison mode, either timer may signal the completion of a count by pulling the microcomputer's $\overline{\text{IRQ}}$ line low. The microcomputer, with the aid of the MC6840's status register, then *polls* the timers to find which produced the interrupt.

The status register is an 8-bit, read-only register containing interrupt flags. It shares an address with control register 2 (CR2). The R/$\overline{\text{W}}$ line selects whether CR2 is written or the status register is read. Individual bits of the status register are assigned as shown in table 1.

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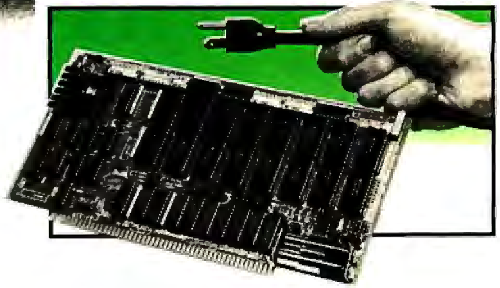

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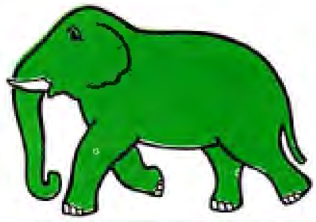

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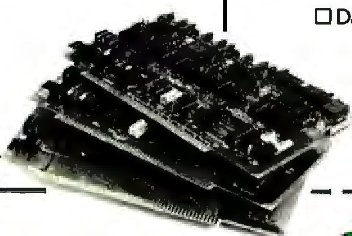

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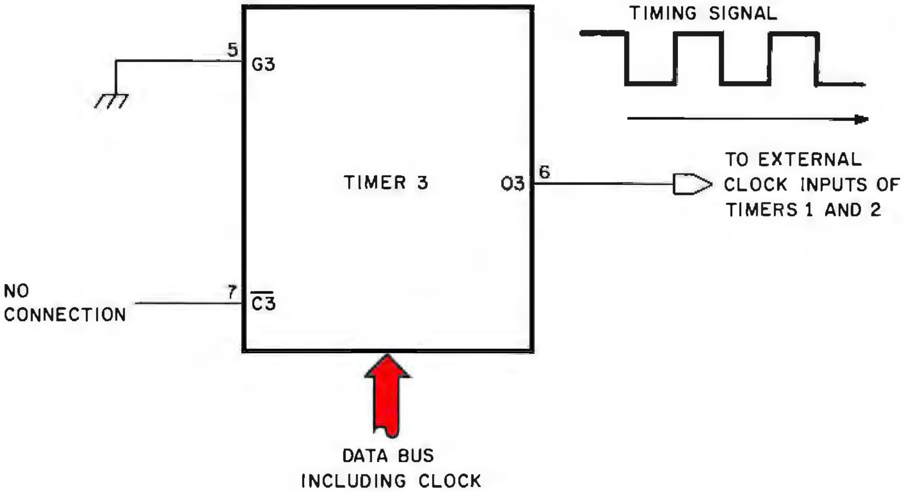


**Figure 5:** *Connection of the MC6840's timer-section 3 for use as a frequency scaler. The microprocessor's clock frequency is divided by 2(n+1) to provide a timing signal to timers 1 and 2.*

| | |
|---|---|
| Bit 0: | Timer 1 individual interrupt flag. |
| Bit 1: | Timer 2 individual interrupt flag. |
| Bit 2: | Timer 3 individual interrupt flag. |
| Bit 3: | Composite interrupt flag. |
| Bits 4 thru 7: | All read as zero. |

**Table 1:** *Assignment of bits in the status register of the Motorola MC6840 programmable-timer module.*

comparison mode or the frequency-comparison mode, then its individual interrupt flag is *set* whenever the timer completes a time measurement before its counting register decrements to zero. The flag is automatically *cleared* when the status register *and* the timer's counting register are read (in that order).

The composite interrupt flag is the logical OR of the individual interrupt flags. For the operating modes that I have selected for the three timers, the composite interrupt flag will be clear only if both the timer 1 and timer 2 flags are clear. (Timer 3's configuration as a scaler prevents it from affecting the composite interrupt flag.)

The MC6840 pulls the microcomputer's $\overline{IRQ}$ line low when the composite interrupt flag is set, which, for these operating modes, is whenever the timer 1 or timer 2 individual interrupt flags are set. The $\overline{IRQ}$ line is released only when both timer 1 and timer 2 individual interrupt flags are cleared.

Upon receipt of the interrupt request ($\overline{IRQ}$ line pulled low), the microcomputer performs an interrupt-service routine that examines the status register to find which timer's interrupt flag is set. With that deter-

mined, it then performs the remaining steps (4, 5, and 6) of the program's data-acquisition routine.

### Building the Timing System

I have just described the system-independent design details of a two-channel, data-logging, millisecond timer using a Motorola MC6840 programmable-timer module; I will now show you how to implement this design on a Heathkit ET-3400 microprocessor trainer.

We have seen that a millisecond-resolution timer requires a 1 kHz external timing signal, and we have seen how this external timing signal can be scaled from a 1 MHz microprocessor clock. The implementation assumes the use of an ET-3400 trainer with a 1 MHz crystal-controlled clock. This 1 MHz clock is a feature of all trainers modified for use with the Heathkit ETA-3400 expansion accessory.

The demonstration program (see listing 2) assumes the availability of 340 bytes of memory for program storage. This exceeds memory available in the trainer alone, unless some page-zero memory is used for this purpose. Addition of the ETA-3400 expansion accessory easily provides the additional program-storage space required.

Figure 6 is a complete circuit diagram for the two-channel, millisecond timer. The entire circuit (except for the phototransistors) may be wired on the trainer's built-in breadboard socket (see photo 1).

Figure 6 contains one system-dependent feature that requires explanation. The ET-3400 trainer uses a bidirectional buffer to couple its data bus to outside devices. Normally set in the write (output) state, this buffer is placed in the read (input) state by pulling the trainer's $\overline{RE}$ (read enable) line low. The 7445 binary-to-decimal decoder in figure 6 provides the address decoding needed to do this each time the trainer reads the MC6840 registers. *Text continued on page 144*

**Listing 2:** *Complete timer-demonstration program for using the Motorola MC6840 with Heath's ET-3400 microcomputer trainer. The program (written in 6800 assembly language) assumes the availabilty of 340 bytes of memory for program storage, so an ETA-3400 memory-expansion module must be installed.*

```
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00001                        NAM     TIMLOG    BY J. H. GIBSON, ALMA COLLEGE


00003 0000                   ORG     0

00005 0000 0003      T11     RMB     3         / ELAPSED TIME A
00006 0003 0003      T12     RMB     3         / ELAPSED TIME B
00007 0006 0003      T13     RMB     3         / ELAPSED TIME C

00009 0009 0003      T21     RMB     3         / ELAPSED TIME D
00010 000C 0003      T22     RMB     3         / ELAPSED TIME E
00011 000F 0003      T23     RMB     3         / ELAPSED TIME F

00013 0012 0001      TEMP1   RMB     1
00014 0013 0001      TEMP2   RMB     1

00016 0014 0002      POINT1  RMB     2         / POINTER FOR TIMER #1
00017 0016 0002      POINT2  RMB     2         / POINTER FOR TIMER #2

00019      00F7      UIRQ    EQU     $00F7     / MONITOR VECTORS HERE ON IRQ


00021                * ADDRESSES IN PROGRAMMABLE TIMING MODULE

00023      8000      CR1     EQU     $8000
00024      8001      CR2     EQU     CR1+1
00025      8000      CR3     EQU     CR1

00027      8001      STATUS  EQU     CR2       / CONTAINS INTERRUPT FLAGS

00029      8002      M1      EQU     CR1+2
```

*Listing 2 continued on page 136*

*Listing 2 continued:*

```
        8003    L1      EQU     CR1+3

        8004    M2      EQU     CR1+4
        8005    L2      EQU     CR1+5

        8006    M3      EQU     CR1+6
        8007    L3      EQU     CR1+7


                * THESE ET-3400 MONITOR SUBROUTINES ARE USED.

        FCBC    REDIS   EQU     $FCBC     / RESETS DISPLAY TO 1ST LED
        FE28    OUTHEX  EQU     $FE28     / DISPLAYS HEX DIGIT FROM 'A'
        FE3A    OUTCH   EQU     $FE3A     / DISPLAYS CODED CHARACTER
        FDBB    ENCODE  EQU     $FDBB     / RETURNS KEY'S HEX VALUE
        FD7B    DSPLAY  EQU     $FD7B     / DISPLAYS HEX DIGIT STRING
                * THESE STEPS INITIALIZE TIMERS 1 AND 2 FOR USE IN
                * THE PULSE WIDTH COMPARISON MODE IN WHICH AN IRQ
                * INTERRUPT IS GENERATED AT THE END OF EACH TIMED
                * INTERVAL.  TIMER 3 IS USED TO SCALE THE 1MHZ
                * MICROPROCESSOR CLOCK TO PROVIDE A 1KHZ EXTERNAL
                * CLOCK FREQUENCY TO TIMERS 1 AND 2.

0100                    ORG     $100      / START FROM THIS ADDRESS.

0100 0F         START   SEI               / MASK IRQ INTERRUPT

0101 CE 01F3            LDX     #499      / SCALING FACTOR = 2(499+1)
0104 FF 8006            STX     M3        / INITIALIZE TIMER #3

0107 86 82              LDA A   #$82      / CONFIGURE TIMER #3 FOR USE
0109 B7 8000            STA A   CR3       / AS A SCALAR

010C 86 59              LDA A   #$59      / CONFIGURE TIMERS #1 AND #2
010E B7 8001            STA A   CR2       / FOR PULSE WIDTH COMP MODE;
0111 B7 8000            STA A   CR1       / INTERNALLY RESET ALL TIMERS

0114 4A                 DEC A             / CLEAR INTERNAL RESET BIT
0115 B7 8000            STA A   CR1       / TO ENABLE ALL TIMERS


                * ON IRQ, THE ET-3400 VECTORS TO LOCATION
                * #UIRQ, WHERE IT MUST FIND A JUMP INSTRUCTION
                * AND A VECTOR TO TRANSFER TO THE PROGRAM'S
                * IRQ SERVICE ROUTINE AT LOCATION #POLL.

0118 86 7E              LDA A   #$7E      / LDA A WITH JUMP COMMAND
011A 97 F7              STA A   UIRQ      / STORE JUMP COMMAND AT UIRQ

011C CE 01BE            LDX     #POLL     / JUMP TO THIS LOCATION
011F DF F8              STX     UIRQ+1    / STORE #POLL AT UIRQ VECTOR

0121 0E                 CLI               / CLEAR IRQ INTERRUPT MASK


                * INITIALIZE THE MEMORY LOCATION POINTERS

0122 CE 0009            LDX     #T21
0125 DF 16              STX     POINT2

0127 CE 0000            LDX     #T11
012A DF 14              STX     POINT1
                * CLEAR ALL MEMORY LOCATIONS

012C 6F 00      CLEAR   CLR     0,X       / CLEAR THIS BYTE
012E 08                 INX               / POINT TO THE NEXT BYTE
012F 8C 0012            CPX     #T23+3    / DONE YET?
0132 26 F8              BNE     CLEAR     / GO CLEAR THE NEXT BYTE


                * MAIN PROGRAM LOOP

0134 8D 11      RUN     BSR     SHOW      /SHOW LETTERS OF LOGGED TIMES
0136 8D 30              BSR     KEY       /RETURNS DEBOUNCED KEY IN 'A'
0138 24 FA              BCC     RUN       / GO BACK IF NO KEY PRESSED

013A 4D                 TST A
013B 27 C3              BEQ     START     / GO TO START ON '0' KEY

013D 8D 35              BSR     SETX      / POINT TO KEYED LOCATION
013F 24 F3              BCC     RUN       / BRANCH IF KEYS 1-9 PUSHED

0141 8D 44              BSR     READOU    / SHOW KEYED ELAPSED TIME
0143 8D 6E              BSR     RELEAS    / WAIT FOR KEY RELEASE
0145 20 ED              BRA     RUN       / RETURN TO SHOW LETTERS
```

*Listing 2 continued on page 138*

*Listing 2 continued:*

```
                         * THIS ROUTINE DISPLAYS LETTERS FOR MEMORY
                         * LOCATIONS IN WHICH ELAPSED TIMES ARE LOGGED.

0147 CE 0000 SHOW    LDX    #T11      / POINT TO THE FIRST LOCATION
014A 86 0A           LDA A  #$0A      / INITIALIZE DISPLAY LETTER
014C BD FCBC         JSR    REDIS     / INITIALIZE DISPLAY POINTER

014F E6 00   SHOW1   LDA B  0,X       / TEST BIT7 FOR TIME LOGGED
0151 2A 05           BPL    SHOW2     / BRANCH IF NO TIME LOGGED

0153 BD FE28         JSR    OUTHEX    / SHOW THE LETTER FROM 'A'
0156 20 06           BRA    SHOW3

0158 36      SHOW2   PSH A            / SAVE THE LETTER FROM 'A'
0159 4F              CLR A            / PREPARE TO SHOW A BLANK
015A BD FE3A         JSR    OUTCH     / SHOW A BLANK HERE
015D 32              PUL A            / RESTORE KEYED LETTER TO 'A'

015E 4C      SHOW3   INC A            / INC 'A' TO THE NEXT LETTER
015F 08              INX
0160 08              INX              / ADVANCE THE POINTER TO THE
0161 08              INX              / NEXT 3-BYTE MEMORY LOCATION
0162 8C 0012         CPX    #T23+3    / DONE YET?
0165 26 E8           BNE    SHOW1     / EXAMINE THE NEXT LOCATION

0167 39              RTS
                     * THIS ROUTINE DEBOUNCES A PRESSED KEY AND RETURNS
                     * ITS HEX VALUE IN ACC A.  THE ROUTINE ALSO
                     * RETURNS CARRY SET FOR KEY PRESSED, CARRY
                     * CLEAR FOR NO KEY PRESSED.

0168 C6 14   KEY     LDA B  #20       / INITIALIZE DELAY COUNTER

016A BD FDBB KEY1    JSR    ENCODE    / RETURNS KEY VALUE IN 'A'
016D 24 04           BCC    KEY2      / BRANCH IF NO KEY DOWN

016F 5A              DEC B            / DECREMENT THE DELAY TIME
0170 26 F8           BNE    KEY1      / GO BACK, IF DELAY NOT DONE

0172 0D              SEC              / SET CARRY IF KEY DOWN

0173 39      KEY2    RTS


                     * THIS ROUTINE USES THE HEX VALUE (IN ACC A)
                     * OF THE KEY PRESSED TO POINT X TO THE PROPER
                     * MEMORY LOCATION.  THE ROUTINE RETURNS CARRY
                     * SET IF KEYS A-F PRESSED, CARRY CLEAR
                     * IF KEYS 1-9 ARE PRESSED.

0174 CE 0000 SETX    LDX    #T11      / POINT X TO FIRST LOCATION
0177 C6 0A           LDA B  #$0A      / INITIATE 'B'

0179 11      SETX1   CBA              / DOES 'B' EQUAL KEY VALUE?
017A 27 09           BEQ    SETX2     / BRANCH IF EQUAL

017C 0C              CLC              / CLEAR THE A-F KEY FLAG
017D 2B 07           BMI    SETX3     / RTS IF 'B' > KEY VALUE

017F 08              INX
0180 08              INX              / ADVANCE THE POINTER TO THE
0181 08              INX              / NEXT 3-BYTE MEMORY LOCATION
0182 5C              INC B            / INCREMENT 'B' AND
0183 20 F4           BRA    SETX1     / GO COMPARE AGAIN

0185 0D      SETX2   SEC              / SET THE A-F KEY FLAG

0186 39      SETX3   RTS
                     * READOUT ROUTINE: DISPLAYS KEYED LETTER AND
                     * ELAPSED TIME STORED IN THIS LOCATION.  THE
                     * DISPLAY IS IN SECONDS WITH RESOLUTION TO
                     * 1 MILLISECOND.  LEADING ZEROS TO THE LEFT
                     * OF THE DECIMAL POINT ARE SUPPRESSED.

0187 E6 00   READOU  LDA B  0,X       / FETCH BIT 7
0189 2A 27           BPL    READ2     / BRANCH IF NO TIME LOGGED

018B 36              PSH A            / SAVE KEY VALUE (FROM 'A')
018C BD FCBC         JSR    REDIS     / INITIALIZE DISPLAY POINTER
018F C6 03           LDA B  #03       / TO DISPLAY 3 BYTES
0191 BD FD7B         JSR    DSPLAY    / DISPLAY THIS ELAPSED TIME

0194 BD FCBC         JSR    REDIS     / RESET THE DISPLAY POINTER
0197 32              PUL A            / RESTORE KEY VALUE TO 'A'
```

*Listing 2 continued on page 140*

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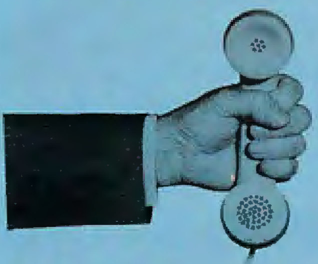

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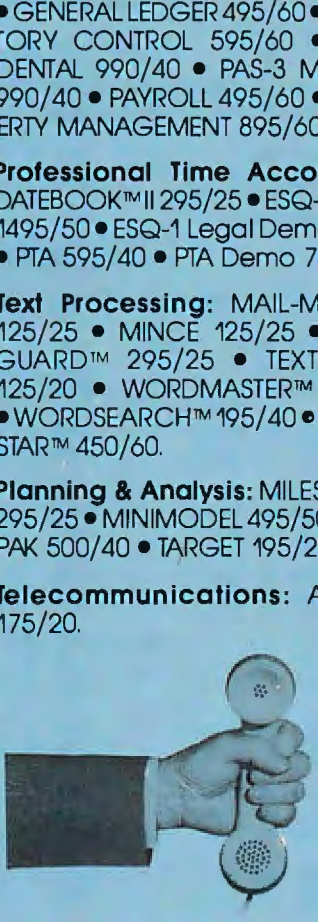

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*Listing 2 continued:*

```
0198 BD FE28           JSR    OUTHEX   / SHOW KEY PUSHED (FROM 'A')

019B A6 00             LDA A  0,X      / GET 1ST DIGIT (AND BIT 7)
019D 84 0F             AND A  #$0F     / MASK TO FIRST DIGIT
019F 26 0C             BNE    READ1    / BRANCH IF NOT LEADING ZERO

01A1 BD FE3A           JSR    OUTCH    / BLANK 2ND 7-SEGMENT LED

01A4 A6 01             LDA A  1,X      / GET 2ND (AND 3RD) DIGIT
01A6 84 F0             AND A  #$F0     / MASK TO 2ND DIGIT
01A8 26 03             BNE    READ1    / BRANCH IF NOT ALSO ZERO

01AA BD FE3A           JSR    OUTCH    / BLANK 3RD 7-SEGMENT LED

01AD 86 01     READ1   LDA A  #$01
01AF B7 C147           STA A  $C147    / LIGHT 3RD DECIMAL POINT

01B2 39        READ2   RTS


               * THIS ROUTINE WAITS FOR A KEY RELEASE

01B3 C6 14     RELEAS  LDA B  #20      / INITIALIZE DELAY COUNTER

01B5 BD FDBB   REL1    JSR    ENCODE   / GET KEY RELEASE CONDITION
01B8 25 F9             BCS    RELEAS   / KEEP TRYING UNTIL RELEASE

01BA 5A                DEC B           / DECREMENT THE DELAY TIME
01BB 26 F8             BNE    REL1     / GO BACK IF DELAY NOT DONE

01BD 39                RTS
               * THIS BEGINS THE IRQ SERVICE ROUTINE THAT
               * READS AND LOGS THE MEASURED TIMES.

01BE B6 8001   POLL    LDA A  STATUS   / GET THE INTERRUPT FLAGS

01C1 44        POLL1   LSR A           / SHIFT TIMER1 FLAG INTO 'C'
01C2 36                PSH A           / SAVE THE TIMER2 FLAG
01C3 24 11             BCC    POLL2    / BRANCH IF NO TIMER1 FLAG

01C5 B6 8002           LDA A  M1       / READ THE TIMER1 COUNT AND
01C8 F6 8003           LDA B  L1       / CLEAR THE TIMER1 FLAG

01CB DE 14             LDX    POINT1   / POINT TO THE T1X LOCATION
01CD 8C 0009           CPX    #T13+3   / TIMER1 MEMORY BLOCK FULL?
01D0 27 04             BEQ    POLL2    / BRANCH IF FULL

01D2 8D 18             BSR    LOG      / LOG COUNT, ADV POINTER
01D4 DF 14             STX    POINT1   / SAVE THE NEW POINTER

01D6 32        POLL2   PUL A           / RESTORE THE TIMER2 FLAG
01D7 44                LSR A           / SHIFT TIMER2 FLAG INTO 'C'
01D8 24 11             BCC    DONE     / BRANCH IF NO TIMER2 FLAG

01DA B6 8004           LDA A  M2       / READ THE TIMER2 COUNT AND
01DD F6 8005           LDA B  L2       / CLEAR THE TIMER2 FLAG

01E0 DE 16             LDX    POINT2   / POINT TO THE T2X LOCATION
01E2 8C 0012           CPX    #T23+3   / TIMER2 MEMORY BLOCK FULL?
01E5 27 04             BEQ    DONE     / BRANCH IF FULL

01E7 8D 03             BSR    LOG      / LOG COUNT, ADV POINTER
01E9 DF 16             STX    POINT2   / SAVE THE NEW POINTER

01EB 3B        DONE    RTI


               * THIS SUBROUTINE TRANSFORMS AND LOGS THE
               * MEASURED TIMES AND ADVANCES THE POINTER.

01EC 43        LOG     COM A           / COMPLEMENT THE COUNT TO GET
01ED 53                COM B           / HEXADECIMAL ELAPSED TIME
01EE 8D 5F             BSR    SAVE     / SAVE THE HEX ELAPSED TIME

01F0 86 80             LDA A  #$80     / SET BIT 7 TO SHOW THAT THIS
01F2 A7 00             STA A  0,X      / MEMORY LOCATION IS FILLED
01F4 8D 04             BSR    BD       / CONVERT HEX TIME TO DECIMAL

01F6 08                INX
01F7 08                INX             / ADVANCE THE POINTER TO THE
01F8 08                INX             / NEXT 3-BYTE MEMORY LOCATION

01F9 39                RTS
               * THIS ROUTINE CONVERTS THE 2-BYTE HEX NUMBER IN
               * 1,X AND 2,X TO A 3-BYTE DECIMAL NUMBER IN
```

*Listing 2 continued on page 142*

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*Listing 2 continued:*

```
                           * 0,X, 1,X AND 2,X.

01FA 7F 0012 BD     CLR    TEMP1     /TO HOLD 1000'S & 100'S COUNT
01FD 7F 0013        CLR    TEMP2     /TO HOLD 10'S COUNT

0200 8D 48   BD4    BSR    FETCH     / FETCH REMAINDER
0202 C0 10          SUB B  #$10
0204 82 27          SBC A  #$27      / SUBTRACT 10,000
0206 25 06          BCS    BD3       / BRANCH IF REMAINDER NEGATIV

0208 8D 45          BSR    SAVE      / SAVE REMAINDER
020A 6C 00          INC    0,X       / INCREMENT 10,000'S COUNT
020C 20 F2          BRA    BD4       / GO SUBTRACT ANOTHER 10,000

020E 8D 3A   BD3    BSR    FETCH     / FETCH REMAINDER
0210 C0 E8          SUB B  #$E8
0212 82 03          SBC A  #$03      / SUBTRACT 1000
0214 25 0A          BCS    BD2       / BRANCH IF REMAINDER NEGATIV

0216 8D 37          BSR    SAVE      / SAVE REMAINDER
0218 96 12          LDA A  TEMP1     / GET 1000'S COUNT
021A 8B 10          ADD A  #$10      / INCREMENT 1000'S COUNT
021C 97 12          STA A  TEMP1     / SAVE 1000'S COUNT
021E 20 EE          BRA    BD3       / GO SUBTRACT ANOTHER 1000

0220 8D 28   BD2    BSR    FETCH     / FETCH REMAINDER
0222 C0 64          SUB B  #$64
0224 82 00          SBC A  #$00      / SUBTRACT 100
0226 25 07          BCS    BD1       / BRANCH IF REMAINDER NEGATIV

0228 8D 25          BSR    SAVE      / SAVE REMAINDER
022A 7C 0012        INC    TEMP1     / INCREMENT 100'S COUNT
022D 20 F1          BRA    BD2       / GO SUBTRACT ANOTHER 100

022F 8D 19   BD1    BSR    FETCH     / FETCH REMAINDER
0231 C0 0A          SUB B  #$0A
0233 82 00          SBC A  #$00      / SUBTRACT 10
0235 25 0A          BCS    BD0       / BRANCH IF REMAINDER NEGATIV

0237 8D 16          BSR    SAVE      / SAVE REMAINDER
0239 D6 13          LDA B  TEMP2     / GET 10'S COUNT
023B CB 10          ADD B  #$10      / INCREMENT 10'S COUNT
023D D7 13          STA B  TEMP2     / SAVE 10'S COUNT
023F 20 EE          BRA    BD1       / GO SUBTRACT ANOTHER 10

0241 96 12   BD0    LDA A  TEMP1     / GET 1000'S & 100'S COUNT
0243 D6 13          LDA B  TEMP2     / GET 10'S COUNT
0245 EB 02          ADD B  2,X       / ADD REMAINDER TO 10'S COUNT
0247 8D 06          BSR    SAVE      / SAVE DECIMAL COUNTS
0249 39             RTS
                   * THIS ROUTINE FETCHES THE NUMBER SAVED IN 1,X
                   * AND 2,X.

024A A6 01   FETCH  LDA A  1,X
024C E6 02          LDA B  2,X       / FETCH THESE VALUES

024E 39             RTS


                   * THIS ROUTINE SAVES 'A' & 'B' IN 1,X
                   * AND 2,X.

024F A7 01   SAVE   STA A  1,X
0251 E7 02          STA B  2,X       / SAVE THESE VALUES

0253 39             RTS


                    END

SYMBOL TABLE

T11     0000  T12     0003  T13     0006  T21     0009  T22     000C
T23     000F  TEMP1   0012  TEMP2   0013  POINT1  0014  POINT2  0016
UIRQ    00F7  CR1     8000  CR2     8001  CR3     8000  STATUS  8001
M1      8002  L1      8003  M2      8004  L2      8005  M3      8006
L3      8007  REDIS   FCBC  OUTHEX  FE28  OUTCH   FE3A  ENCODE  FDBB
DSPLAY  FD7B  START   0100  CLEAR   012C  RUN     0134  SHOW    0147
SHOW1   014F  SHOW2   0158  SHOW3   015E  KEY     0168  KEY1    016A
KEY2    0173  SETX    0174  SETX1   0179  SETX2   0185  SETX3   0186
READOU  0187  READ1   01AD  READ2   01B2  RELEAS  01B3  REL1    01B5
POLL    01BE  POLL1   01C1  POLL2   01D6  DONE    01EB  LOG     01EC
BD      01FA  BD4     0200  BD3     020E  BD2     0220  BD1     022F
BD0     0241  FETCH   024A  SAVE    024F
```

*Text continued from page 134:*

The demonstration program was used to time the motion of two colliding air cars on a linear air track. [*This apparatus is a cousin to an air-hockey table....*RSS] Each timer was controlled by one phototransistor illuminated by a 1 W incandescent bulb, and each air car carried an opaque vane 10 cm long (see photo 2). The vane blocked the light as the car passed in front of the phototransistor. With timers 1 and 2 operating in the pulse-width-comparison mode, the microcomputer measured how long each phototransistor was blocked as the cars approached and then recoiled from the collision. These measured times, the known lengths of the opaque vanes, and the cars' masses were then used to calculate momenta before and after the collision.

I required that each timer be able to record three elapsed times. Each timer therefore has three memory locations reserved for saving its measurements. Labeled T11 thru T23 in the demonstration program, these memory locations are accessed during readout as times A, B, and C for timer 1 and times D, E, and F for timer 2.

The trainer's six 7-segment LEDs (light-emitting diodes) are used for data display. Each experimental trial begins with the LEDs dark. The 7-segment LEDs then light individually to show letter labels of the elapsed times as they are measured (see photos 3 and 4). When the experimental trial ends, each of the keys A thru F, when pushed, will produce a display of the corresponding elapsed time (see photo 5). Pushing the zero key clears all six memory locations to prepare for another trial.

Although the demonstration program specifies operation of timers 1 and 2 in the pulse-width-comparison mode, it will just as easily support their operation in the frequency-comparison mode. To make the conversion, simply change the number stored at hexadecimal location 010D from hexadecimal 59 (for pulse-width-comparison mode) to hexadecimal 49 (for frequency-comparison mode).

## Conclusion

This computer-based timer has been a stable and dependable measurement tool in my introductory physics laboratory. The students enjoy using it and appreciate the repeatability of results attained with it. I hope that you too will find it useful, and I would be interested to hear from readers who develop their own applications. ■

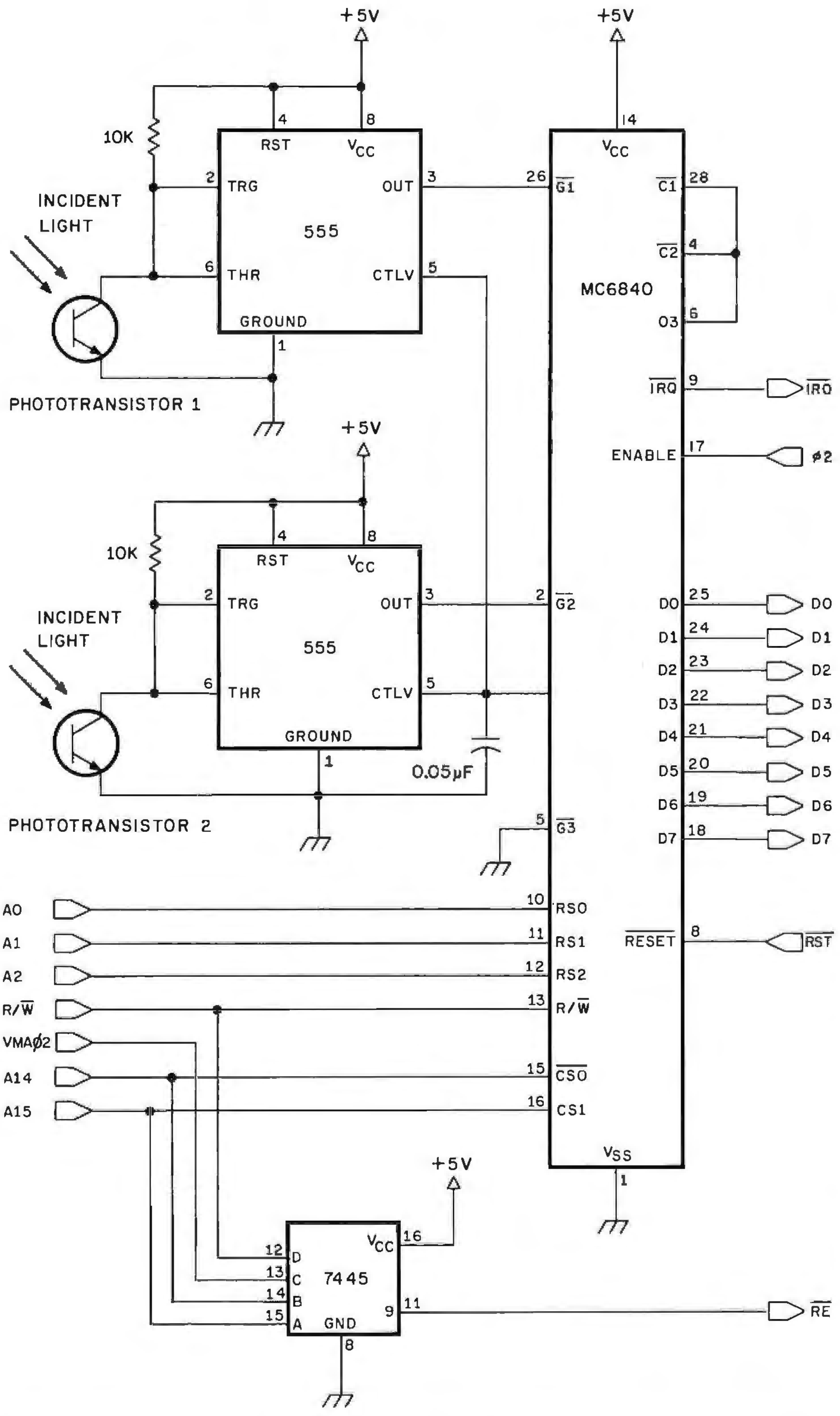


**Figure 6:** *A complete circuit schematic diagram for the two-channel, data-logging, millisecond timer. This is designed to work with the Heath ET-3400 microprocessor trainer.*

# Microcomputers in Education: A Concept-Oriented Approach

George Wolfe, James Madison University
Harrisonburg VA 22807

In the wake of new technologies, there generally comes an abundance of dreams and possibilities. Inherent in these possibilities is the seed of some new transformation of great or modest proportion. Such a transformation first occurs externally, manifesting itself in the conveniences or specialized abilities the new technology offers. But soon it touches us subjectively and we find ourselves perceiving reality differently. We construct new paradigms to help us understand our changed relationship with the world, and structure new vocabularies of experience.

Familiar examples of such technologies surround us—the electric light bulb, radio and television, satellite communication, medical technology, and nuclear energy. Each of these has altered our way of life to such an extent that any citizen of our culture from a century ago could not have entertained the world view we, by nature, have today. But, the technology that possesses the greatest potential to transform society and human life is just now entering the home: the microcomputer. Unlike some previous technological advances, the computer is not merely a specialized device fulfilling a specialized function. The convenience it provides is less tangible than bringing light into the home or Broadway entertainment into the living room. The computer's role and potential are much more abstract and profound. The new promise it offers is that of AI (artificial intelligence), which we not only create, but also, via the computer, communicate and interact with.

One of the most constructive fields to apply AI (to capitalize on its capacity to transform) is education. Various applications of microcomputers are already in the classroom and their effect has been found to be highly reinforcing to the learning process. These applications can be placed into the following categories:

- cataloging and processing of information
- learning to program a computer
- using the computer as an instructional tool; ie: CAI (computer-aided instruction)

The first two categories are self-explanatory and may even be somewhat familiar. There is no doubt that the computer can greatly increase the efficiency of a system through data processing, and that skill in computer programming is a growing necessity in our society. The third category may be somewhat less known, but clearly it is growing in use. It involves using computer programs designed to supplement students' assignments in the classroom. Such programs are usually in the form of drills, information exercises, or educational games. They often provide students with a moderate degree of interaction with the computer.

CAI has been defined in various ways and various opinions have been expressed as to its effectiveness. Certainly the value and success of CAI lies in the creative design of the programs and the appropriate setting for their use. Unfortunately, many teachers seem to view CAI as merely an automated drill instructor. Indeed, there is some value in having the computer play this role—it can hold pupils' attention and effectively reinforce their learning. Also, students learn to operate a computer long before any formal programming skill is acquired. But there is one application of CAI which as yet is relatively

**About the Author**

*George Wolfe is a music graduate of Indiana University and has been teaching at James Madison University for the past three years. He is a member of the Association for Integrative Studies and has been privately researching integrative education and the role of the microcomputer in the classroom. Mr Wolfe has also been developing integrative arts related television programs on a grant from the School of Fine Arts and Communications at James Madison University.*

unexplored. This is the use of the microcomputer to aid students in developing the ability to conceptualize. It is my belief that the transforming value of the microcomputer will be most fully realized through a concept-oriented approach to computer-aided instruction. The purpose of this article is to awaken educators to the solutions concept-oriented computer instruction offers our educational system.

### Artificial Intelligence and Specialization

Inherent in the growth of technology is the need for specialization. New information and research, vocational training, and industrial development must accompany advancing technologies. Along with these also comes the expertise necessary to maintain that growth. With the surge of technological and industrial growth in the twentieth century modern education has shifted away from the liberal arts toward pragmatism and specialization. As this trend has increased the classical ideal of a liberal arts education has fallen by the wayside. (See reference 2, page 407.)

While certainly necessary in a technological society, there is a danger which emerges if specialization is carried too far. This danger is dependence and the loss of comprehensive viewpoints. We have seen how a technological society can become dangerously dependent on foreign energy sources needed to drive that society and maintain its standard of living. We have also witnessed how the interaction among nations, motivated by their own individual interests, demands a perspective in world leaders that must be holistic if a stable peace is going to be achieved and sustained. Thus, the many specialized technologies that have brought nations closer together and made them dependent on one another have ironically recreated the need for the Integrated Person; someone who is able to recognize and effectively apply fundamental concepts to numerous, rapidly changing, and adaptively taxing circumstances. Such an individual must necessarily possess a more comprehensive understanding of the various academic disciplines, so that he or she can make decisions that are universally beneficial.

The common belief among educators today is that this *ideal* is impossible to achieve. It certainly appears that way when we examine the flood of information present within every discipline. Education, in keeping pace with technology, has become so oriented toward information gathering and retention that the conceptual links among

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**ANADEX, LTD.** • Dorna House, Guildford Road • West End, Woking, Surrey GU24 9PW, England • Tel: Chobham (09905) 6333 • Telex 858762 ANADEX G the academic disciplines have been all but lost. The advent of artificial intelligence has the potential to change this, because computer technology provides a means through which information within all disciplines can be effectively handled, processed, and made available. It turns out that mechanical brains manage information better than human brains (ie: a computer's memory and processing capabilities are in many ways superior in efficiency and organization to our own). Thus, the availability of information can be increased in quantity and reliability with microcomputers in the learning environment. The preoccupation of education with information can now be relieved somewhat. Rather than gearing students primarily for absorbing and retaining data, their attention can be directed toward the abilities to conceptualize, abstract, and apply available information creatively. These higher abilities remain uniquely human. We should no longer neglect their formal development for the sake of having students retain enormous amounts of information.

A movement in American education dedicated to promoting a concept-oriented approach to teaching began several decades ago with a small circle of scientists, most of whom had been strongly influenced by general systems theory. Among this group's members were Henry Margenau of Yale University and author-scientist Ervin Laszlo. Their efforts enjoyed a brief period of international recognition during the 1950s and 1960s under the auspices of the Center for Integrative Education. (See reference 1, pages v thru vii.) Their ideas have never been fully realized in the American classroom, but the microcomputer now makes the fulfillment of their approach a definite possibility. The computer is certainly the catalyst through which the integration of knowledge can be achieved in modern education and the direction of teaching changed to include principles and fundamental concepts, as well as specialized information.

### Fundamentals of an Integrative Approach

The first and foremost demand of concept-oriented education is the development of thinking skills. Today, we devote much time to cultivating reading and mathematical skills, artistic abilities, and other talents in our students. But we tend to ignore the abilities to think rationally, evaluate circumstances and information accurately, and integrate two or more disciplinary perspectives. As a result, high school and college students often lack the intellectual faculties needed to grasp issues in a sharp and accurate focus.

As with other abilities, developing thinking skills takes practice, something teachers do not always have the time and understanding to offer. Properly structured and applied computer programs, however, can provide the time and mental exercise needed to sharpen students' reasoning faculties.

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It is possible, for example, to develop a series of logic programs ranging in difficulty from simple reasoning using concrete ideas, to complex reasoning employing abstract ideas. The relationship between logical and mathematical proof can also be incorporated into such programs. The format could be a kind of logical dialogue between student and computer. For example,

Computer: What do you say to us having a philosophical discussion? I'll start by making a simple statement, and you tell me if you think it is true or false.
"Seeing is believing."

Student: True.

Computer: I take it then, that if you see something, you believe it to be really happening or really there. Is this correct?

Student: Yes.

Computer: OK. So far you are thinking very logically. But now, let me ask you another question.
"Have you ever seen the sun rising in the morning sky?"

Student: Yes.

Computer: Do you know that the sun is not actually rising in the sky? What is actually happening is that the Earth is revolving on its axis, and in doing so, creates the illusion that the sun is moving upward. Now that I have pointed this out, do you still believe the sun is really rising in the sky?

Student: No.

Computer: But do you still see the sun rising in the morning sky?

Student: Yes.

Computer: Well then, you have to reconsider my original statement which was "seeing is believing." You said that this was a true statement, yet you just admitted that even though you have seen the sun rise in the morning sky, it is not really rising.
Do you still think that in all cases "seeing is believing."

Student: No.

Computer: Very good! We simply have to recognize that illusions do exist and that seeing something does not always mean that what we are seeing is really happening or really there.... Now consider this next statement.
"The sun appears to be rising in the sky."
Is this statement true or false?

Student: True.

Computer: Correct. The word "appears" is what makes the statement true because it suggests that the rising sun is indeed an illusion.

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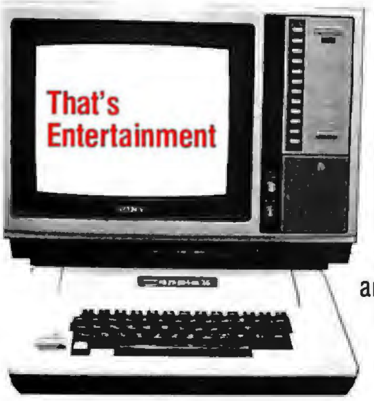


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Another series of programs can be composed to help students learn to discriminate between objectively, rationally, and intuitively derived conclusions. The aim is to develop discernment in the student and provide the time and practice necessary for one to become adept at applying such thinking skills.

Interdisciplinary perspectives can be the theme of still another thinking-model program. Here, the goal is to arrive at the most plausible explanation for something by considering information from various disciplines. For example, students examine explanations based on economic influences, historical factors, or any other perspectives that are appropriate to the subject being considered.

Such a program, in addition to the ones mentioned above, can be designed for educational levels ranging from junior high school through college. (Anyone interested in more information regarding the programs discussed in this article can write the author in care of the Music Department, James Madison University, Harrisonburg VA 22807.)

With thinking skills heightened, we are now ready to pursue the second most important aspect of integrative education, concept development. Concept development often utilizes basic rules and principles, many of which have several exceptions. The idea is for the students to find the exceptions and be able to adapt the principles to suit varying circumstances. To illustrate this, let us compare the steps of an information-oriented approach to a concept-oriented one.

The information-oriented approach is basically an inductive one. That is, we begin by giving out specific facts and data, then we draw conclusions, and finally derive our concepts. (Unfortunately, many teachers today never follow through to the final step of deriving the basic concept!) A concept-oriented approach is deductive rather than inductive. After prerequisite definitions are given, students are taught a generalized concept. From there, students speculate on probable conclusions and hypotheses, then search out the necessary information in an effort to test the conclusions. What the deductive, concept-oriented approach develops is the ability to apply a general concept, and the skills to resourcefully and efficiently locate the information needed to test one's speculative conclusions. To accelerate, simplify, and reinforce this process, the needed information could be made available through a computer retrieval system.

Let us consider how this method can be employed within a discipline through the use of the microcomputer. The following example pertains to basic music theory. The prerequisite information required of the student are knowledge of the definition and labeling of music intervals, the definition of a triad, and how to read treble clef.

Computer: Now I am going to show you how to derive various types of triads by teaching you a simple harmonic concept. This concept is:
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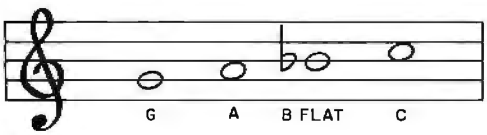


Figure 1: *See text for details.*

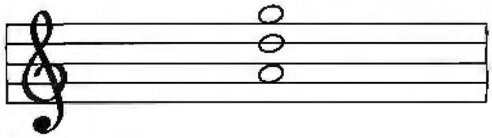

Figure 2: *See text for details.*

This means that by choosing an interval, and stacking notes on top of one another at the interval you have selected, you can form various types of triads and harmonic textures.

Let us begin by selecting one of the following notes on the treble clef staff shown in figure 1.

Student: A.

Computer: Now choose one of the following intervals:

second
third
fourth
fifth

Student: Fourth.

Computer: Very good. Now build the triad out of fourths using the note you selected as the root of the chord. (List the two added notes.)

Student: D and G.

Computer: Correct! (See figure 2.)
Because this triad is built in fourths, it is called a quartal triad. Quartal harmony has been used by many twentieth-century composers. Now check the text file for information on quartal harmony and answer the following questions....
Now choose another interval...(etc)

Computer: This is a basic principle for building triads. Usually, students only learn about tertian harmony (chords built in thirds) in the early years of music theory. But by using this concept, you can jump ahead and learn to write triads which are usually considered advanced...

A third important element of concept-oriented education is the interdisciplinary transfer of knowledge. Here, we are dealing with unifying relationships among disciplines, usually closely related disciplines. In the arts for example, there are certain fundamental aesthetic elements that are common to media. Among these are contrast, intensity, and proportion. The techniques used to employ these elements in an artwork are different for every medium, but the aesthetic purpose served is essentially the same. Microcomputer programs could be developed to teach such interdisciplinary, isomorphic relationships. If used early enough in a child's education, a network of unity could be structured among the disciplines. Then, even when specialization becomes necessary later on, a holistic perspective would always remain with the student.■

References

1. Margenau, Henry. *Integrative Principles of Modern Thought.* New York: Gordon and Breach, 1972.
2. Meyer, Adolphe E. *An Educational History of the American People.* New York: McGraw-Hill, 1967.

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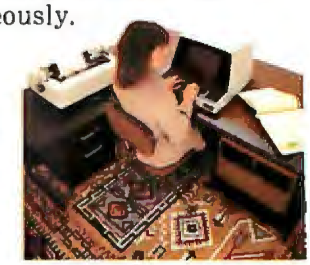

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# We Interrupt This Program...

Gary V Small
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The phrase "we interrupt this program to bring you an important announcement" is as applicable to computers as it is to radio or television. The interrupt system of a computer stops the program being processed to perform a more important task.

What is an interrupt? It is a computer control-signal input that is sampled by the microprocessor during every instruction cycle. If an external device has *asserted* (activated) the interrupt line, the microprocessor will cease processing the normal flow of instructions, put an *interrupt vector* on the address lines, and load the program counter with the address pointed to by the interrupt vector. The microprocessor can then begin execution of the interrupt-handling program found at this address.

Simply stated, an interrupt is a forced, immediate branch to some specified memory address in response to an externally generated control signal. A computer system will generally use additional hardware to implement a number of possible interrupts, each with its own priority and interrupt-handling routine.

## Why Interrupt?

At present, few microprocessor-based systems are interrupt driven. Any program requiring I/O (input/output) operations, or timing functions, must employ a timing loop (a sequence of instructions that takes a known interval to execute) until the operation is complete. As an example, writing eighty characters to a teletypewriter at a rate of 110 bits per second would require about eight seconds. The processor uses most of this time to constantly sample the *transmitter ready* status of the interface involved. In eight seconds, an 8080A microprocessor could process about four million instructions. As you can see, sitting in a status-checking loop is not an efficient processing method.

Now suppose that the transmitter-ready signal from the interface is used to assert the interrupt line to the microprocessor. Whenever the interface is ready to accept another character, the processor is forced to branch to the output routine. It sends the next character, then returns to the main program. For the specific example we are using, this fairly simple procedure results in making four million additional instruction periods available.

Obviously, in many low-level applications, it really doesn't matter how much time is spent in an I/O loop because the user won't be proceeding with the program until the output is complete. However, in many higher-level applications, such as multiprogramming and high-speed instrumentation programs, it becomes imperative that the processor not be tied up. Interrupt-driven software and hardware become essential. Multiuser, multiprogramming systems become feasible only in an interrupt-driven environment.

Any programming that requires timing or periodic functions can also benefit from the use of interrupts in conjunction with a programmable timer. Tasks such as keyboard scanning or display refreshing are very simple to accommodate using an interrupt system. There is very little impact on the main program task by occasional interrupts, and a little software can replace additional hardware.

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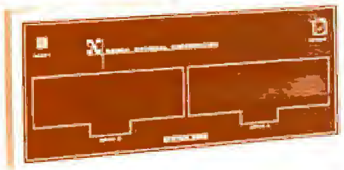

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Multiple programs can also run under an interrupting, time-sharing system. Each program may be assigned a certain percentage of the total processing time. A timed interrupt and executive routine are used to *rotate* the processor between programs. The executive program, from which the interrupt branches, acts as a "traffic cop" to give each program its fair share of time.

### Multilevel Interruption

A computer system generally has several interrupting devices. To sort out these interrupts a priority scheme is generally used. The priority scheme assigns each device in the system a priority level, according to its importance. This allows the most important I/O devices to be serviced before those of lower priority. Except in the simplest interrupt implementations, a higher-level interrupt is allowed to interrupt the current routine of a lower-priority interrupt. In this way, several interrupt routines could conceivably be nested in a busy system.

Most microprocessors have only one general-purpose interrupt input, and external hardware must be used to resolve priorities between the various interrupt lines. The hardware may also provide for additional functions, such as individually selectable interrupt levels and nesting of interrupts. The hardware involved in a very simple interrupt system is shown in figure 1a. In this system, once an interrupt occurs, the interrupt system should remain disabled until completion of the interrupt routine. With this very simple implementation a high-level interrupt may not interrupt a lower-level routine once it is in progress.

For an interrupt to be recognized by the microprocessor an *enable interrupts* instruction must have been previously executed by the program. Additionally, some devices will require that a special interrupt register be set with the proper vectoring data. When an interrupt is recognized, the contents of the program counter will be pushed onto the stack, and the start address of the interrupt routine will replace the old program-counter data.

When an interrupt occurs, the return address is saved on the stack, and the processor branches unconditionally to the interrupt routine. The microprocessor will also disable its internal interrupt system whenever an interrupt occurs. Software must enable interrupts again before other interrupts will be recognized by the device.

An interrupt routine should also do some housekeeping to insure a successful return to the interrupted program. First, the contents of all the registers should be saved so that their contents can be restored prior to resuming the interrupted program. Depending upon your hardware, you may need to output the priority level of the current interrupt for comparison with incoming interrupts.

In the case of serial devices, such as terminals or cassette decks, the microprocessor is usually interfacing with a UART (universal asynchronous receiver-transmitter). These devices have signals indicating "receiver ready" and "transmitter ready" to assert interrupt lines. The signals can be used as independent interrupts (one per device) or can

Circle 174 on inquiry card.





be combined into a single interrupt. In the latter case, software can examine the device status to determine the required operation. The act of servicing the UART will clear the condition of the signals.

In dealing with parallel devices such as printers, the usual feedback is in the form of a "busy" signal; inverted, this becomes a "ready" signal that can be used to generate an interrupt. Here again, servicing the device will clear the interrupt signal.

In a good system, the interrupt hardware will allow interrupt nesting and individual selection of interrupts (see figure 1b). The computer interrupt system is a truly useful and efficient tool for increasing the throughput and general capabilities of a microprocessor-based computer system. With interrupts a whole world of high-level applications, such as multiuser systems, becomes feasible. Once understood, the interrupts system becomes an indispensable programming tool. ■

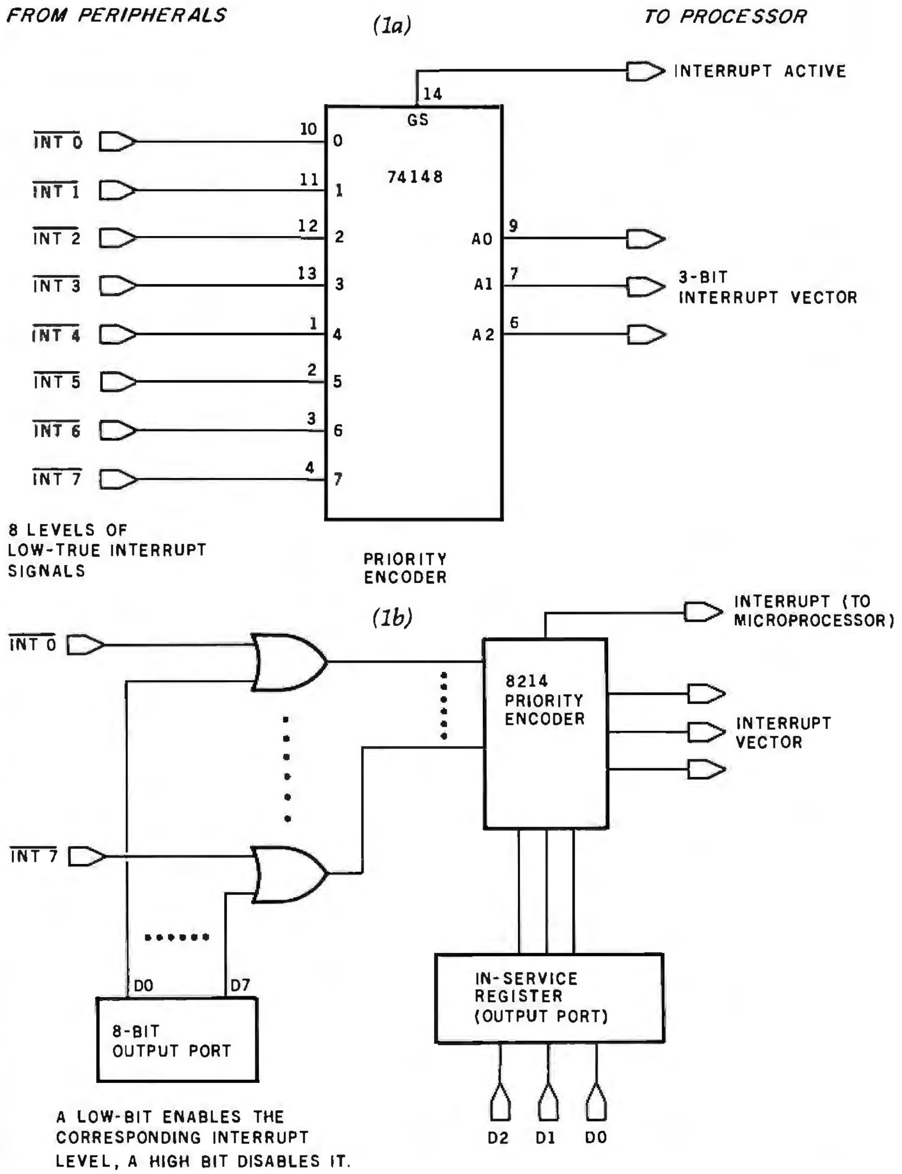


**Figure 1:** *Hardware for handling multiple-level interrupts. This system allows a computer to handle the requests of peripheral devices in order of priority. The arrangement in figure 1a has the capacity to service eight separate priority levels. Each interrupt is completed before others are allowed. A more sophisticated scheme is shown in figure 1b. It has the ability to halt current interrupt service if a higher-level interrupt occurs (when the higher-level interrupt is finished, control is returned to the lower-priority interrupt and its service is completed).*



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# Z80 Table Lookup

Thomas McCloud, 26572 Hickory Ave, Hayward CA 94544

Among the problems familiar to experienced programmers is that of table lookup: given a value (the argument, or *key*), search through a list of values of the same kind to find a matching entry. Then, once a match is found, extract the corresponding entry (the function, or *result*) from a second list, often of a different kind of data. This article discusses a single table-lookup routine (written specifically for a Zilog Z80 microprocessor) that, given an 8-bit value, finds a corresponding 16-bit value. As such, this article is of primary interest only to Z80 programmers. But it shows them how the special instructions peculiar to the Z80 can be used to good effect.

The routine, ZTL, is shown in listing 1. It achieves a great economy of program size, and a good economy of execution time, by using the special Z80 block-search instruction, CPDR (Compare, Decrement and Repeat). The similar search instruction, CPIR (Compare, Increment and Repeat), may seem more natural to use. But for the routine presented here, CPDR provides more easily used "leftover information" in the BC register pair.

To show how the routine works, consider the following example. A computer-system monitor is being written. The system user types a single character command, and the system responds by performing an indicated action. The commands are:

I — Initialize system
D — Display hexadecimal memory dump
G — Get a file from external media
X — Execute a program
E — Enter hexadecimal data into memory
B — Set a breakpoint

Some of the commands need additional data, such as the address at which a breakpoint is to be set. However, the only current concern is to identify the command and branch to the address of the corresponding command-handling routine. Listing 2 shows the memory arrangement of the table for ZTL. (Values given for the addresses of the command-handling routines are purely arbitrary.)

The call to use the ZTL routine is shown in listing 3. Listing 4 shows a step-by-step illustration of the contents of each register involved, assuming that the program has extracted a G command from the typed input.

The first two instructions simply copy the contents of the BC register pair (used to hold the byte count) into the DE register pair (to be used later). The next instruction is the Z80 CPDR. It is executed four times in the current example. On the first execution, the G in register A is compared to the B at the location (hexadecimal 12F5) indicated by the HL register pair, the contents of HL are decremented from hexadecimal 12F5 to 12F4, and the byte count is decremented from 6 to 5. Since the bytes compared did not match, and the byte count did not go to zero, the instruction is repeated, using the new values in the HL and BC register pairs.

On the fourth execution of the CPDR instruction, the G in register A is compared to the G at the location indicated by the HL register pair (hexadecimal 12F2), the contents of HL are decremented from hexadecimal 12F2 to 12F1, and the byte count is decremented from 3 to 2. Since the bytes compared did match, the instruction is not repeated. Notice that the HL register no longer points to the G in the table; it points one location below the G. This is a nuisance caused by Zilog's choice of a "post-test

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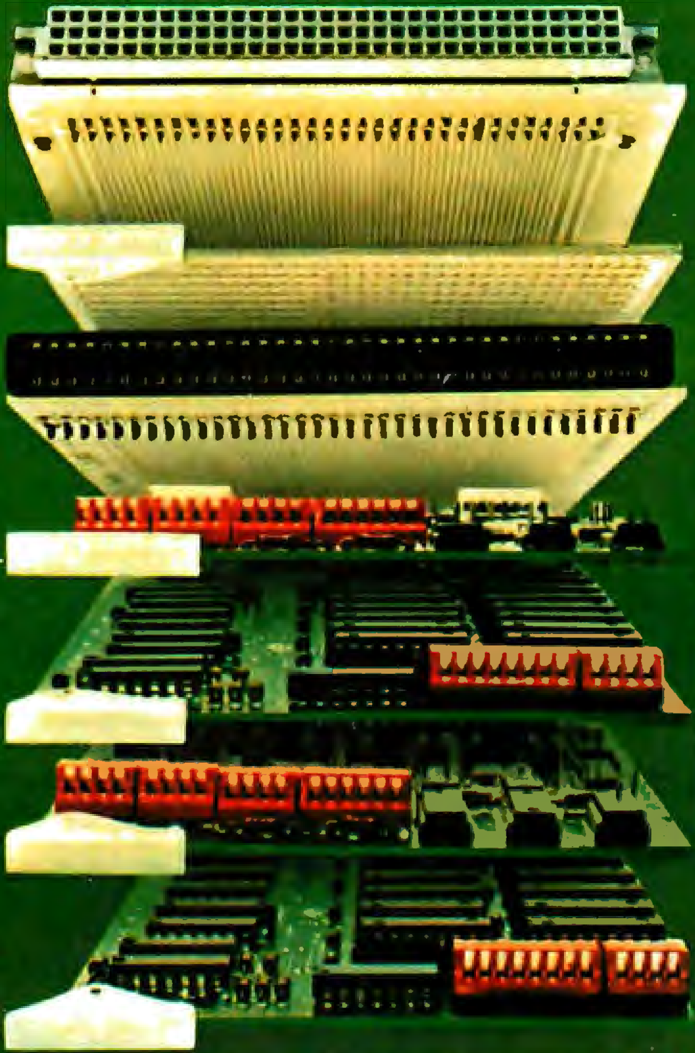

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loop" approach instead of a "pre-test loop." It is not difficult to compensate for it, but it is easy to forget.

The next instruction executed is a RET NZ (return on not zero), which provides an exit when the byte for which a match is sought does not occur in the table. In the current example, this return is not taken. Following the RET NZ is an instruction to increment the contents of the HL register pair. This instruction is used to compensate for the incorrect value stored in the HL register, described above.

The next two instructions compute the address of the first (low-order due to high/low storage reversal) byte of the sought argument—the corresponding entry in the second part of the table. Suppose $B$ is the beginning address of the first part of the table, $L$ is the length of the first part of the table, and $I$ is the position of the sought byte in the table, $I$ ranging from 1 to $L$. The second part of the table starts at address $B + L$, and the sought entry starts at address $B + L + (I - 1) \times 2$. At this point in the execution of the routine, BC holds $I - 1$, because the CPDR decrements the byte count once too often, as well as the address in HL. Furthermore, the address in HL is $B + (I - 1)$ (compensated). So, when the routine adds BC to HL:

$$HL = B + (I - 1) + (I - 1)$$

Then, adding the table length $L$, saved in DE:

$$HL = B + (I - 1) + (I - 1) + L$$

so:

$$HL = B + L + (I - 1) \times 2$$

which is the address of the sought argument.

*Text continued on page 174*

**Listing 1:** *ZTL, a table-lookup routine for the Z80 microprocessor. The use of the Z80's block-search instructions makes this routine short and fast, but some of the microprocessor's idiosyncrasies need compensation.*

```
;NAME: ZTL
;PURPOSE: Z80 TABLE LOOKUP
;INPUTS: A  = ARGUMENT (BYTE VALUE FOR WHICH
;             WORD VALUE IS TO BE FOUND.)
;        BC = LENGTH OF TABLE ARGUMENT LIST
;        HL = ADDRESS OF LAST TABLE ARGUMENT
;NOTE: TABLE MUST CONSIST OF AN ARGUMENT LIST OF
;      SINGLE-BYTE ENTRIES, FOLLOWED BY A FUNCTION
;      LIST OF CORRESPONDING SINGLE-WORD ENTRIES.
;      (WORDS STORED WITH USUAL LOW-HIGH BYTE
;      INVERSION.)
;OUTPUTS: IF NO MATCH FOUND FOR INPUT:
;            ZERO FLAG OFF (NZ)
;         IF MATCH FOUND FOR INPUT:
;            ZERO FLAG ON (Z)
;            HL = VALUE FROM CORRESPONDING
;                 FUNCTION ENTRY
ZTL:    EQU     $
        LD      D,B     ;COPY LENGTH FROM BC
                         (BYTE COUNT) . . .
        LD      E,C     ;. . . INTO DE (TO SAVE FOR LATER)
        CPDR            ;SEARCH DOWN ARGUMENT ENTRIES
        RET     NZ      ;"NOT ZERO" MEANS NO MATCH
                         FOUND
;NOTE THAT NONE OF THE FOLLOWING CHANGES THE
;ZERO FLAG
        INC     HL      ;COMPENSATE FOR CPDR OVERSHOT
        ADD     HL,BC   ;ADD REMNANT OF BYTE COUNT
        ADD     HL,DE   ;ADD ORIGINAL LENGTH
;AT THIS POINT THE HL REGISTER PAIR POINTS TO THE
;DESIRED FUNCTION ENTRY
        LD      E,(HL)  ;PICK UP LOW-ORDER BYTE
        INC     HL
        LD      D,(HL)  ;PICK UP HIGH-ORDER BYTE
```

*Listing 1 continued on page 172*

*Listing 1 continued:*

```
        EX      DE,HL  ;PUT RESULT INTO HL (MORE
                        USEFUL THERE)
        RET            ;DONE
```

**Listing 2:** *Arrangement of the table in memory for use by ZTL.*

```
ADDRESS    DATA
  12F0      49          [LETTER "I"]
  12F1      44          [LETTER "D"]
  12F2      47          [LETTER "G"]
  12F3      58          [LETTER "X"]
  12F4      45          [LETTER "E"]
  12F5      42          [LETTER "B"]
  12F6      00      [INITIALIZE ROUTINE AT ADDRESS
  12F7      00        0000]
  12F8      AA      [DISPLAY ROUTINE AT ADDRESS
  12F9      06        06AA]
  12FA      0B      [GET ROUTINE AT ADDRESS 070B]
  12FB      07
  12FC      12      [EXECUTE ROUTINE AT ADDRESS
  12FD      01        0112]
  12FE      08      [SET BREAKPOINT ROUTINE AT
  12FF      0A        ADDRESS 0A08]
```

**Listing 3:** *Sample of the call to ZTL.*

```
        .
        .
        .
[NOTE: AT THIS POINT IT IS ASSUMED THAT REGISTER A
ALREADY CONTAINS THE ASCII CHARACTER "G", EX-
TRACTED FROM INPUT, FOR WHICH THE TARGET ADDRESS
IS TO BE FOUND.]
      LD      BC,6      ;LOAD LENGTH OF ARGUMENT
                         TABLE
      LD      HL,12F5H  ;ADDRESS OF LAST TABLE ENTRY
;FIND ADDRESS IN FUNCTION TABLE CORRESPONDING TO
;BYTE IN A
      CALL    ZTL       ;Z80 TABLE LOOKUP
      JP      (HL)      ;GO TO THE ADDRESS SO FOUND
        .
        .
        .
```

**Listing 4:** *Register contents as ZTL executes (see the text for an explanation of the specific example).*

```
INSTRUCTION        REGISTER CONTENTS              TABLE BYTE
EXECUTED         A   Z-FLAG   B  C  D  E  H  L      (HL)
ZTL ROUTINE CALLED
                 47    ??     00 06 ?? ?? 12 F5      42
  LD     D,B  ;COPY LENGTH FROM BC (BYTE COUNT)...
                 47    ??     00 06 00 ?? 12 F5      42
  LD     E,C  ;...INTO DE (TO SAVE FOR LATER)
                 47    ??     00 06 00 06 12 F5      42
  CPDR        ;SEARCH DOWN ARGUMENT ENTRIES
                 47    ??     00 05 00 06 12 F4      45
  CPDR        [INSTRUCTION REPEATS ITSELF]
                 47    NZ     00 04 00 06 12 F3      58
```

*Listing 4 continued on page 174*

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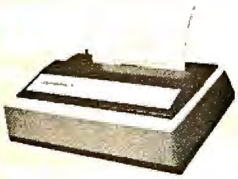

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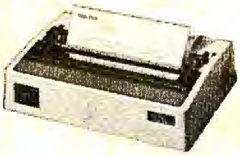

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*Listing 4 continued:*

```
CPDR       [INSTRUCTION REPEATS ITSELF]
           47   NZ    00 03 00 06 12 F2    47
CPDR       [INSTRUCTION REPEATS ITSELF]
           47   Z     00 02 00 06 12 F1    44
RET   NZ  ;"NOT ZERO" MEANS NO MATCH FOUND
           47   Z     00 02 00 06 12 F1    44
INC   HL  ;COMPENSATE FOR CPDR OVERSHOT
           47   Z     00 02 00 06 12 F2    47
ADD HL,BC ;ADD REMNANT OF BYTE COUNT
           47   Z     00 02 00 06 12 F4    45
ADD HL,DE ;ADD ORIGINAL LENGTH
           47   Z     00 02 00 06 12 FA    0B
LD  E,(HL) ;PICK UP LOW-ORDER BYTE
           47   Z     00 02 00 0B 12 FA    0B
INC   HL
           47   Z     00 02 00 0B 12 FB    07
LD  D,(HL) ;PICK UP HIGH-ORDER BYTE
           47   Z     00 02 07 0B 12 FB    07
EX  DE,HL  ;PUT RESULT INTO HL (MORE USEFUL THERE)
           47   Z     00 02 12 FB 07 0B    ??
RET   ;DONE
           47   Z     00 02 12 FB 07 0B    ??
```

*Text continued from page 170:*

The next instructions pick up the low-order byte, increment HL, and pick up the high-order byte of the sought argument word. They are put directly into the DE register pair by means of the HL register indirect instructions. If the answer is useful in DE, the routine can be ended here with a return; but, since an answer is generally more useful in the HL register pair, the routine as shown includes an exchange of DE with HL.

Finally, the routine ends with a simple unconditional return statement. It is important to note that *none* of the instructions following the CPDR will affect the zero flag. This allows the calling routine to easily determine if a match was found by examining the zero flag. The fact that the 16-bit ADD (without including previous carry) instructions do not set the zero flag is often a nuisance. But in this routine it is an advantage.

### Beyond Tables

This article described a simple routine with a great deal of power. The example of usage presented dealt with finding the address of a software routine when given a single character command. However, the same routine can be called whenever you want to find 16 or fewer bits of information from a single 8-bit value. For example, it could be used to interpret single-byte codes used to store 3-digit telephone prefixes. Or it might be useful in a compiler to store a table of kinds of variables and their attributes. Hopefully, you will find that problems of your own can be solved with this simple and efficient routine.■

Circle 24 on inquiry card.

# Four Word Processors for the Apple II

Keith Carlson
43 McDill Rd
Bedford MA 01730

Steve Haber
14 Larchmont Dr
Nashua NH 03062

The world of word processors has expanded rapidly in the past few years, and it appears to be only the beginning. We have seen a flourish of office automation machines from the big manufacturers, but with few exceptions the small machine software manufacturers have led the way. And, after reviewing some of the word-processing systems designed for microcomputers, we discovered that they have several advantages.

It was a temptation when reviewing these word processors to compare them to their large mainframe brothers. Eventually we stopped resisting that temptation. Both Steve and I have access in our work to such mainframe word processors as those by Wang and Honeywell. The comparison hardly seems fair, but in reality most of the microcomputer word processors offer the features found in their larger brothers: in fact, a few of them are easier to use and learn, while still providing all of the features a user could possibly want. This will be evident in specific reviews.

There are two kinds of word processors: *screen-* or *cursor*-oriented, and *line*-oriented. Cursor-oriented means that the editing and entry take place at the cursor, which is moved throughout the text. In line-oriented word processors, all text is entered and referred to with line numbers. Neither method appears to have a distinct advantage over the other: they are merely different ways of referencing the text.

## Super-Text

Super-Text is a super word processor that, despite minor problems, exhibits some of the power-packed features you would expect in a word processor designed for a much larger machine. Super-Text (from Muse Software) can be easily adapted to your current equipment, as well as any you may acquire in the future.


**Photo 1:** *Apple word processors: the Datacope Scribe, the Rainbow Write-On!, the IUS EasyWriter Professional system, and the Muse Super-Text II. (The cream-colored binder in the upper left corner is for Super-Text I, which has been discontinued by Muse.)*

**At a Glance**

**Name**
Super-Text II

**Type**
Word processor

**Manufacturer**
Muse Software
330 N Charles St
Baltimore MD 21201
(301) 659-7212

**Price**
$150

**Format**
5-inch floppy disk

**Language**
6502 machine language

**Computer**
Apple II or II+ with 48 K bytes of memory and one disk drive

**Documentation**
82 pages, 15.5 by 23 cm (6 by 9 inches); three-ring binder

**Audience**
Anyone needing a word-processing system



Circle 223 on Inquiry card. →

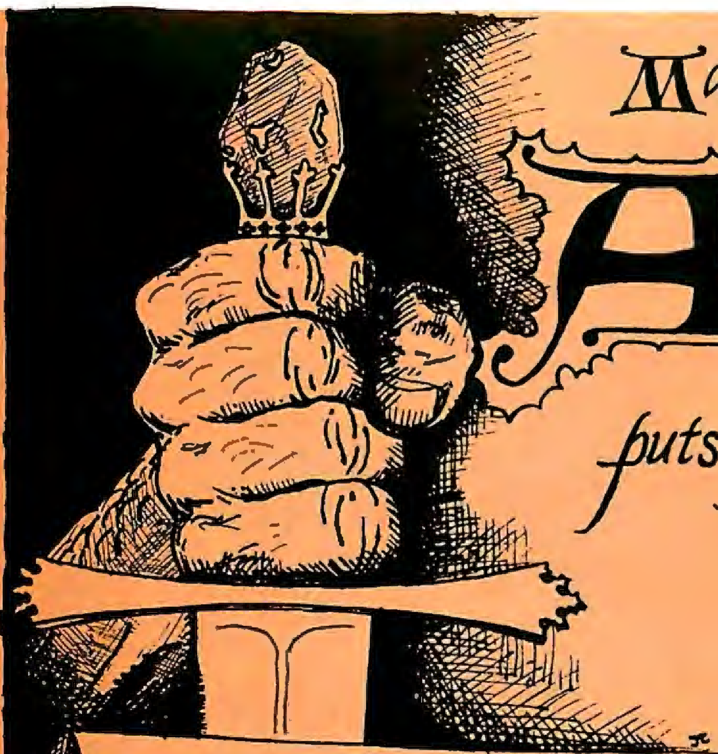
With the Dan Paymar lowercase adapter (which allows the Apple to display lowercase letters), this processor supports true lowercase.

Super-Text also allows conversion of files for use with the Paymar lowercase adapter. However, it does not allow the reverse, so you must either keep two copies of the text file or always use an Apple II with the lowercase adapter. Most of the other Apple II word processors use reverse-video to represent uppercase letters on the screen. If you don't have a Paymar lowercase adapter, Super-Text places a reverse-video A in front of the character to be capitalized, instead of highlighting the character itself. This can be confusing until you get used to it, because the reversed A does not print when you print the file. We found that we had a tendency to compensate for the nonprinting character when lining up text. You have to use the control key as a shift, but Super-Text will support the use of the shift key with a minor modification to the keyboard. (Muse provides the short piece of wire and instructions for the modification.)

Super-Text does not support an 80-column board, but it simulates 80 columns by using a preview mode. This mode allows you to see what your text will look like on paper, with obvious limitations on color, super-/subscripting, and underlining. (In any case, these limitations are dependent upon the printer that you use.)

Since you can only see the leftmost 40 columns on the screen, the preview mode allows you to move the left margin to the right to see the other half of the document; however, we found the operation awkward to use because the text scrolls past quickly. Still, this arrangement is better than wasting paper to see what you have written.

Super-Text uses the wraparound method of text entry (ie: if a word will not fit on a line, the entire word is automatically moved to the next line). Some word processors use a



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# Amethyst

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*Talk with Amethyst about words, sentences, paragraphs, chapters, quotations, footnotes, and more—it understands. Its ability to edit and display several documents and programs at once is absolutely unequaled by any other system.*

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*One year's support is included—we don't leave you to fend for yourself. And our thorough, readable documentation has received high acclaim from our users. Amethyst comes with the BDS C compiler. How many other word processing systems let you write programs as well?*

Amethyst $350 (less C compiler $250) manual $35

Mince (Amethyst text editor) $125 manual $15 demo disk $10
Scribble (Amethyst text formatter) $125 manual $15
Mince and Scribble ordered together $175

48K CP/M[R] required. Available on 8" soft sector diskettes. Mince and Amethyst require a cursor-addressable terminal. Dealer, site, OEM, and **NIX versions and licenses available.

Mark of the Unicorn, P.O. Box 423, Arlington, MA. 02174 (617)489-1387

Circle 209 on inquiry card.

"hot zone" to prompt for hyphenation, but if you want hyphenation with Super-Text you must perform it manually. By embedding control characters in the text, you can instantly invoke format changes, tab stops, automatic paragraph indentation, word centering, and left margin changes. These control characters appear as reverse video letters. Super-Text formats the text upon printout, so the effects of these control characters are visible only on printout or during preview mode.

The only files Super-Text will accept, other than those written by itself, are Dr Memory files. (Dr Memory is the predecessor of Super-Text.) Muse also has add-on modules that can produce form letters (available for $100), input files by telecommunication ($75), and plot graphs (no price quoted).

Super-Text's ability to edit is excellent. The word processor is cursor-oriented, and it gives the user a full set of commands to move the cursor about the text. The cursor scrolls backward or forward by operator choice, and the direction is clearly marked in the lower left-hand corner. The replacement, deletion, insertion, and rearrangement of text processes are all easy to use and understand. However, one minor problem appears with insertion: normally insertion occurs in front of the current cursor location—with Super-Text, it occurs *after* the cursor location. This is unnerving and hard to get used to. Super-Text can also copy blocks of text easily throughout the text file, and it can save and load blocks of text separately, a feature that is especially helpful with "boilerplate" files used in business correspondence.

Find-and-replace operations are easy and efficient. The operations even include a "wild card" notation that will match any number of intervening characters (including none). For example, an attempt to find "COMPUT#WORLD" would match "COMPUTER WORLD" or "COMPUTING WORLD". Super-Text is loaded with prompts that make find-and-replace operations easy for the operator.

# DYNACOMP

*Quality software for⁺:*

| | |
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| ATARI | TRS-80 (Level II)* |
| PET | NORTH STAR |
| APPLE II Plus | CP/M 8" Disk |

## GAMES, SIMULATIONS, EDUCATION and MISCELLANEOUS

**BRIDGE2.0 (Available for all computers)** — **Price: $17.95 Cassette/$21.95 Diskette**
An all-inclusive version of this most popular of card games. This program both BIDS and PLAYS either contract or duplicate bridge. Depending on the contract, your computer opponents will either play the offense OR defense. If you bid too high, the computer will double your contract! BRIDGE 2.0 provides challenging entertainment for advanced players and is an excellent learning tool for the bridge novice.

**HEARTS 1.5 (Available for all computers)** — **Price: $14.95 Cassette/$18.95 Diskette**
An exciting and entertaining computer version of this popular card game. Hearts is a trick-oriented game in which the purpose is not to take any hearts or the queen of spades. Play against two computer opponents who are armed with hard-to-beat playing strategies.

**CRIBBAGE (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.

**STUD POKER (ATARI only)** — **Price: $11.95 Cassette/$15.95 Diskette**
This is the classic gambler's card game. The computer deals the cards one at a time and you (and the computer) bet on what you see. The computer does not cheat and *usually* bets the odds. However, it sometimes bluffs! Also included is a five card draw poker betting practice program. This package will run on a 16K ATARI. Color, graphics, sound.

**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.

**NOMINOES JIGSAW (Atari, Apple and TRS-80 only)** — **Price: $16.95 Cassette/$20.95 Diskette**
A jigsaw puzzle on your computer! Complete the puzzle by selecting your pieces from a table consisting of 60 different shapes. NOMINOES JIGSAW is a virtuoso programming effort. The graphics are superlative and the puzzle will challenge you with its three levels of difficulty. Scoring is based upon the number of guesses taken and by the difficulty of the board set-up.

**CRANSTON MANOR ADVENTURE (North Star only)** — **Price: $19.95**
At last! A comprehensive Adventure game for the North Star. CRANSTON MANOR ADVENTURE takes you in 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. Requires 32K.

**VALDEZ (Available for all computers)** — **Price: $14.95 Cassette/$18.95 Diskette**
A simulation of supertanker navigation in the Prince William Sound and Valdez Narrows. The program uses an extensive 256X256 element radar map and employs physical models of ship response and tidal patterns. Chart your own course through ship and iceberg traffic. Any standard terminal may be used for display.

**FLIGHT SIMULATOR (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.

**STARTREK 3.2 (Available for all computers)** — **Price: $ 9.95 Cassette/$13.95 Diskette**
This is the classic Startrek simulation, but with several new features. For example, the Klingons now shoot at the Enterprise without warning while also attacking starbases in other quadrants. The Klingons also attack with both light and heavy cruisers and move when shot at! The situation is hectic when the Enterprise is besieged by three heavy cruisers and a starbase S.O.S. is received! The Klingons get even!

**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.

**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.

**HODGE PODGE (Apple only, 48K Integer BASIC)** — **Price: $19.95 Cassette/$23.95 Diskette**
Let HODGE PODGE be your child's baby sitter. 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 9. HODGE PODGE is a non-intimidating teaching device which brings a new dimension to the use of computers in education. HODGE PODGE requires a 48K Apple running with Integer BASIC.

**TEACHER'S PET I (Available for all computers)** — **Price: $ 9.95 Cassette/$13.95 Diskette**
This is the first of DYNACOMP's educational packages. Primarily intended for pre-school to grade 3, TEACHER'S PET provides the young student with counting practice, letter-word recognition and three levels of math skill exercises.

**SPACE TILT (Apple only)** — **Price: $10.95 Cassette/$14.95 Diskette**
Use the game paddles to tilt the plane of the TV screen to "roll" a ball into a hole in the screen. Sound simple? Not when the hole gets smaller and smaller! A built-in timer allows you to measure your skill against others in this habit-forming action game.

**MOVING MAZE (Apple only)** — **Price: $10.95 Cassette/$14.95 Diskette**
MOVING MAZE employs the games paddles to direct a puck from one side of a maze to the other. However, the maze is dynamically (and randomly) built and is continually being modified. The objective is to cross the maze without touching (or being hit by) a wall. Scoring is by an elapsed time indicator, and three levels of play are provided.

**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!

**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.

**GIANT SLALOM (Atari only)** — **Price: $14.95 Cassette/$18.95 Diskette**
This real-time action game is guaranteed addictive! Use the joystick to control your path through slalom courses consisting of both open and closed gates. Choose from different levels of difficulty, race against other players or simply take practice runs against the clock. GIANT SLALOM will run on 16K systems.

**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.

**CHOMP-OTHELLO (Atari only)** — **Price: $11.95 Cassette/$15.95 Diskette**
CHOMP-OTHELLO: It's really two challenging games in one. CHOMP is similar in concept to NIM; you must bite off part of a cookie, but avoid taking the poisoned portion. OTHELLO is the popular board game set to fully utilize the Atari's graphics capability. It is also very hard to beat! This package will run on a 16K system.

**GAMES PACK I (Available for all computers)** — **Price: $9.95 Cassette/$13.95 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.

**GAMES PACK II (Available for all computers)** — **Price: $9.95 Cassette/$13.95 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.

Why pay $7.95 or more per program when you can buy a DYNACOMP collection for just $9.95?

**NORTH STAR SOFTWARE EXCHANGE (NSSE) LIBRARY** — **Price $9.95 Diskette**
DYNACOMP now distributes the 20 + volume NSSE library. Most of these diskettes offer an outstanding value for the purchase price. Write for details regarding the contents of this library and quantity (four or more) purchases.

## 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 format) 8" CP/M floppy disks for systems running under MBASIC.

## BUSINESS and UTILITIES

**MAIL LIST 2.2 (Apple, Atari and North Star diskette only)** — **Price: $34.95**
This program is unmatched in its ability to store a maximum number of addresses on one diskette (minimum of 1100 per diskette, more than 2200 for "double density" systems!). Its many features include alphabetic and zip code sorting, label printing, merging of files and a unique keyword seeking routine which retrieves entries by a virtually limitless selection of user defined codes. A very valuable program!

**FORM LETTER SYSTEM (FLS) (Apple and North Star diskette only)** — **Price: $21.95**
Use FLS to create and edit form letters and address lists. Form letters are produced by automatically inserting each address into a predetermined portion of your letter. FLS is completely compatible with MAIL LIST 2.2, which may be used to manage your address files.

FLS and MAIL LIST 2.2 are available as a combined package for $49.95.

**PERSONAL FINANCE SYSTEM (ATARI only)** — **Price: $34.95 Diskette**
PFS is a single disk menu oriented system composed of 10 programs designed to organize and simplify your personal finances. Features include a 300 transaction capacity; fast access; 26 optional user codes; data retrieval by month, code or payee; optional printing of reports; checkbook balancing; bar graph plotting and more. Also provides on the diskette is ATARI DOS 2.

**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.

**DFILE (North Star only)** — **Price: $19.95**
This handy program allows North Star users to maintain a specialized data base of all files and programs in the stack of disks which invariably accumulates. DFILE is easy to set up and use. It will organize your disks to provide efficient locating of the desired file or program.

**GRAFIX (TRS-80 only)** — **Price: $12.95 Cassette/$16.95 Diskette**
This unique program allows you to easily create graphics directly from the keyboard. You "draw" your figure using the program's extensive cursor controls. Once the figure is made, it is automatically appended to your BASIC program as a string variable. Draw a "happy face", call it H$ and then print it from your program using PRINT H$! This is a very easy way to create and save graphics.

**TIDY (TRS-80 only)** — **Price: $10.95 Cassette/$14.95 Diskette**
TIDY is an assembly language program which allows you to renumber the lines in your BASIC programs. TIDY also removes unnecessary spaces and REMark statements. The result is a compacted BASIC program which uses much less memory space and executes significantly faster. Once loaded, TIDY remains in memory; you may load any number of BASIC programs without having to reload TIDY!

## STATISTICS and ENGINEERING

**DATA SMOOTHER (Not available for ATARI)** — **Price: $14.95 Cassette/$18.95 Diskette**
This special data smoothing program may be used to rapidly derive useful information from noisy business and engineering data which are equally spaced. The software features choice in degree and range of fit, as well as smoothed first and second derivative calculation. Also included is automatic plotting of the input data and smoothed results.

**FOURIER ANALYZER (Available for all computers)** — **Price: $14.95 Cassette/$18.95 Diskette**
Use this program to examine the frequency spectra of limited duration signals. The program features automatic scaling and plotting of the input data and results. Practical applications include the analysis of complicated patterns in such fields as electronics, communications and business.

**TFA (Transfer Function Analyzer)** — **Price: $19.95 Cassette/$23.95 Diskette**
This is a special software package which may be used to evaluate the transfer functions of systems such as hi-fi amplifiers and filters by examining their response to pulsed inputs. TFA is a major modification of FOURIER ANALYZER and contains an engineering-oriented 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 $44.95 (three cassettes) and $56.95 (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 and curve 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**
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Even more useful (and amazing) is *autolink*. Autolink allows Super-Text to find and replace across an unlimited number of files. This action can occur in forward, backward, or even circular directions. Simply enclose the next file in colon symbols, place it at the end of the file (or the beginning, for a backward or circular link), and set the autolink flag. Any further find or replace command automatically searches the current file, loads the next, and searches it as well. Needless to say, this is a powerful feature that is unavailable on some of the big word processors.

Another feature that is neglected by some of the larger manufacturers is the split-screen mode. It is fascinating to see such a sophisticated feature in a word processor for a microcomputer. However, we wondered about the value of this feature. What can it be used for? In any case, it exists in Super-Text, and if you *can* use it—so much the better. We suspect it has only dazzle value.

In addition to Super-Text's excellent editing, there is a math mode that performs as a four-function calculator for columnar and embedded numerical data. It features an accumulator with up to fifteen-digit significance, and a decimal point that can be set by the operator. This calculator also adds up columns—even across screens. Once sums are in the accumulator, they can be easily inserted in the text, and even automatically aligned on decimal points.

The printouts look clean and professional, which is dependent, in part, on the printer you use. We used a Centronics 737, which is a "smart" (microprocessor-controlled) printer that looks good even though it is a dot-matrix printer. The printer can do many things by itself, and this is where the adaptability of Super-Text becomes a factor. Right justification is performed by space insertion, and it has the appearance of being evenly proportioned since Super-Text seems to place spaces after punctuation first, and then randomly across the line. Super-Text does not perform true proportional spacing, but the Centronics 737 does this automatically with a proportional type font.

The Centronics responds to certain control characters that are sent to it to control particular features, such as underlining, choice of type font, super-/subscripting, and elongation of text (any type font may be printed as double-width characters). While Super-Text cannot directly control these printer functions, it allows six control characters which can be user-defined. (Four of these are configured for Diablo printers.) Some technical knowledge is required to redefine these control characters, but step-by-step instructions lead you through the process.

Although you can add an assembly-language printer driver to Super-Text, it is usually unnecessary. The first time you use Super-Text, you should configure it for your printer; this data is then saved on disk, and you should never again have to change your printer configuration (unless you get a different printer). The formatting parameters given at configuration time can be easily changed within the text.

Super-Text can use continuous form or single-sheet paper. It is difficult, however, to change back and forth, since you must reconfigure the printer every time that you switch. The operator can stop and start a printout at any time by the touch of a key. Page numbers can be suppressed, and made relative to the beginning of a chapter with the insertion of a control character. Page numbers can also be moved around the page for maximum flexibility. There is no provision that automatically locates the proper line for footnotes. The operator must count up lines for proper placement.

Human engineering is a weak point with Super-Text. The program does provide excellent prompts when necessary, including warnings for dangerous commands (eg: "PRESS # TO DELETE→" for deleting the entire text buffer) and multiple keystrokes to avoid accidental deletion. The problem, however, is that a lot of the control characters are not mnemonic. Also, multiple keystrokes for simple operations abound in Super-Text.

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(This problem can be avoided, as demonstrated by Write-On!, another word processor designed for Apple II.) Some functions can be "undone" by using the escape key, but since most of the action takes place instantly, it is difficult to undo these commands. This is not the fault of Super-Text.

Text can be easily recovered from a "crash." If you find yourself in the Apple II monitor (denoted by an asterisk at the beginning of the line), simply type "3D0G", hit the return key, and then "CALL 4096", followed by the return key. You are placed back in Super-Text! We have yet to enter a file that exceeds the capacity of the text buffer in Super-Text, so we don't know what happens when it fills up. The manual states that the processor will warn you when the buffer is almost filled.

Super-Text appears to use its own disk operating system, but it does use BLOAD and BSAVE to load and save text files. These operations are quick and easy. The fact that Super-Text can't be copied is probably the biggest problem. Perhaps Muse has realized how inconvenient this is, because it has provided two disks of the program. We understand its reluctance to put a copyable program on the market, but we feel that there are other ways to avoid piracy. One solution is to create a disk that can be copied a limited number of times but that produces uncopyable copies. In any event, there is a replacement policy, but there is also a $10 media replacement charge.

Super-Text documentation comes in the form of an instruction manual. As a teaching tool, this manual is insufficient. The features are explained well, and some are supplemented with examples from the Super-Text disk. However, no quick reference card is provided, and it is sorely needed. The commands summarized at the end of each chapter explain the modes, but this is not enough, since you must leaf through the manual

until you have memorized all of the commands. There are no listings of the program, but as it can't be modified this makes little difference. In all fairness, the program provides for any modification you might want to make, so listings are unnecessary.

Super-Text is a very good word-processing program, and it generally works very well, especially after the user has adapted to the processor's particular methods. We won't give numerical ratings, as too much depends on the user's needs, but we'll give you a hint. We prepared part of this article with the Super-Text word processor.

### Write-On!

Write-On!, like Super-Text, varies little between versions. The additional features of Write-On! II include preset script margins, personalized form letter capabilities using data files, data-file editing and input, and a system for preformatting text files for the printer. Write-On! II can also convert other files into data files.

Write-On! (from Rainbow Computing) is, for the most part, written in BASIC, and it lacks the speed of Super-Text or the Datacope Scribe. Therefore, it is almost a necessity to preformat text files for the printer. Unlike Super-Text, however, the added features are worth the price: in fact, the ability to print personalized form letters justifies the expense.

The following comments apply to both versions of Write-On!, unless otherwise noted.

Write-On! is a *super* word processor, but that name was already taken. Although it lacks some of the flexibility of the other word processors, it provides a full range of commands to process text.

Write-On! supports display of lowercase letters through the use of the Paymar lowercase adapter. It would appear that Mr Paymar and his adapter have become a standard with Apple. [*Paymar had the field to himself for some time, but other companies (particularly Lazer Systems) are also producing lowercase products for the Apple II....*GW] The shift key can be enabled by modifying the keyboard, as mentioned above, but Rainbow Computing does not provide the wire—just the instructions. Without the shift modification, Write-On! uses reverse video and the ESC (escape) key to denote a capital letter. The shift lock is enabled by hitting the ESC key twice.

Write-On! does not support an 80-column board, and since it does its formatting when it prints out, there is no provision for viewing a text file in its final form on the screen. There *is* a feature in Write-On! II that allows print image files to be saved on disk, but the main purpose of these files is

**At a Glance**

**Name**
Write-On! I and II

**Type**
Word processor

**Manufacturer**
Rainbow Computing
9719 Reseda Blvd
Northridge CA 91324
(213) 349-5560

**Price**
Write-On! I, $99.95
Write-On! II, $150

**Format**
5-inch floppy disk

**Language**
Applesoft BASIC with some 6502 machine-language subroutines

**Computer**
Apple II or II+ with Language Card or ROM Applesoft, 48 K bytes of memory, and one disk drive

**Documentation**
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to speed up output to the printer. (The files display gibberish when loaded and viewed on the Apple screen.)

The processor uses the wraparound technique to divide words, so touch typists can enter text quickly and easily. Unfortunately, there is no provision for hyphenation. (This seems to be the rule rather than the exception in word processors for microcomputers.) Write-On! uses control symbols embedded in the text to control tabs, text width, margins, page numbering, text centering, and paragraph indentation. These symbols take the form of "backslash-some characters-backslash" and they are also highlighted on the screen.

Write-On! will accept files not written by itself. Understandably, the process is slower than loading its own files, but the feature does exist. After we tried this command, we found that the files had to be text files in thirteen-sector format. The files that Super-Text saved would not even show up with the CATALOG command because Super-Text uses BLOAD to save its files. The ability to edit previously created text files is an important consideration when you convert from one word processor to another.

Write-On! performs its editing chores with ease and speed. The processor is line-oriented, and although I feel it is more difficult to work with, this is largely a matter of personal preference. An asterisk appears to the left of the line that is currently operating. The replace and find commands are facilitated by machine code, so they are even quicker. Blocks of text can be moved, copied, deleted, or saved easily. Write-On! does not have an autolink command for editing, so you cannot edit across files (as you can with Super-Text) but it does have a merge command similar to that in Datacope's Scribe. Text from a disk file can be inserted anywhere in the text that you are currently editing. Overall, the editing commands are easy to learn and use.

The standard Apple DOS (disk operating system) is used. However, text files are loaded and saved using BLOAD and BSAVE, which reduces waiting time considerably. The saving and loading commands are clear and understandable, and have prompts that lead the user through the process. If you are a programmer, you can modify this function quite easily, because Write-On! is completely modifiable and copyable. There are some machine-language subroutines for *find* and *replace* functions, but those subroutines work well so there is little need to change them. The program runs in 48 K-byte machines only, but there is adequate room for lengthy files. The manual doesn't tell you what happens if the text buffer fills up, but we never encountered that problem.

There does appear to be a problem where output is concerned: there is no provision for a machine-language driver (sometimes used to drive a nonstandard printer). When initially configured, Write-On! only asks what slot your printer is in. In addi-






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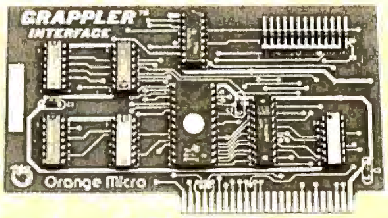


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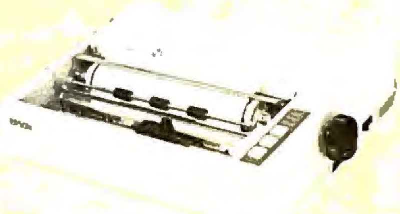

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tion, it is not very adaptable to particular features of different printers. Although Write-On! has several features such as underlining and boldface, it needs some user-defined control characters because it does not provide for such conditions as different type fonts, super-/subscripting, different color ribbons, or proportional spacing. It *will* justify to the right margin, and it does a good job of it. The text doesn't look thin in any particular spot.

Write-On! changes easily from sheet to continuous form. Page numbers can be moved to any position on the page, and numbering can be suppressed. While we were investigating page numbering, we encountered a mystery: Write-On! only allows an absolute page number, yet the manual, which was written with Write-On!, has chapter-relative page numbers (eg: 3 - 4). It seems there is a command that allows a string to be printed to the left or the right of the page number. The chapter must have been inserted as that string and then changed at the beginning of every chapter. This is still mysterious, however, because the manual makes no mention of it. (Except for the EasyWriter Professional word processor, none of these word processors have provisions for footnoting, and Write-On! is no exception.) Write-On! also provides predefined titles. You can define up to twenty titles, which will appear at the beginning of each page.

Write-On! II even provides for form letters using data files. You can build a file of personal or company names, or addresses, and then insert them into a form letter upon printout. This is a tremendously powerful and useful feature (especially for the price). As if this is not enough, Rainbow includes a data-file converter program that takes files from mailing lists and general ledgers and automatically converts them to the proper data-file format. If you want to insert data while your text is printing, Write-On! will accept input from the keyboard and print it where you have embedded the special control character. It even provides for a string that will print on the screen to prompt for the proper information. These are undoubtedly the most powerful features found in a microcomputer-based word processor.

The human engineering in Write-On! is superb. All of the commands are mnemonic and provoke little confusion. Most of the commands use only one keystroke, thus simplifying matters even further. Although the print module is separate from the editor program, its use is simplified by prompts and a menu selection. All of the editing and printing commands are prompted, and error traps are included so that it is difficult to inadvertently destroy several hours of typing.

Along with the excellent human engineering, Write-On! provides superlative documentation. This documentation leads the user by the hand; explanations of the various features are clear and concise, and even the complex operations make sense the

*Text continued on page 196*


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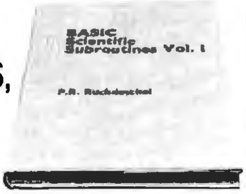

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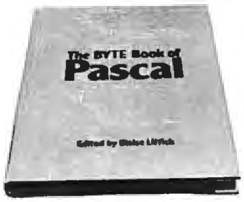



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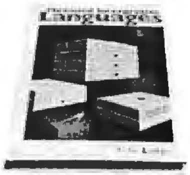

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Ron Loeliger is a Senior Analyst with Intermetrics, Inc.

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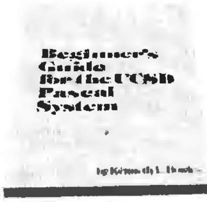

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Dr. Kenneth L. Bowles is Director of the Institute for Information Systems, University of California, San Diego.

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Dr. Thomas Dwyer is a Professor of Computer Science at the University of Pittsburgh.

Margot Critchfield is a doctoral student in Foundations in Education at the University of Pittsburgh.

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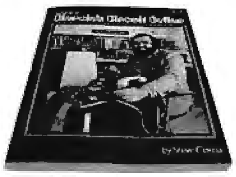


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Dr. Henry D'Angelo is the Associate Dean of the College of Engineering and Professor of Manufacturing Engineering at Boston University.

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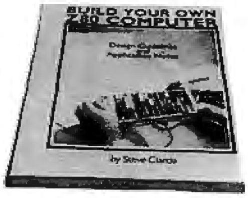


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Steve Ciarcia is a Computer Consultant, Electrical Engineer, and author of "Ask Byte" and "Ciarcia's Circuit Cellar" columns in BYTE magazine.

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*Text continued from page 190:*
first time. Examples, both in the manual and in text-file form on the reverse side of the disk, accompany the tutorial narrative. Finally, there is a quick reference sheet near the back of the manual that explains every command (our version is on 14- by 11-inch printout paper, but Rainbow plans to reduce it to an 8½- by 11-inch card).

The manual also includes a question and answer sheet that tries to anticipate any problems, and a reader service card on which you can describe any problem not covered by the question and answer sheet and send to Rainbow for an answer. If you'd rather not wait for the return of the reader service card, you can call Rainbow, and they will try to solve your problem over the phone. No listings of the program are provided, but this is unnecessary as you can load and list it yourself. The program is not a marvel of documented programming, but then BASIC is not known for its accessibility.

Write-On! is amazingly error-free, and it ran the first time we put it on the computer. It can also be easily converted to the new 16-sector format. One of us thinks that Write-On! is his choice of all the word processors that we reviewed. The only reason we didn't use it to prepare this review is that it won't support all of the features of the Centronics 737, which was the printer we used for our final copy.

## The Datacope Scribe

The Datacope Scribe (from Datacope) is the only word processor we reviewed that *requires* the Dan Paymar lowercase adapter (which provides true lowercase and uppercase letters on the monitor's screen). One would hope that use of the adapter would eliminate use of inverse characters. However, this word processor uses inverse characters to indicate the various editing functions, such as centering, underline, or new page or paragraph. All of the word processors we reviewed use inverse characters for various reasons (eg: special character representing new paragraph). Inverse characters and special characters are items that we will have to live with, at least for now. The Datacope Scribe does, however, provide a feature that allows us to view the text without all the special control characters; this will be described later in the review.

The Datacope Scribe utilizes two techniques found in several of the word processors for the Apple II: use of the ESC key for shift and use of Control-A for shift lock. The word processor accommodates touch typists and eliminates the need to worry about margins. Hyphenation is indicated by a hyphen when you execute the "implementation" command (the command that causes the word processor to execute all the other commands you have given it). Scribe then prompts for your approval (press RETURN). If you wish to change the location of the hyphen, press either of

**The Datacope Scribe is the only word processor described that requires the Dan Paymar lowercase adapter.**

the arrow keys until the hyphen is where you want it, then press RETURN.

Tabs are input through the use of control-Y. Each time a control-Y is pressed, an inverse ^ appears on the screen. This prints the next character at the next tab position (as given by the values in the tab position table). The word processor supports line centering, underlining and indentation.

The Datacope Scribe has the ability to specify, during input, locations where keyboard input is desired during printing. This feature is nice for adding personal touches to form letters or addresses to letters. Text files on a disk other than the one being worked on must be appended to the current file (ie: they cannot be inserted into the middle of the file). This requires that you preplan in detail before you enter text.

Editing is accomplished with cursor control and additional support from buffer (text-blocks) movements. The Datacope Scribe includes on-line reference guides that will assist the novice during entry and edit modes. These guides provide information on the various control keys and functions. By using the customize program, these guides may be removed from the word processor to make room for more text.

After the text has been entered and edited, the define mode should be

### At a Glance

**Name**
Datacope Scribe

**Type**
Word processor

**Manufacturer**
Datacope
PO Drawer AA
Hillcrest Station
Little Rock AR 72205

**Price**
$79.95

**Format**
5-inch floppy disk

**Language**
6502 machine language

**Computer**
Apple II or II+ with Language Card or ROM Applesoft; 48 K bytes of memory, and one disk drive

**Documentation**
34 pages, 22 by 28 cm (8.5 by 11 inches); booklet form, prepunched for three-ring binder

**Hardware Required**
Dan Paymar lowercase adapter and a printer

**Audience**
Anyone needing a word-processing system

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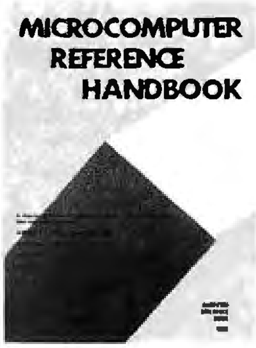


**PART I.** Chapters 1 to 3 include a wealth of useful information on microcomputer theory including peripheral and software capability. Succeeding Chapters provide additional microcomputer information under the following headings: *BASIC Language Summary; Guidelines for the Selection of Microcomputers in Commercial Applications; Microcomputers and Word Processing, Big Future for Desktop/Personal Computers* (containing comments by IDC, a leading industry information resource); *Future Trends in Microprocessing and Microcomputing; Communications and Networking with Microcomputers; Microcomputers in Education; and Microcomputing For The Home Hobbyist.*

**PART II.** Covers a range of microcomputer software from independent vendors. Products discussed are broken down into the five major system types: CP/M-based; Apple Systems; Commodore Systems; Radio Shack TRS-80 Systems; and the 6800-based models. The different programs described include operating systems, high-level languages, utilities and a wide variety of application packages.

**PART III.** Provides a 2 to 5 page summary on more than 130 different microcomputers and microcomputer systems from over 50 suppliers. These summaries describe hardware, software, peripherals, pricing and head office location. The different microcomputer suppliers covered include, in manufacturer order:

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used to define the main format of the final printed text product. This feature allows you to set several parameters associated with printed output: left and right margin positions, number of lines per page, tab positions, single or double spacing between paragraphs and lines, justified right margin (yes/no), and page numbering (yes/no). Up to eight tab settings are provided. When you finish defining the format, use the implement command to prepare for viewing and/or printing. The view command enters the view mode, which displays the text on the monitor in the final output form. Of course, the view mode is limited by the Apple's 40-column display.

The Datacope Scribe is available in both DOS 3.2 and 3.3 versions, and the DOS 3.2 version will work on a DOS 3.3 Apple if you use the BASICS floppy disk first. The Datacope Scribe cannot be copied with standard copy programs. Should you develop disk problems, the processor can be replaced up to ninety days after purchase, with proof of purchase.

### EasyWriter

The EasyWriter and EasyWriter Professional word processors have much in common. Anyone who changes to the Professional version should have little difficulty making the transition. Unlike Super-Text and Write-On!, however, there is a noticeable change between EasyWriter and EasyWriter Professional. EasyWriter uses Apple's 40-column display, while the Professional version uses any one of the three most popular 80-column video cards (M & R Sup'R'Terminal, Videx, or DoubleVision). This difference may be the deciding factor when you decide which version to buy. The serious user, most likely a professional, will probably purchase the video card and EasyWriter Professional and write off the cost as a business investment. The home user, unless she or he already has the video card, will purchase the 40-column version.

Both versions begin by offering a menu of activities. The Professional version begins with the disk commands, whereas the original version displays the menu for the editor. The Professional version has added the ability to append disk files during input, which is not possible with the 40-column EasyWriter. The ability to append "glossary"-type files is just one example of the changes made to EasyWriter between versions. Input is much easier with the Professional version, because the 80-column display uses true uppercase and lowercase characters. The original EasyWriter uses the standard inverse characters for uppercase characters (as do most of the other word processors for the Apple). One nice feature about

#### At a Glance

**Name**
EasyWriter and EasyWriter Professional

**Type**
Word processor

**Manufacturer**
Information Unlimited Software
281 Arlington Ave
Berkeley CA 94707

**Price**
EasyWriter, $99.95; EasyWriter Professional, $250

**Format**
5-inch floppy disk

**Language**
FORTH (threaded 6502 machine language)

**Computer**
Apple II or II+ with 48 K bytes of memory and one disk drive

**Documentation**
50 pages, 15.5 by 23 cm (6 by 9 inches); three-ring binder

**Hardware Required**
Videx, M & R Sup'R'Terminal, or DoubleVision 80-column board (for Professional system only)

**Audience**
Anyone needing a word-processing system

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| TRS80 MODEL 1 LEVEL II COMPATIBLE | YES | YES | NO |
| 48K BYTES RAM | YES | YES | YES |
| CASSETTE BAUD RATE | 500/1000 | 500 | 500/1500 |
| FLOPPY DISK CONTROLLER | SINGLE/ DOUBLE | SINGLE | SINGLE/ DOUBLE |
| SERIAL RS232 PORT | YES | YES | YES |
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| VIDEO MONITOR | YES | YES | YES |
| UPPER AND LOWER CASE | YES | OPTIONAL | YES |
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| HI-RESOLUTION B/W GRAPHICS, 480 X 192 | YES | NO | NO |
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this display is that only the letter displayed in inverse is made uppercase.

EasyWriter displays the least amount of extraneous information with the text of all the word processors covered in this review. Shift is accomplished by pressing the ESC key once; twice for shift lock. The Professional version also uses the ESC key, but allows for the wire between the shift key and 16-pin game I/O port (the game paddle connector) for easier use by a touch typist.

The method of ending paragraphs has also been improved. The original EasyWriter uses two shift-Ms, whereas the Professional uses only a return. The original version used one shift-M to end a line. The Professional's reference manual warns the typist to use the return only to start new paragraphs.

Paragraphs may be formatted to automatically indent through the use of special embedded commands, which are placed between text lines. These commands may appear more than once, thus providing the opportunity to change indentation formats several times in any document. Both versions of EasyWriter support the centering of lines of text, but the method of implementation varies. The original version uses the embedded command technique, while the Professional uses a special editing tool that will be described later.

**EasyWriter has the least amount of extraneous information displayed with text.**

The 40-column version does not provide a method for viewing the text in final form, but the Professional's 80-column display is the image of the output. And since it is the direct image, an added capability is provided to align text, both after input and prior to printing. Through the use of "additional commands" (which have their own menu screen), the Professional version allows you to realign margins, center lines of text, set and reset tabs, and, for use with printers such as Qume, Diablo, and Spinwriter, vary spacing between letters.

The Professional EasyWriter can translate files from the original 40-column version for use with the 80-column display. Both versions use various control keys to scroll up or down by page or line. Left or right movement on any line is performed with the Apple's normal arrow keys.

Editing is a pleasure with either version. Global search and block movement of text is supported in both versions, but global replace is supported only in the Professional. After you have finished editing, output can be tailored to each document, or you can rely on the default values. The original version accomplishes tailoring with embedded commands; the Professional version uses the additional commands to realign text (as described above), as well as optional

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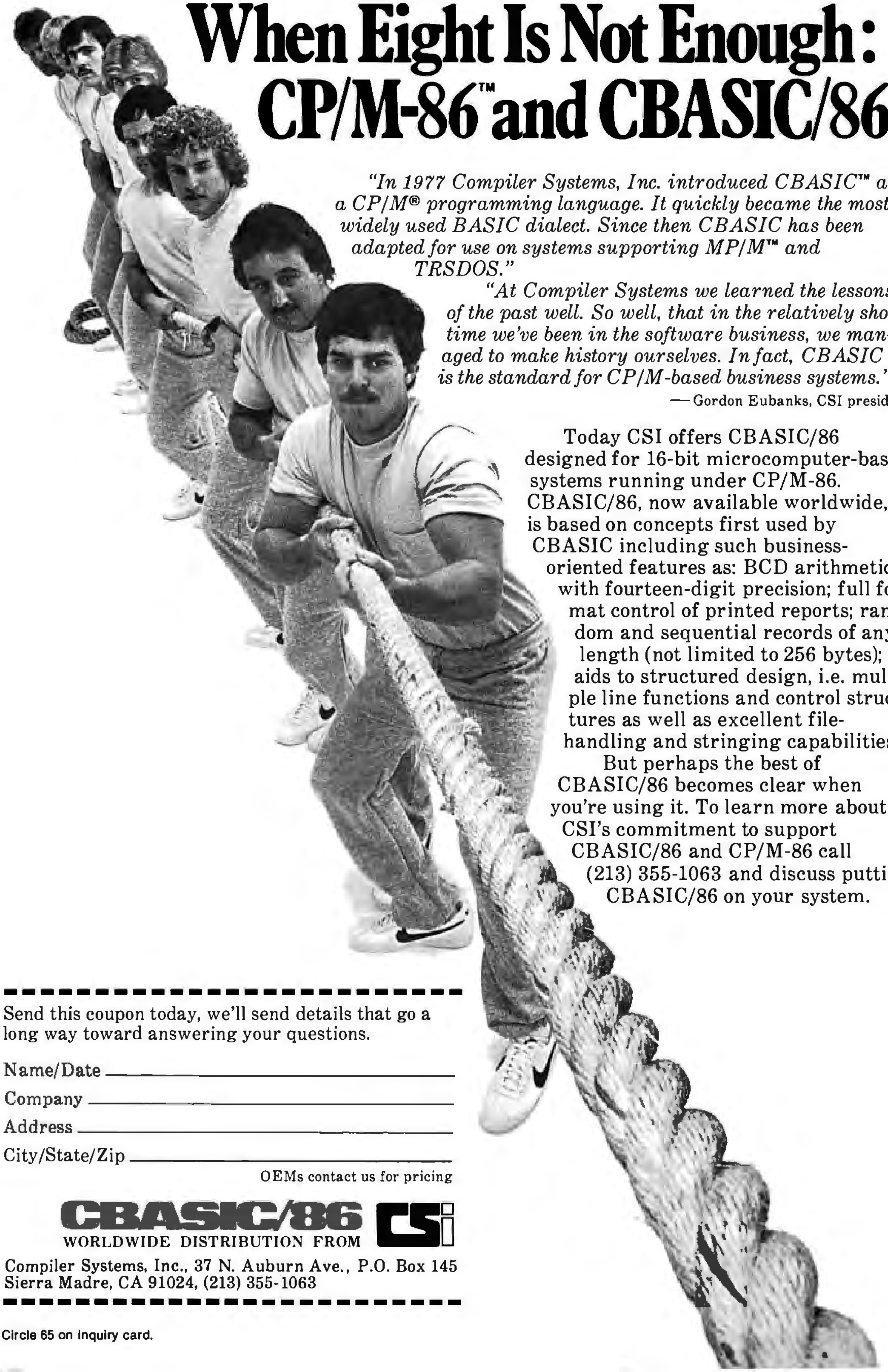

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embedded commands.

The provision for titling and numbering pages is one of the best we have seen for the Apple. The placement of titles and page numbers is limited only by your imagination.

Other advantages specific to EasyWriter Professional are suggestions and instructions for adding footnotes (the only word processor we reviewed that had such suggestions); capability of being linked to EasyMailer for processing of bulk mailings, and ability to transfer EasyWriter files over phone lines to other computers located anywhere in the world. (EasyMover and EasyMailer are separate programs and not part of EasyWriter. They can be obtained from Information Unlimited Software.)

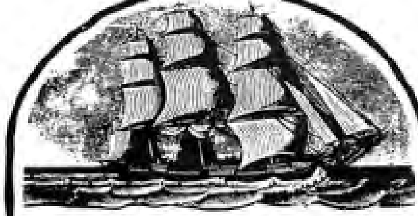
Special printer characteristics are supported by both versions. Those printers that are capable of underlining, boldface printing, and super-/subscripting are conveniently accommodated.

EasyWriter's reference manual was input directly into an Addressograph Multigraph typesetting machine using the proportional spacing option. Even on a printer without proportional spacing, the text spacing is pleasing to the eye.

Many of the EasyWriter features are appealing from the human engineering aspect. Most of the commands on the menu are easy to remember and require only one key to invoke a command. The use of CTRL (control) keys is basically confined to cursor movements during editing.

Before it clears text or deletes files, EasyWriter requests verification: "ARE YOU SURE?" Insert operations can be confusing as to when the insertion mode is exited. (Datacope Scribe has probably done the *best job* of avoiding confusion on insert operations.)

EasyWriter manuals generally provide good, detailed explanations of the various features. Both manuals attempt to lead the user through the capabilities of the EasyWriter by presenting information that teaches its use and interlacing it with details of the various features.



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| Program \ Feature | Titles | Global Search and Replace | Merge from Disk | Form Letters with Data Files | User-Defined Control Characters | Displays Lowercase (with adapter) | Requires Use of 80-Column Display Board | Print Multiple Files | Search Across Files | Supports Shift Key (with keyboard modification) | Split Screen | Wild-Card Search | Quick Reference Card | Chapter-Relative Page Numbers | Copyable | Uses Standard DOS | Preview Mode | Footnote |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Write-On! I | Y | Y | Y | N | N | Y | N | Y | N | Y | N | N | Y | Y[3] | Y | Y | N | N |
| Write-On! II | Y | Y | Y | Y | N | Y | N | Y | N | Y | N | N | Y | Y[3] | Y | Y | N | N |
| Super-Text II | N | Y | N | N | Y | Y | N | Y | Y | Y | Y | Y | N | Y | N | N | Y | N |
| Scribe | N | N | Y | N | Y | Y[1] | N | N | N | Y | N | N | Y[2] | Y | N | N | Y | N |
| EasyWriter | Y | N | N | N | Y | N | N | Y | N | N | N | Y | Y | N | Y | Y | N | N |
| EasyWriter Professional | Y | Y | Y | N | Y | Y | Y | Y | N | Y | N | Y | N | N | N | N | Y[4] | Y |

[1]Requires Paymar lowercase adapter
[2]On-line quick reference
[3]Indirectly provided
[4]Print image appears on 80-column screen

**Table 1:** *Feature comparison of four popular word-processing programs for the Apple II.*

## Conclusions

Choosing a word processor is similar to deciding on a microcomputer. Each has special features (see table 1), and none of the products have all the features.

If you want a word processor that performs math operations, the Super-Text II program is for you. If you're looking for a word processor that you can modify, and you know only BASIC, then Write-On! should satisfy your requirements. If you already have one of the 80-column cards, perhaps you should choose the Easy-Writer Professional version. If you are looking for a workhorse processor that will handle bulk mailings, then the EasyWriter Professional linked with EasyMailer is also for you, although Super-Text may meet this demand, and, with some pushing, Write-On! could meet the lower end of these requirements. Datacope Scribe has some very nice features, and if you only wish to process text and can live without a find-and-replace feature, the processor will fulfill your needs.

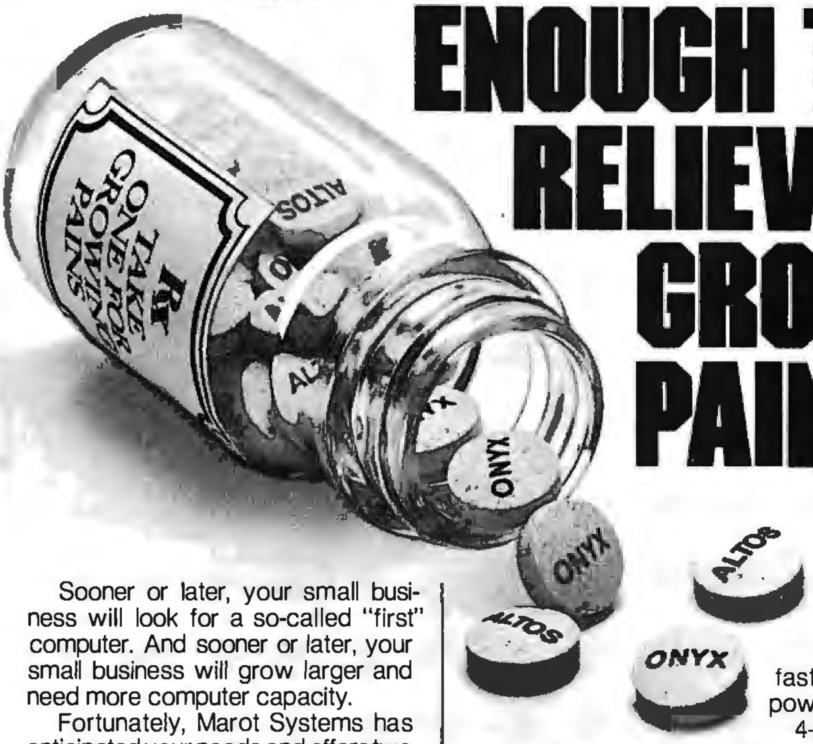
About this time, you may be thinking, "This is a typical review that says all the products are great." Possibly this is true, but we speak with some experience as we used all of the processors while preparing this article. Each met our needs, and performed basic text processing in less than an hour.

A few years ago, such power in a small package, and at this price, was only a dream. And even today, some of the larger systems don't have equivalent features. ■

**Acknowledgments**

*We would like to acknowledge David A Lingwood for his "Word Processor Guidelines," presented in* Call-Apple, *September 1980, page 19.*

# MAROT ANNOUNCES THE FIRST COMPUTERS POWERFUL ENOUGH TO RELIEVE GROWING PAINS.

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# BYTELINES

## News and Speculation About Personal Computing

### Conducted by Sol Libes

**IBM and Matsushita To Join Forces?** Matsushita, the giant Japanese electronic conglomerate that markets Panasonic and Quasar products in the US, recently admitted that it had been approached by IBM in regard to manufacturing a personal computer for the US market. It's been rumored for some time that IBM is planning to market a Japanese-made personal computer in the US. Although Matsushita officials released no details regarding their talks with IBM, another report that Matsushita has already designed and built a personal computer has prompted some observers to theorize that the unit will bear the IBM name when it is marketed in the US later this year.

**How Are The Personal-Computer Makers Doing?** Tandy Corporation, Radio Shack's parent company, continues to have an outstanding growth record. Tandy's sales for the 1979-1980 fiscal year rose to $1.4 billion, up from the previous year's $1.2 billion. Its income has increased 35% since it joined the microcomputer business, which now totals 13% of its overall sales.

This year Tandy expects to add 400 more stores to its fold of nearly 8000. In the US, there will be 250 more stores and 50 computer centers. Tandy plans to open 100 outlets overseas. Foreign sales currently account for 25% of its total sales.

Each Radio Shack store stocks more than 2600 items. The largest portion of a store's sales is parts and accessories (23%), with radios, tape recorders and phonographs second (19%), other audio components third (17%), and toys and microcomputers tied for fourth place (13%). Citizen's Band radios (10%) and telephones (5%) constitute the remaining sales.

Tandy leads the field in microcomputer sales. It sold over 200,000 computers last year for a total of $180 million.

Tandy's gross sales for the final half of calendar year 1980 were $869 million, and profits were $80 million, compared with $739 million and $60 million for the same period the previous year. The upward trend continues: sales this past January shot up to $141 million, from $112 million the year before.

You can still purchase a TRS-80 Model I in England. The Model I was pulled from US shelves in January because it did not comply with the Federal Communications Commission's radio-frequency-interference regulations. Also in England, TRS-80s are sold through independent computer stores as well as through Tandy-owned TRS-80 Computer Centers. So, the same dealer selling Apple IIs and Commodore PETs has TRS-80s on the display shelf. Some dealers also carry the Video Genie EG3000, the Far-Eastern copy of the TRS-80.

Apple Computer Inc also chalked up record sales and income last year. Sales for the last quarter of 1980 were up 246%, and profits were up 180%. The demand for Apple products in the first quarter of 1981 was greater than anticipated, but the company considers it unlikely that this growth will continue into the second quarter of the year.

Apple revealed that the commissions required to sell its stock last year came to $93.3 million, or $1.30 a share. The stock initially sold for $20 to $25 a share; it peaked at a high of $35, and it's currently selling in the neighborhood of $25 a share.

Apple has had problems getting its Apple III computer into production. Announced in May 1980, the first Apple IIIs were not shipped until January 1981, and then only in limited quantities.

Commodore International's sales for the last quarter of 1980 were $45 million, up from $31 million for the same period in 1979. Commodore has announced plans to construct a $5 million plant in the Philadelphia area to build its microcomputer systems. Commodore expects to hire 250 to 400 people for the operation and open it before year-end.

Sinclair Research, maker of the low-cost ZX80 personal computer, claims that it is number three in units shipped, behind Radio Shack and Apple.

Mattel's keyboard-equipped Intellivision personal-computer system seems to be bumping up against the same sort of buyer resistance that Texas Instruments encountered with its TI 99/4. Consumers are put off by the keyboard unit's $700 list price, plus $300 for the game-playing "master" component—total cost $1000. That's several hundred dollars more than the TRS-80 Color Computer, the Commodore VIC, and even Texas Instruments' TI-99/4. Further, Mattel has had delivery problems: it had originally intended to introduce the system in 1979. Intellivision's marketing is mainly through department stores.

**First Personal Computer With Built-In Winchester-Disk Drive:** Vector Graphic Inc has unveiled the first personal-computer system with a built-in Winchester-type hard-disk drive. The Model 3005 houses a video monitor, keyboard, S-100 motherboard, Z80 processor, 64 K bytes of programmable memory, a video interface called Flashwriter, a dual-mode disk controller, a Seagate Technology 5-inch Winchester drive, and up to three quad-density 5-inch floppy-disk drives. The system with one floppy-disk drive costs $7950.

**Tandy Files Suit Against Competitor:** Tandy Corporation has brought suit against Personal Microcomputers Inc (PMC), Mountain View, California. Tandy accuses PMC of conspiracy and infringement on the design of the Radio Shack TRS-80 personal computer. Included in the suit are five manufacturers and dealers for Personal Microcomputers' PMC-80 personal computer. The PMC-80 is hardware- and

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software-compatible with the TRS-80 Model I. Tandy is demanding damages and an injunction. Tandy claims that the PMC-80 contains "input/output programming copied from the plaintiff's TRS-80," and that the "defendants have marketed said microcomputer under the name PCM-80, which is confusingly similar to Tandy's registered trademark TRS-80."

**Chess Game Has Robot Arm:** The newest model of the popular Boris computer chess game has a robotic arm that moves and captures chess pieces. Called "Boris Handroid," it features the Boris 2.5 chess program that won the 1979 European Microcomputer Chess Championship. Sensors in the chessboard detect the human opponent's moves, and Boris Handroid responds by moving its piece. The game costs $1495 with the arm or $295 without.

**UCSD Pascal Version 4.0 Being Tested:** Softech Microsystems' new 4.0 version of UCSD (University of California, San Diego) Pascal is being tested at selected user sites. Softech has not yet set a release date. The new version adds multitasking and upgraded screen-handling functions. Four new p-code instructions have been added, which will create problems for version 3 users.

The UCSD Pascal compiler translates Pascal statements into a series of p-code (pseudocode) instructions, which are then interpreted during execution by a p-code-interpreter program, except on the Western Digital (WD) Pascal Microengine, which executes p-codes according to hardware microcode. The p-code system allows the UCSD Pascal system to operate the same way on many different systems.

Western Digital has not yet decided on how it will upgrade machines currently in the field to work with the new p-codes. WD notes that its control-store memory still has about 25% free space; therefore, an "outboard" control store on the main computer board could be added, rather than changing the entire control store.

**Update On 32-Bit Microprocessors:** The International Solid-State Circuits Conference (ISSCC) met in New York last February and heard presentations on two 32-bit microprocessors and some disclosures on a third.

Intel released further details on its 32-bit iAPX432 processor. It is Intel's first departure from previous architecture and instruction sets, so there is no software compatibility with its 8086 (16-bit) and 8085 (8-bit) microprocessors. Each of the iAPX432's three integrated circuits has four lines of sixteen pins. There are two general processors and an I/O (input/output) processor. The iAPX432 can link to 8086s and existing peripheral and memory integrated circuits. Intel is boasting performance of up to 2 MIPS (million instructions per second).

It took five years to engineer the iAPX432, and the company estimates that $25 million was spent on the project. Intel expects to sell at least 10,000 sets in the first year of production, which is projected for 1982. The initial price for the set will be $1500. Intel started shipping evaluation sets in February and is offering a board-level evaluation kit for $4250.

Intel claims that each of the three integrated circuits contains about 200,000 transistors. Two chips operate as a pipeline pair: the 43201 processor, which contains the instruction decoder, and the 43202, which is the microexecution unit. The 43203 is the I/O processor. It provides an interface from the I/O subsystem to the protected-access environment of the central system. Each I/O subsystem uses an 8- or 16-bit microprocessor to control I/O, independent of the central system. An address space of more than 4 gigabytes ($4 \times 10^9$ bytes) and a virtual memory-address space of a terabyte ($10^{12}$ bytes) is supported.

A protection scheme is provided to limit access to programs. The iAPX432 can perform floating-point operations on 32-, 64-, and 80-bit numbers. Hardware failures can be detected by interconnecting identical iAPX432 processors in a self-checking arrangement.

The system uses compiled Ada code as its machine language. The language interpreter is contained in a 64 K-byte microcode ROM (read-only memory).

Intel has also released an Ada cross-compiler for the iAPX432. The compiler runs on a DEC (Digital Equipment Corporation) VAX-11/780 or an IBM 370. It costs $30,000. A $50,000 hardware link is needed to download the compiled code to Intel's $4250 development board.

With the iAPX432, Intel appears to have a two-year jump on its competition. At the conference, Hewlett-Packard (HP) disclosed that it is in the early stages of development on a 32-bit microprocessor. HP claims to have built and tested a single chip with 450,000 transistors (which is about what Intel has in its set of three integrated circuits). It operates with an 18 MHz clock and is microprogrammed in 9 K 38-bit words in an on-board ROM. HP will have four other peripheral devices: an I/O controller, a memory controller, a 128 K-bit programmable memory, and a 512 K-bit ROM. The device is still being developed and no production commitment or product use has been determined.

Texas Instruments announced that early next year it will unveil a 99000 processor. TI refuses to disclose details, but it appears that the 99000 will have 32-bit addressing without 32-bit processing.

Chairperson Andrew Allison and his IEEE (Institute of Electrical and Electronics Engineers) working group is developing a bus standard to accommodate microprocessors from 8 to 32 bits in word length. The standard will have a 32-bit multiplexed address- and data-path compatible with 32-, 16-, and 8-bit microcomputers. It will allow up to thirty-two bus masters and multitasking via a serial interprocessor link that may use interrupt arbitration. A maximum initial clock rate of more than 10 MHz will be specified.

**Floppy-Disk Densities Increasing:** Ten years ago, IBM introduced an 8-inch disk drive capable of storing 400 K bytes of data (unformatted) on one side of a floppy disk. Shortly afterwards, double-density encoding schemes that allowed up to 800 K bytes of storage were introduced. Then in 1976, IBM came up with the double-sided drive, which increased data storage up to 1.6 megabytes. That same year Shugart Associates introduced a drive using a 5-inch floppy disk that could store 110 K bytes on a single-sided single-density disk. Later double-density double-sided (DDDS)

floppy-disk drives were introduced that could store up to 440 K bytes (unformatted).

Recently, Shugart announced 5-inch drives in which track density was increased from 48 tpi (tracks per inch) to 96 tpi, allowing up to 1 megabyte on a DDDS drive. However, increasing the track density on 8-inch drives is more difficult because the larger disks have deformation problems that result in errors. Drive and disk makers are trying to overcome the problems by changing the disk materials and drive designs. The current objective is to increase track density to 96 or 100 tpi by early next year. It is felt that 200 tpi is feasible with different materials.

Manufacturers are trying to obtain densities of 3 and 6.5 megabytes on 5-inch floppy disks and 5 to 10 megabytes on 8-inch floppies. The 3- and 5-megabyte densities appear to be achievable in the near future; however, reaching 10 megabytes on an 8-inch disk is expected to take longer to achieve.

In the meantime, PerSci Inc has taken the wraps off an 8-inch floppy-disk drive with a storage capacity of 2.5 megabytes. It's the same size as a standard 8-inch drive, but uses four read/write heads to access both sides of two DDDS disks.

**IBM To Build Josephson Computer:** IBM is going to construct an experimental computer entirely based on exotic Josephson-junction devices. This will be the first of its kind, and IBM hopes to have it up and running in five years. The 5000-circuit processor, with 400 K bits of programmable memory, is expected to have a 2 ns cycle time and will be no larger than 18 by 20 by 41 mm.

Josephson-junction transistors are superconductive and can switch in less than 10 ps (picoseconds). They consume very little power (usually 500 nW) and typically require a +1 V power supply.

Such a computer could be fifty times faster than current high-speed computers. Engineers have hypothesized that a Josephson-junction-based computer could have a nonvolatile solid-state magnetic memory, and, because of the greatly reduced resistance within its super-cool liquid-helium immersion, thin connectors could be used. Additional attributes could include no crosstalk between devices and immunity to thermal noise. Problems are anticipated in testing and debugging because of the thermal stresses placed on the devices.

If the project is successful, IBM expects to pack a 300,000-circuit processor (about the capacity of an IBM 3033) with 256 K bytes of cache memory and 64 megabytes of main memory into a cube less than 15 cm on a side.

**Random Rumors:** DEC (Digital Equipment Corporation) is working on a personal computer designed to compete with the Apple III. It's expected to be introduced by year's end. Word is that DEC tried to buy Apple some time ago but was snubbed. . . . Observers expect Apple to introduce a dual-density dual-sided disk system with 600 K bytes of storage for the Apple II and III. You can expect a 5-inch Winchester disk drive with 5-megabyte capacity to hit the shelves by late summer. Apple is considering dropping the present version of the Apple III in favor of a new model that's more business-oriented. The new model will probably contain a hard-disk drive instead of a floppy-disk drive. Apple is scheming an upgraded Apple II with a faster microprocessor and expanded memory size. . . . The Source timesharing system is preparing to sell a low-cost ($600) terminal with built-in modem and printer port; it has a folding keyboard for portability. . . . Texas Instruments is about to introduce a small low-cost robot arm. . . . Hewlett-Packard is preparing an under-$2000 system, maybe for this year. . . . ADDS (Applied Digital Data Systems) says that it will soon introduce a dumb terminal priced one-third less than current models. . . .

**Random News Bits:** Zenith Radio Corporation has a special video display for automobile dashboards. . . . RCA has received a patent for a technique that stores up to 100 gigabits (ie: 100 billion bits) on a laser disk intended for video. A complete encyclopedia can be stored on such a disk. . . . Sears Roebuck will open five computer stores. If they are successful, Sears Roebuck will sell computers nationwide. . . . Marker Ski Bindings has a binding with a built-in microprocessor. The battery-powered unit costs $200 and must be custom programmed for the skier. . . . Ohio Scientific's new Challenger 8P-HD personal computer has a Votrax voice-synthesizer output system and a voice-input system. It requires a 10-megabyte Winchester disk to function. . . . The Votrax SC-01 Voice Synthesizer Chip is now available from The MicroMint of Woodmere, New York. The Vodex division of Votrax will not sell the device in quantities of less than five. . . . Zilog has reduced the price of the 16-bit Z8002 microprocessor from $45 to $19.90, in OEM quantities of 1000. . . . Intel may reduce its prices for the 8088 and 8086. . . . IBM has a 32-bit microprocessor up and running in its labs. . . . Apple recently purchased its distributor in Great Britain, and now has well over 1000 employees. . . .

**Miniaturization Continues:** Semiconductor manufacturers keep on packing more capability onto a single wafer of silicon. Intelligent controllers, especially, are benefitting from such efforts. Two of the most recent products are the National Semiconductor INS8073 and the Zilog Z8 system. The Zilog product line includes a microprocessor, designated Z8671, which contains a limited-BASIC interpreter and debugging monitor in on-board read-only memory. Steve Ciarcia is using the Z8671 to build a complete computer system measuring 4 by 4½ inches with serial and parallel I/O ports and 4 K bytes of user memory. Users can program process-control and monitoring functions using the BASIC interpreter. (See next month's "Ciarcia's Circuit Cellar.")

**Know Your Dealer:** Sources at Radio Shack report the company has been receiving a large number of complaints because of confusion over warranty service on TRS-80s. The problem stems from the fact that Radio Shack does *not* honor warranties on computers purchased from dealers who are not authorized by Radio Shack. A large number of unauthorized dealers have appeared in the past year—most offering extremely low mail-order

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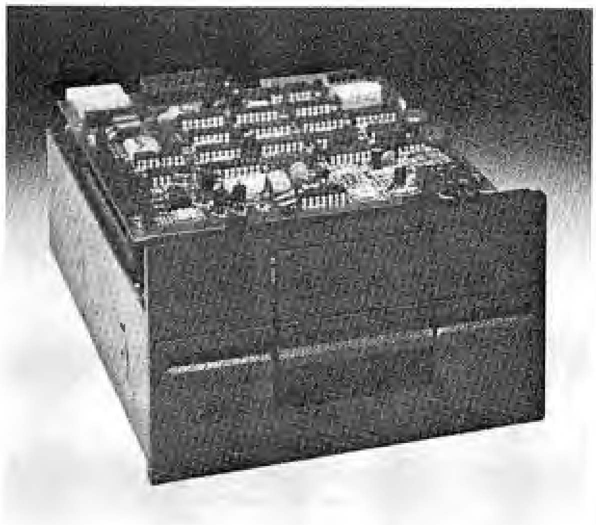

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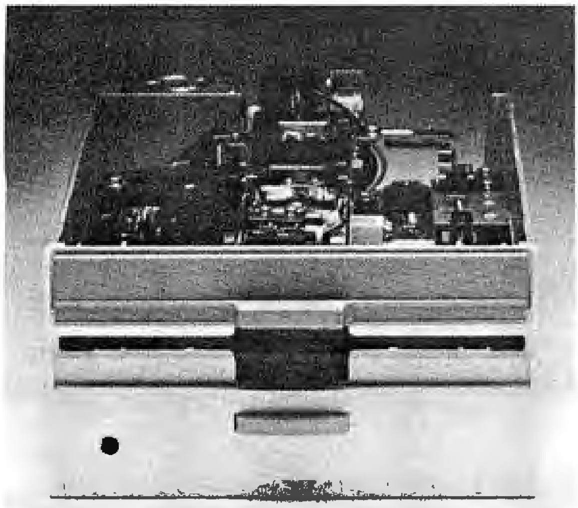
**Performance Specifications** • Capacity: Unformatted: 437.5K or 500K bytes; Qume Formatted: 286.7K or 327.7K bytes • Recording Density: 5456 BPI • Track Density: 48 TPI • Cylinders: 35 or 40 • Tracks: 70 or 80 • Recording Method: FM or MFM • Rotational Speed: 300 RPM • Transfer Rate: 250K bits/second • Latency (avg.): 100 ms • Access Time: Track-to-track 12 ms; Settling 15 ms • Head Load Time: 50 ms



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## Product Specifications

**Performance Specifications** • Capacity: Unformatted: 1.6 Mbytes/disk; IBM Format: 1.2 M/bytes/disk • Recording Density: 6816 BPI • Track Density: 48 TPI • Cylinders: 77 • Tracks: 154 • Recording Method: MFM • Rotational Speed: 360 RPM • Transfer Rate: 500K bits/second • Latency (avg.): 83 ms • Access Time: Track-to-track 3 ms; Settling 15 ms; Average 91 ms • Head Load Time: 35 ms • Disk: Diskette 2D or equivalent

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prices on TRS-80 systems.

A Radio Shack spokesman said the company is attempting to close the pipeline to unauthorized dealers but declined comment on how the dealers are obtaining the equipment. He stressed that the majority of mail-order dealers are authorized and advertise the fact, but consumers are cautioned to be sure before ordering. If you need service on units purchased from unauthorized vendors, you'll have to pay full labor and parts rates.

**DEC Drops LSI-11 Prices:** Digital Equipment Corporation has lowered the prices on the 16-bit LSI-11 microcomputer products by almost 29%. Obviously, DEC is eager to compete with the new Intel 8086-, Zilog Z8000-, and Motorola 68000-based systems now coming on the market. In fact, the new prices compete well with 8-bit microcomputer systems. A complete LSI-11 system with 32 K bytes of programmable memory and I/O interfaces, assembled in a cabinet, lists for $2090. Also, the DEC RT-11 and FORTRAN package is now only $640—$40 more than the cost of a Microsoft CP/M FORTRAN package.

**Packet Repeater Goes On The Air:** The nation's first digital simplex packet-radio repeater (KA6M, Menlo Park, California) for amateur radio use has gone into operation. A similar system went into operation earlier in Vancouver, British Columbia, Canada. The station serves as a packet repeater and beacon. It receives a message or block of data and, after verification, retransmits that message on the same frequency. The message may have some address or control bytes altered. The repeater extends the range and coverage of fixed and mobile stations. It is the first step in what promises to be a nationwide network of interconnected computer systems that allow toll-free communications.

**Ethernet Acceptance Spreading:** Ethernet, the local networking system, appears to be emerging as the de facto network standard. Although created by Xerox, Intel and DEC have agreed to support it with integrated circuits and system interfaces. Now Zilog has acknowledged that it will implement Ethernet interfaces on its microcomputer systems. This is particularly noteworthy because Zilog is an Exxon subsidiary, and Exxon has announced its intention to develop a local-network system. Zilog's previously announced networking system Znet will still be supported by the company, in addition to the Ethernet interface.

Hewlett-Packard has made public that it will include Ethernet interfaces in some of its products. Digital Research intends to provide an Ethernet-to-CP/M software package.

**MAIL:** I receive a large number of letters each month as a result of this column. If you write to me and wish a response, please include a self-addressed stamped envelope.

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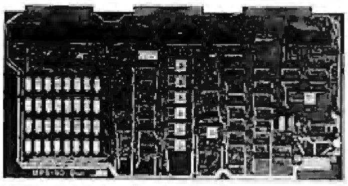

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| Dynamic RAM (std) | **64 Kb.** | 32 Kb. |
| Disk drive type | Double density | Same |
| No. of drives (std/max) | 2/4 | Same |
| Capacity per drive (on-line) | **200 Kb.** | 180 Kb. |
| Direct Memory Access (DMA) | **Yes** | No |
| CP/M® disk operating system | **Standard** | Optional |
| Unit Price | **$2,995.** | $3,095. |

| SPECIFICATIONS | QUAY 520 | HORIZON-2-32K-Q |
|---|---|---|
| Disk drive type | Quad density | Same |
| Capacity per drive (on-line) | **400 Kb.** | 360 Kb. |
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# CP/M: A Family of 8- and 16-Bit Operating Systems

Dr Gary Kildall
Digital Research
POB 579
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This article is about microprocessors and CP/M: where they came from, what they are, and what they're going to be. Where they came from is history, what they are today is fact, and what they will become is, like any projection of technology, pure "science fiction" speculation. CP/M is an operating system developed for microcomputers. But as microprocessors changed, CP/M and its related programming tools evolved into a family of portable operating systems, languages, and applications packages.

The value of computer resources has changed dramatically with the introduction of microprocessors. Three major events have precipitated a revolution in computing: hand-threaded core memory has been replaced by mass-produced semiconductor memory; microprocessors have become plentiful; and IBM decided that the punched card is obsolete. Low-cost memory and processors have reduced the cost of computer systems to a few hundred dollars, but IBM's specification of the floppy disk standard has made the small computer system useful.

In the early days of the 8080 microprocessor, a small company called Shugart Associates was taking shape up the street from Intel. Shugart Associates, along with a number of other companies, viewed the floppy disk as more than a punched card replacement: at that time the primary low-cost storage medium was paper tape (used in applications ranging from program development to word processing). At a cost of $5, a floppy disk held as much data as two hundred feet of paper tape, and a disk drive retailed for only $500—an unbeatable combination. Memory, processor, and floppy-disk technology improved, and by the mid-1970s, a floppy-based computer could be purchased for about one quarter of a programmer's annual salary. Quite simply, it was no longer necessary to share computer resources.

Since that time, microprocessors have been applied to a variety of computing needs beyond replacement of low-end minicomputers. Due to applications such as machine-tool movement and sensing, data acquisition, and communications, current interest lies in real-time control. In a real-time operating system, process management can be separated from the I/O (input/output) system (which is not required in many applications). Real-time facilities allow the execution of interactive processes according to priority, and their addition or deletion in a simple fashion. This results in a custom operating system designed to solve a particular problem. In contrast to timesharing, real-time operating systems have minimal "interrupt windows" in which external interrupts are disabled. Real-time operating systems such as the Intel RMX and National Starplex packages provide this level of support.

**The 16-bit version of CP/M is basically the same as the 8-bit version, with the addition of memory management and enhancements to the file system.**

The emerging interest in *local networks* poses a new challenge to designers of operating systems. Recently, Intel, DEC (Digital Equipment Corporation), and Xerox formed an alliance to promote Ethernet, a *packet-switching* network intended to provide point-to-point data transfer in an office environment. (In a packet-switching network, data from several slow-speed sources, such as user terminals, is collected over local lines by a single network node, which then periodically transmits the data to its destination at a much higher speed, in groups called packets.) In terms of evolution and potential, Ethernet is today what floppy disks were a decade ago. This inexpensive office network performs such tasks as the transfer of a form letter from data storage at one location to a memory typewriter in another part of the

### The Emergence of Software as a Problem-Solving Tool

*Microprocessors are a natural consequence of our technology. I recently visited the British Science Museum, where two particularly interesting historical developments were on display. The first exhibit chronicled the development of the finely machined iron and brass steam engines, complete with magnificent gauges, gears, whistles, and valves, that founded the Industrial Revolution.*

*The second exhibit displayed progress in computing, beginning with Charles Babbage's inventions of the early 1800s. What did these exhibits have in common? They showed machines built with the same technology: Babbage's analytic engine might easily be mistaken for a small steam engine!*

*I followed the sequence of displays, from Babbage's difference and analytic engines to great brass calculators and early punch cards, past relay and vacuum tube processors to unit record equipment, then to transistor and random-logic computers and semiconductors and, finally, to a single Intel 8080 microprocessor.*

*Examined in this way, the technological momentum was obvious. Microprocessors are a direct result of our pattern of refinement through engineering. Just as a Boeing 727 is a refined version of the original Wright Brothers' invention, the microprocessor is a consequence of "fine tuning" by scientists and engineers who strive to understand, simplify, and add function to mankind's tools. There were several conspicuous spaces waiting to be filled following the 8080 display.*

*In public television's "Connections" series, James Burke claimed that we are a society filled with machines that do everything: sew materials for our clothes, carry us from coast to coast, and print millions of newspapers daily. But the most important machines in our society do absolutely nothing by themselves. These multifunctional devices provide a variety of services depending upon our needs, and herein lies the essential advantage: in the past, we identified a need and built a machine to satisfy that need; today, technology provides us with a single machine that we can instruct, through a program, to solve almost any problem. Where are the "Thomas Edisons" who used to build machines? Most are now inventing programs.*

*The evolution of our electronics industry typifies refinement through engineering. Beginning with electrical and electronic switches, we began manufacturing general-purpose function chips: put a value x on the input pins, define the function f by setting voltage levels on a second set of pins, and the result, f(x), magically appears on the output pins. Many examples of such integrated circuits exist, ranging from three-state logic gates to arithmetic/logic units.*

*With the introduction of microprocessors, the function f may be defined through instructions in a read-only memory allowing, in principle, the implementation of any function using a single device. A design that once required connecting resistors, capacitors, and logic gates has developed into a program that instructs a multipurpose machine to perform the same function. Controlling a stoplight and balancing a checkbook are now equivalent problems: both require the invention of a program.*

*Refinement through engineering: does this not also apply to software? To properly frame the answer, remember that the primary purpose of a computer is to be useful. Therefore, the application program is really the only important result of a software-engineering activity. Our primary goal in refining software tools is to provide the means for rapid and accurate generation of simple, understandable, and effective application programs. We do this through three levels of software support: system languages, operating systems, and application languages. These tools form an inverted pyramid underlying application software.*

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| NAME | DESCRIPTION |
|---|---|
| 1 RULE78 | Interest Apportionment by Rule of the 78's |
| 2 ANNUI | Annuity computation program |
| 3 DATE | Time between dates |
| 4 DAYYEAR | Day of year a particular date falls on |
| 5 LEASEINT | Interest rate on lease |
| 6 BREAKEVN | Breakeven analysis |
| 7 DEPRSL | Straightline depreciation |
| 8 DEPRSY | Sum of the digits depreciation |
| 9 DEPRDB | Declining balance depreciation |
| 10 DEPRDDB | Double declining balance depreciation |
| 11 TAXDEP | Cash flow vs. depreciation tables |
| 12 CHECK2 | Prints NEBS checks along with daily register |
| 13 CHECKBK1 | Checkbook maintenance program |
| 14 MORTGAGE/A | Mortgage amortization table |
| 15 MULTMON | Computes time needed for money to double, triple, etc. |
| 16 SALVAGE | Determines salvage value of an investment |
| 17 RRVARIN | Rate of return on investment with variable inflows |
| 18 RRCONST | Rate of return on investment with constant inflows |
| 19 EFFECT | Effective interest rate of a loan |
| 20 FVAL | Future value of an investment (compound interest) |
| 21 PVAL | Present value of a future amount |
| 22 LOANPAY | Amount of payment on a loan |
| 23 REGWITH | Equal withdrawals from investment to leave 0 over |
| 24 SIMPDISK | Simple discount analysis |
| 25 DATEVAL | Equivalent & nonequivalent dated values for oblig. |
| 26 ANNUDEF | Present value of deferred annuities |
| 27 MARKUP | % Markup analysis for items |
| 28 SINKFUND | Sinking fund amortization program |
| 29 BONDVAL | Value of a bond |
| 30 DEPLETE | Depletion analysis |
| 31 BLACKSH | Black Scholes options analysis |
| 32 STOCVAL1 | Expected return on stock via discounts dividends |
| 33 WARVAL | Value of a warrant |
| 34 BONDVAL2 | Value of a bond |
| 35 EPSEST | Estimate of future earnings per share for company |
| 36 BETAALPH | Computes alpha and beta variables for stock |
| 37 SHARPE1 | Portfolio selection model-i.e. what stocks to hold |
| 38 OPTWRITE | Option writing computations |
| 39 RTVAL | Value of a right |
| 40 EXPVAL | Expected value analysis |
| 41 BAYES | Bayesian decisions |
| 42 VALPRINF | Value of perfect information |
| 43 VALADINF | Value of additional information |
| 44 UTILITY | Derives utility function |
| 45 SIMPLEX | Linear programming solution by simplex method |
| 46 TRANS | Transportation method for linear programming |
| 47 EOQ | Economic order quantity inventory model |
| 48 QUEUE1 | Single server queueing (waiting line) model |
| 49 CVP | Cost-volume-profit analysis |
| 50 CONDPROF | Conditional profit tables |
| 51 OPTLOSS | Opportunity loss tables |
| 52 FQUOQ | Fixed quantity economic order quantity model |
| 53 FQEOWSH | As above but with shortages permitted |
| 54 FQEOQPB | As above but with quantity price breaks |
| 55 QUEUECB | Cost-benefit waiting line analysis |
| 56 NCFANAL | Net cash-flow analysis for simple investment |
| 57 PROFIND | Profitability index of a project |
| 58 CAP1 | Cap. Asset Pr. Model analysis of project |
| 59 WACC | Weighted average cost of capital |
| 60 COMPBAL | True rate on loan with compensating bal. required |
| 61 DISCBAL | True rate on discounted loan |
| 62 MERGANAL | Merger analysis computations |
| 63 FINRAT | Financial ratios for a firm |
| 64 NPV | Net present value of project |
| 65 PRINDLAS | Laspeyres price index |
| 66 PRINDPA | Paasche price index |
| 67 SEASIND | Constructs seasonal quantity indices for company |
| 68 TIMETR | Time series analysis linear trend |
| 69 TIMEMOV | Time series analysis moving average trend |
| 70 FUPRINF | Future price estimation with inflation |
| 71 MAILPAC | Mailing list system |
| 72 LETWRT | Letter writing system-links with MAILPAC |
| 73 SORT3 | Sorts list of names |
| 74 LABEL1 | Shipping label maker |
| 75 LABEL2 | Name label maker |
| 76 BUSBUD | DOME business bookkeeping system |
| 77 TIMECLCK | Computes weeks total hours from timeclock info. |
| 78 ACCTPAY | In memory accounts payable system-storage permitted |
| 79 INVOICE | Generate invoice on screen and print on printer |
| 80 INVENT2 | In memory inventory control system |
| 81 TELDIR | Computerized telephone directory |
| 82 TIMUSAN | Time use analysis |
| 83 ASSIGN | Use of assignment algorithm for optimal job assign. |
| 84 ACCTREC | In memory accounts receivable system-storage ok |
| 85 TERMSPAY | Compares 3 methods of repayment of loans |
| 86 PAYNET | Computes gross pay required for given net |
| 87 SELLPR | Computes selling price for given after tax amount |
| 88 ARBCOMP | Arbitrage computations |
| 89 DEPRSF | Sinking fund depreciation |
| 90 UPSZONE | Finds UPS zones from zip code |
| 91 ENVELOPE | Types envelope including return address |
| 92 AUTOEXP | Automobile expense analysis |
| 93 INSFILE | Insurance policy file |
| 94 PAYROLL2 | In memory payroll system |
| 95 DILANAL | Dilution analysis |
| 96 LOANAFFD | Loan amount a borrower can afford |
| 97 RENTPRCH | Purchase price for rental property |
| 98 SALELEAS | Sale-leaseback analysis |
| 99 RRCONVBD | Investor's rate of return on convertable bond |
| 100 PORTVAL9 | Stock market portfolio storage-valuation program |

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building. When modifications are completed, the letter is typed locally or sent to a laser (or other) printer that is a shared network resource.

Most timesharing systems handle a network through simple file transfers between the machines (*nodes*) in the net, but real refinements occur when the operating system itself is distributed among the nodes. File access is provided by one *server* node, while a computing function is performed by another. To the user, a *requester* node appears as a powerful computing facility, even though it may consist of only a local microprocessor, a console, and a limited amount of memory.

What refinements have been made to operating systems? Our models have been simplified; we understand primitive operations required for reliable process synchronization in real-time systems, and the human-oriented interface in interactive subsystems has been improved. We will, no doubt, continue to refine our models for timesharing and real-time operating systems, but the most exciting new operating system technology will develop around emerging network hardware.

## Application Languages

Application languages form the top level of support for application programming. How does this level of language differ from other language levels? First and foremost, an application language contains the operations and data types suitable for expressing programs in a particular problem environment. FORTRAN (*FORmula TRANslation*), for example, was designed in the late 1950s for scientific applications; FORTRAN programs, therefore, consist primarily of algebraic expressions operating upon binary floating-point numbers expressed in scientific notation. However, FORTRAN contains only primitive file-access facilities and no decimal arithmetic, making it unsuitable for commercial data processing. COBOL (*COmmon Business Oriented Language*) has the commercial facilities, but it excludes scientific features such as a complete transcendental-function library.

In contrast to system languages that run on a given machine, these application languages would ideally contain no machine-dependent features. An application language is either poorly designed or ill-suited for a particular problem if the programmer is forced to use extra-lingual constructs to access lower-level functions of the operating system or machine. The language must be a standard, without the necessity for various locally defined language extensions. An extended standard language is of limited value since the extensions are unlikely to exist in other implementations.

The evolution of PL/I (*Programming Language/One*) provides a good example of refinement in application languages. PL/I is not a new invention: rather, it was defined by a committee of IBM users in 1960 as a combination of ALGOL (*ALGOrithmic Language*), FORTRAN, and COBOL, with a liberal sprinkling of new facilities. ALGOL's principal contribution was block structure and nested constructs, while FORTRAN contributed scientific processing and COBOL added commercial facilities. This combination produced a large, unwieldy language with twists and nuances that can trap the unwary programmer. Nevertheless, PL/I was quite comprehensive, and it served as the basis for uncounted numbers of application programs on large systems. One noted use of PL/I was in the implementation of the Multics operating system at MIT under Project MAC.

In 1976, an ANSI (American National Standards Institute) committee produced a standard language definition for PL/I. The standard is an implementation guide for compiler writers, and it precisely defines the form and function of each PL/I statement. Aware that PL/I was too large and complicated, the committee produced a smaller version for minicomputers, called Subset G. This new language excluded the redundancies and pitfalls of full PL/I but retained the

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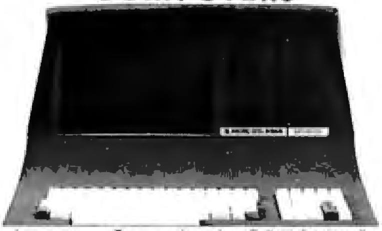






useful application programming features. Recently approved by ANSI, Subset G has given new life to PL/I, with manufacturer support for the Data General Eclipse and MV/8000 computers, Prime computers, Wang machines, and DEC's popular VAX computer.

Strangely, the refinements found in application languages follow those of hardware and operating systems. Large, cumbersome languages have been rejected in favor of simple, Spartan programming systems that are consistent in their design. The resulting languages are easier to implement, simpler to comprehend, and allow straightforward program composition.

### PL/M: The Base for CP/M

In 1972, MAA (Microcomputer Applications Associates), the predecessor of Digital Research, consulted with the small, aspiring microprocessor division of a semiconductor memory company called Intel Corporation. MAA defined and implemented a new systems-programming language, called PL/M (*Programming Language for Microcomputers*), to replace assembly-language programming for Intel's 8-bit microprocessor. PL/M is a refinement of the XPL compiler-writing language which is, in turn, a language with elements from Burroughs Corporation's ALGOL and the full set of PL/I.

The first substantial program written by MAA using PL/M was a paper-tape editor for the 8008 microprocessor, which later became the CP/M program editor, called ED. PL/M is a commercial success for Intel Corporation and, although licensing policies have limited its general accessibility, it has become the standard language of the Intel microprocessor world, with implementations for the 8080, 8085, and 8086 families.

MAA also proposed a companion operating system, called CP/M (*Control Program for Microcomputers*), which would form the basis for resident PL/M programming. The need for CP/M was obvious: 8080-based computers with 16 K bytes of main memory could be combined with

### System Languages

*A system language is a high-level machine-dependent programming language used to implement so-called "system software," including operating systems, text editors, debuggers, interpreters, and compilers. In the early days of computing, virtually all system software was implemented in assembly language. One revolutionary machine, the Burroughs B5500, used a variant of ALGOL-60 as its only system-programming tool and appeared in the early 1960s. The machine was a commercial success against the other major mainframes, proving that assemblers were no longer necessary. Many successful system languages followed Burroughs' ALGOL, including the C language, produced at Bell Laboratories in the late 1960s, which served as the basis for the UNIX operating system.*

*A system language, by definition, matches the architecture of a particular machine or class of machines; all facilities of the machine are accessible in the language, and the language contains no nontrivial extensions beyond the basic machine capabilities. The benefit is that a compiler for the system language is easy to implement and transport from machine to machine, as long as the architecture of each machine is similar. Further, a system language requires little run-time support since application facilities, such as extensive I/O (input/output) processing, are not generally embodied in the language.*

*Refinements in system languages are made by increasing their usability. Their acceptance as replacements for assembly languages is encouraging. Today, one can publicly admit that system software is implemented in a high-level language without implying that it must be rewritten in assembly language to be effective.*

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Shugart's new (at that time) floppy-disk drives to serve as development systems. For the first time, it was *feasible* to dedicate a reasonably powerful computer to the support of a single engineer. But the use of PL/M on larger timesharing computers was considered sufficient, and the CP/M idea was rejected.

### The CP/M Family

CP/M was, however, completed by MAA in 1974. It included a single-user file system designed to eliminate data loss in all but the most unlikely situations, and used recoverable directory information to determine storage allocation rather than a traditional linked-list organization. The simplicity and reliability of the file system was an important key to the success of CP/M: file access to relatively slow floppy disks was immediate, and disks could be changed without losing files or mixing data records. And because CP/M is a Spartan system, today's increased storage-media transfer rates simply improve overall response. The refinements found in CP/M are based on its simplicity, reliability, and a proper match with limited-resource computers.

By the mid-1970s, CP/M added a new philosophy to operating system design. CP/M had been implemented on several computer systems, each having a different hardware interface. To accommodate these varying hardware environments, CP/M was decomposed into two parts: the invariant disk operating system written in PL/M, and a small variant portion written in assembly language. This separation allowed computer suppliers and end users to adapt their own physical I/O drivers to the standard CP/M product.

Hard-disk technology added yet another factor. CP/M customers required support for disk drives ranging from single 5-inch floppy disks to high-capacity Winchester disk drives. In response, CP/M was totally redesigned in 1979 to become *table-driven*. All disk-dependent parameters were moved from the invariant disk operating system to tables in the

### Operating Systems

*Operating systems, too, have become more refined. But why do we have operating systems at all? In the 1960s we used expensive mainframes with power-hungry central processors and magnetic-core memory. Downtime for complicated card readers, printers, and backup data-storage devices was high, requiring constant maintenance. A card-oriented "batch" operating system provided two functions. First, it allocated processor time, memory, and peripherals to application programs in an attempt to utilize each expensive component to its fullest. Second, common I/O subroutines were a part of the operating system to avoid duplication in each application program. In the early 1960s, batch operating systems began to incorporate* online *terminals that allowed the programmer to interact with the program—this is where things became interesting. With an online terminal, a program could write a prompt message, read the data entered by the operator, and write a response almost instantly.*

*The crude terminal systems evolved into today's timesharing computers, where program interaction is the primary function, with batch processing in the background. General Electric and Digital Equipment Corporation led the way with BASIC-based 235 and multilingual PDP-10 computers. Countless timesharing operating systems followed, including IBM's interactive APL and CP/CMS, along with UNIX from Bell Laboratories. These timesharing systems were the forerunners of personal computing: all assumed that the hardware was too expensive to dedicate, so each terminal becames an emulation of a single computer.*

variant portion, to be filled in by the system implementer.

CP/M is now a multifunction program whose exact operation is defined externally through tables and I/O subroutines. The widespread use of CP/M is directly attributed to this generality: CP/M becomes a special-purpose operating system when it is field-programmed to match an operating environment. Through the efforts of system implementers who provide this field-programming, CP/M is used worldwide in close to 200,000 installations with over 3000 different hardware configurations.

**CP/M, PL/I, and PL/M have all played a role in the development of CP/M-86.**

### MP/M

As single-user CP/M became widely accepted, Digital Research began to develop a new operating system for real-time processing. The design called for a real-time nucleus to support cooperating sequential processes, including a CP/M-compatible file manager with terminal-handling capabilities. This operating system, called MP/M (*Multiprogramming Monitor for Microcomputers*), is a further refinement of the process model found in Intel's RMX and National's Starplex. As a side effect, the combination of MP/M's real-time nucleus with the terminal handler and the CP/M file system produces a traditional timesharing system with multiprogramming and multiterminal features.

Timesharing allows programs to execute in increments of processor time in a "lock-step" fashion. In a timesharing context, a printer program, often called a *spooler*, might have the task of printing a series of disk files which result from program output. The spooler starts with a disk-file name and, by using increments of processor time allocated by the real-time nucleus, writes each line from the file to the printer. Upon completion, the spooler obtains another disk-file name and repeats

the process. You can, for example, send the name of a disk file to the spooler and, while the file is being printed, edit another file in preparation for compilation. The spooler and editor share processor time to complete their respective tasks. In general, many such processes share processor time and system resources.

MP/M process communication is performed through *queues* (or waiting lines) managed by the nucleus. The spooler, for example, reads file names from an input queue posted by another process (which reads spooler command lines from the console). When the spooler is busy printing a file, additional file names may enter the input queue in a first-in first-out order.

Process synchronization through queuing mechanisms is commonplace, but MP/M treats queues in a unique manner, simplifying their use and decreasing queue management overhead. Queues are treated as files: they are named symbolically so that a queue can be added dynamically. Like files, queues have queue control blocks that are created, opened, deleted, written, and read. In fact, the set of queue operations closely matches the file functions of CP/M so that MP/M provides a familiar programming environment.

The implementation of queues is transparent to an operator or system programmer, but it is important to MP/M's effective operation on limited-resource computers. Queues are implemented through three different data structures, depending upon the message length. So-called "counting semaphores" count the occurrence of an event with message length zero, and are implemented as 16-bit tallies. Single-byte messages are processed using a circular buffer. Similarly, queues containing addresses are processed using circular buffers. In all other cases, MP/M uses a general linked list, which requires additional space and processing time. It is this sensitivity to the capabilities of limited-resource computers that makes MP/M effective: while real-time operating systems often incur 25 to 40% overhead, MP/M has been streamlined to increase available compute time by 7% over single-user CP/M.

Like CP/M, MP/M is separated into variant and invariant portions. The file-system interface is identical to that of CP/M, with the addition of user-defined functions to handle non-CP/M operations (such as control of the real-time clock). Field-reconfiguration of MP/M allows a variety of device protocols including CP/M-style busy-wait loops, polled devices, and interrupt-driven peripherals. In fact, the variety of interface possibilities makes the MP/M implementer a true system-software designer, since a fine-tuned MP/M system may operate considerably faster than its initial implementation.

What are the refinements found in MP/M? First, it is a state-of-the-art operating system based on current process-synchronization technology and microprocessor real-time system design philosophies. Process communication is conceptually simple and requires minimal overhead. Finally, it is the only operating system of its type that can be field-tailored to match almost any computer configuration.

## CP/NET

CP/NET, introduced in late 1980, leads a series of network-oriented operating systems that distribute operating system functions throughout a network of nonhomogeneous processors. CP/NET connects CP/M requesters to MP/M servers through the use of an arbitrary network protocol. Similar to CP/M and MP/M, CP/NET consists of the invariant portion, along with a set of field-reconfigurable subroutines that define the interface to a particular network. For purposes of CP/NET, this interface need only provide point-to-point data-packet transmission. Since the actual data transmission media are unimportant to CP/NET, any one of the number of standard protocols can be used, from low-speed RS-232C through high-speed Ethernet. Physical connections are also arbitrary, allowing active hub-star, ring, and common-bus architectures.

The invariant portions of CP/NET operate under a standard CP/M system to direct various system calls over the network to an MP/M server. The MP/M server, in turn, responds to network requests by simulating the actions of CP/M. This simulation is transparent to an application program: any program operating under standard CP/M operates properly in the network environment.

Suppose, for example, you wish to store common business letters in a central data base under MP/M and access these letters from a CP/M-based word processor. You begin by assigning one local disk drive to the MP/M master, using the CP/NET interface. You then direct your word processing system to read the particular letter on the assigned drive, causing the data to be obtained from the server rather than from the local disk. After local update using your word processor, you can print the result on your local printer or optionally assign your listing device to the network for printing at the MP/M server.

CP/NET is accompanied by three related network operating systems: CP/NOS, MP/NET, and MP/NOS. CP/NOS is, in effect, a diskless CP/M, which can be stored in read-only memory, and that operates with a console, memory, and network interface. MP/NET, on the other hand, is a complete MP/M system with an embedded network interface that, like CP/NET, allows local devices to be reassigned to the network. MP/NET configurations allow MP/M systems as both requesters and servers with CP/M requesters. Finally, MP/NOS contains the real-time portion of MP/M without local disk facilities. Like CP/NOS, MP/NOS performs all disk functions through the network.

The interface protocol is publicly defined so that non-MP/M or non-CP/M systems can participate in network interactions. A server interface for the VAX 11/780, for example, is under preparation so that it can perform I/O functions for a large number of MP/M and CP/M requesters.

The principal advantage of CP/NET is that all CP/M-compatible software becomes immediately available for operation in the network environment, solving the problem that builders of network hardware face: the total absence of application software. Although the promise is there, networking is in its infancy, and CP/NET is truly a software package awaiting the evolution of suitable hardware.

## PL/I: The Application Language

In 1978, Digital Research investigated the final level of software support: application languages. One such language was to be supported throughout the operating system product line, and the choice would have to be a multipurpose language. Further, the language would have to be an international standard to promote the generation of software by independent vendors. Standard Pascal seemed a logical choice but was rejected for several reasons. First, Pascal is an ALGOL derivative with scientific orientation. Commercial facilities in the standard language are absent: decimal arithmetic, file processing, string operations, and error-exception handling were essential. Further, separate compilation and initialization of tables were not in the language. There was a temptation to extend Pascal in order to include these features, but these extensions would have defeated the benefits of standardization.

PL/I Subset G was the obvious choice. It satisfied scientific and commercial needs and, because of subset restrictions, was consistent and easy to use. The project was a bit daring, however, because Subset G was unknown in the computer community. PL/I was viewed as a large IBM-oriented language with huge, inefficient compilers that required tremendous runtime support.

The Digital Research implementation of Subset G was started in mid-1978 and completed two years later. The compiler is a three-pass system written in PL/M. The first two passes are machine independent and produce symbol tables and intermediate language suitable for any target machine. The third pass is largely machine dependent and is dedicated to code optimization and final machine-code production. The compiler is accompanied by a linkage editor (compatible with the Microsoft format), a program librarian, a set of runtime subroutines, and a relocating macro assembler.

Thus, PL/I completes the final level of the inverted pyramid of support tools. The message should be clear to the application programmer: it is not the system language or the operating system which is important in the production of a final application. Rather, it is the availability of a standard, widely accepted application language that can provide program longevity. Once expressed in PL/I Subset G, the program can be transported through the CP/M family of operating systems to a variety of minicomputer systems. Digital Research has a long-term commitment to PL/I support for popular operating systems and processors.

## New Processor Architectures

We've spent little time discussing processor refinements. What is happening to our software tools as we augment our 8-bit machines with the more powerful 16-bit processors? Will 16-bit processors replace 8-bit machines, or are they simply a temporary phenomenon in the transition to 32-bit machines?

There are several considerations when answering these questions. First, 8-bit machines are economical to produce, their software systems are mature, and they satisfy the needs of a substantial computer base. Therefore, we can safely assume that 8-bit machines are here to stay. Newer 16-bit machines are marginally faster, but they have substantially more address space. To use this additional address space, the computer must contain more memory, which increases the computer system cost.

As system costs increase, the margin between low-end minicomputers and high-end microcomputers diminishes, placing microcomputer hardware and software manufacturers such as ourselves in direct competition with major minicomputer manufacturers. The 16-bit machines, by their nature, introduce memory segmentation problems that are not

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present in 32-bit processors.

Finally, we should note that 16-bit minicomputers are already outmoded, and all serious manufacturers are pushing 32-bit machines. This leads to the following conclusion: if we are tracking the minicomputer world, we can assume that the future will be with the 32-bit processors.

Currently, however, 32-bit machines are not available in quantity. Even when they are available, there will be delays while manufacturers tool up for production. At the moment, the 16-bit processors offer an intermediate solution. Digital Research has provided initial support for Intel's 16-bit machines—iAPX-186 and iAPX-286—which are versions of its 8086 product line. Intel provided PL/M-86, rehosted from the 8080 line, which was used by Digital Research to generate CP/M-86 and MP/M-86. In both cases, the fundamental design remains basically the same as that of the 8-bit version, with the addition of memory management and enhancements to the file system that match new computing resources. A familiar program environment is retained so that program conversion is simplified.

CP/NET and related network software will be available sometime this year. Intel's 8087 (an arithmetic coprocessor for the 8086) is of particular interest since it directly supports binary and decimal operations, which substantially increase PL/M-86 execution speed.

In addition to the 8086, the CP/M family will be adapted to the 16-bit machines that prove popular, with special interest in the 32-bit architectures as they become available. During this development and rehosting, however, the 8-bit processors will continue to be supported with new tools and facilities, since this constitutes, without doubt, our best customer base for some time to come.

### Software Vendors

We've concerned ourselves with three levels of software tools that support the most important level: the application programs. A major reason for CP/M's popularity is the general availability of good application software. At last count, there were about 500 commercially available CP/M-compatible software products.

Through the combined efforts of CP/M distributors, independent vendors, and CP/M users, we are participating in a software commodity market with quality and variety that is unequaled by any minicomputer or mainframe manufacturer. The large CP/M customer base allows a vendor to produce and support a software package at low end-user cost. This increases the customer base, drawing more vendors with lower-cost good-quality products. This cyclic effect is, today, solving the "software crunch."

The tools are available, and it is the responsibility of independent software vendors to continue developing their own specialized markets. In this way, computer software technology will reach virtually all application areas where low-cost, reliable computing is required. Refinements? My friend, they're up to you. ■

# LIST—A Source-Listing Program for the C Language

Jeff Taylor, The Toolsmith
POB 22511, San Francisco CA 94122

Most UNIX-system utilities read from a standard input device and write to a standard output device. The Whitesmiths C compiler shows its heritage by doing the same. Until it informs you, for example, that there is a semicolon missing on some line, you don't notice that the source listing isn't being printed. LIST is a program to print source listings. (See listing 1.) Each line is labeled like the compiler's error listing. The version presented here is a system note, and you will probably want to add more features.

**About the Author**
*Jeff Taylor is the owner of The Toolsmith, a software house. He received his bachelor's degree and did graduate work in electrical engineering, specializing in computer science, at the University of California, Davis.*

LIST reads the files named on command line and writes the listing to the standard output. If the files are not named, input is taken from the standard input. The standard input and output default to the user's terminal but can be redirected to or from other devices or files, such as the line printer. Each file's listing starts a new page. At the top of each page is the file's name, the page number, and the date. Obtaining the date from the operating system depends upon your equipment; the code shown is for RT-11. The function DATE returns the number of bytes in the date and puts the date's character string in its single argument.

The C language allows an #include statement. The preprocessor pass of the compiler replaces the #include statement with the contents of the file it names. As an option, LIST can insert the contents of the file after the #include statement. The −n flag on the command line turns on #include processing for nonheader files. The −h option includes header files. Header files are those with the extension .H (such as STD.H, which is the standard header file supplied by Whitesmiths). The depth to which #include can be nested depends on your stack size. Listing 1 was printed by the command:

```
list −n > lp: list.c
```

where lp: is the line printer. The #include processing was performed excluding header files. The angle brackets (< and >) indicate redirection of the standard input and output, respectively.

The subroutine PAGINATE uses a technique that is described in *Principles of Program Design* by M A Jackson. If each print line could be read from a scratch

*Text continued on page 246*



 

# COMPUTERS–TERMINALS–MODEMS!

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**Bell 103/113 style**

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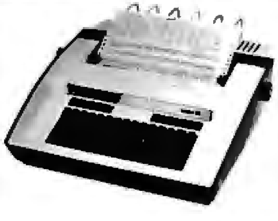

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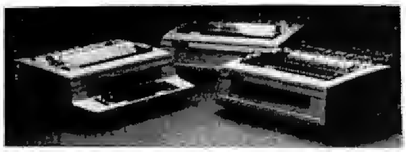

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55 CPS. Impact printer. Selectric print quality. Changeable print fonts. 110, 300 and 1200 baud data rate. Numeric keypad. Friction and tractor feed.

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**Listing 1:** *The program LIST. Normal operation produces a listing with pagination, top and bottom margins on each page, and a header on each page.*

```
list.c                                         Page: 1        24 October 1980

list.c              1: #include <std.h>
list.c              2: #include <local.h>
list.c              3: /*  lister - list 'c' source files
list.c              4: */
list.c              5:
list.c              6: FIO stdin;       /* standard input buffer */
list.c              7:
list.c              8: BOOL n_flag = NO;
list.c              9: BOOL h_flag = NO;
list.c             10:
list.c             11: #include "diagn.c"
diagn.c             1:
diagn.c             2: /* diagnostic - spit out error message */
diagn.c             3: diagnostic(fatal,args)
diagn.c             4:   BOOL fatal;
diagn.c             5:   TEXT *args;
diagn.c             6:   {
diagn.c             7:   FAST TEXT **a;
diagn.c             8:
diagn.c             9:   for(a = &args; *a != NULL; ++a)
diagn.c            10:     write(STDERR,*a,lenstr(*a));
diagn.c            11:   write(STDERR,"\n",1);
diagn.c            12:   if(fatal)
diagn.c            13:     exit(NO);
diagn.c            14:   }
list.c             12:
list.c             13: #include "pagin8.c"
pagin8.c            1:
pagin8.c            2: #include "date.c"
date.c              1:
date.c              2: /* date - return current date, if any in "buf" */
date.c              3: BYTES date(buf)
date.c              4:   FAST TEXT *buf;
date.c              5:   {
date.c              6:   BYTES itob();
date.c              7:   COUNT emt();
date.c              8:   FAST TEXT *b = buf;
date.c              9:   TEXT *cpystr();
date.c             10:   union _date {
date.c             11:     COUNT all;
date.c             12:     struct {
date.c             13:       unsigned year:5;
date.c             14:       unsigned day:5;
date.c             15:       unsigned month:5;
```

```
list.c                                         Page: 2        24 October 1980

date.c             16:       };
date.c             17:     } tmp;
date.c             18:   static TEXT *months[] = {"January","February","March","April","May","June",
date.c             19:     "July","August","September","October","November","December"};
date.c             20:
date.c             21:   tmp.all = emt(0374,012<<8);    /* system call */
```

*Listing 1 continued on page 238*

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Telex: 241596

Circle 305 on inquiry card.

*Listing 1 continued:*

```
date.c          22:   if(tmp.all == 0)      /* no date */
date.c          23:     return(0);
date.c          24:   buf += itob(buf,tmp.day,0);   /* day of month */
date.c          25:   buf = cpystr(buf," ",months[tmp.month-1]," ",NULL);   /* month of year */
date.c          26:   buf += itob(buf,tmp.year+1972,0);     /* year A.D. */
date.c          27:   return(buf-b);
date.c          28:   }
pagin8.c         3:
pagin8.c         4: /* skip - output "n" blank lines */
pagin8.c         5: COUNT skip(n)
pagin8.c         6:   FAST COUNT n;
pagin8.c         7:   {
pagin8.c         8:   FAST COUNT t = n;
pagin8.c         9:
pagin8.c        10:   while(t-- > 0)
pagin8.c        11:     putch('\n');
pagin8.c        12:   return(n);
pagin8.c        13:   }
pagin8.c        14:
pagin8.c        15: #define MARGIN1 3      /* top of page to title line */
pagin8.c        16: #define MARGIN2 2      /* title line to body */
pagin8.c        17: #define MARGIN3 2      /* body to bottom of page */
pagin8.c        18:
pagin8.c        19: TEXT *title = NULL;
pagin8.c        20: int page_size = HARD_PAGE;      /* lines per page */
pagin8.c        21:
```

*Listing 1 continued on page 240*

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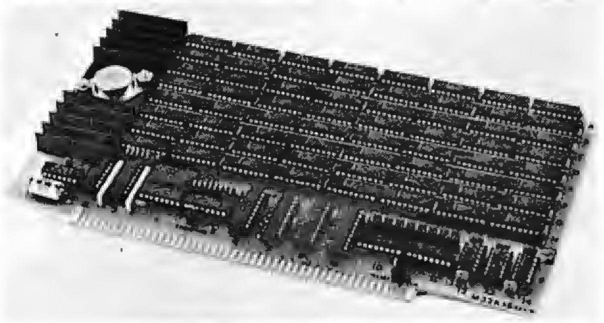

## 32K STATIC MEMORY BOARD

- Fully S100 bus compatible, IMSAI, SOL, ALTAIR, ALPHA MICRO
- Uses Intel low-power 2141L-4 4Kx1 Static RAM
- 2 MHz or 4 MHz operation
- Gold contacts for higher reliability
- Thermally designed heat sink (board operating temperature 0-70 °C)
- Commercially designed power bus; 7 ground bus bars; 0.1 uf decoupling capacitors
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- Each 4K bank addressable to any 4K slot within a 64K boundary
- 4K hardware or software selectable
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- Selectable port address
- 4K banks can be selected or disabled on power on clear or reset
- Will operate with or without front panel
- Compatible with Alpha Micro, with extended memory management for selection beyond 64K
- No DMA restriction
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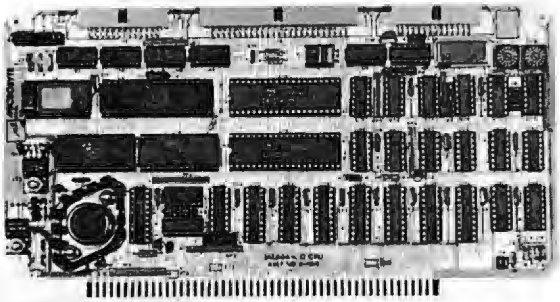

## Z-80A/I-O

- A complete single board Z-80A CPU with serial/parallel interface
- Fully compatible with the proposed IEEE S-100 Bus Standard
- Z-80A CPU (4MHz version of the Z-80)
- 158 instructions—superset of and upward compatible from the 8080's 78 instructions
- Up to 4K of on board Eprom with optional Z-80 monitor program — 1K(2708), 2K(2716) or 4K(2732)
- Full vectored interrupt capability
- 2MHz or 4MHz operation is jumper selectable
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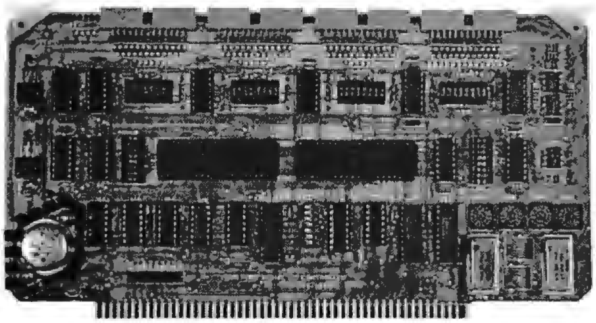
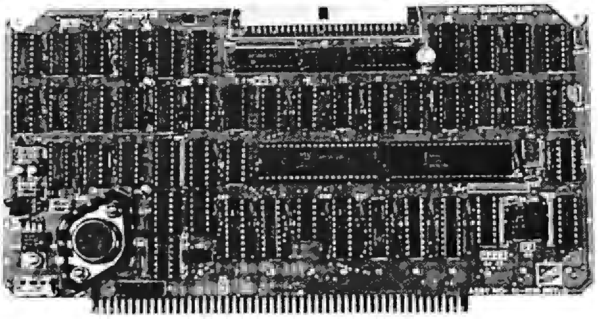
- Dual RS-232 serial I/O ports using the Z80A-DART with individual baud rate selection (16 baud rates from 50-19,200 baud)
- Up to 24 bit parallel I/O port—fully programmable Intel 8255A
- Up to 8 separate counter/timers using 2 Z-80A CTC





## DISK CONTROLLER

- DMA to within 16M byte of memory
- State-of-the-art NEC765 LSI Controller
- IEEE-S100 compatible
- DMA arbitration allows use of multiple boards within a system
- PLL data recovery for totally reliable operation
- Write pre-comp switched at mid-disc for reliable double density operation
- Supports up to four (4) drives
- Power On, Power Off or Reset deselects drives to avoid damaging files
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- Single density/double density operation
- 8" standard drives
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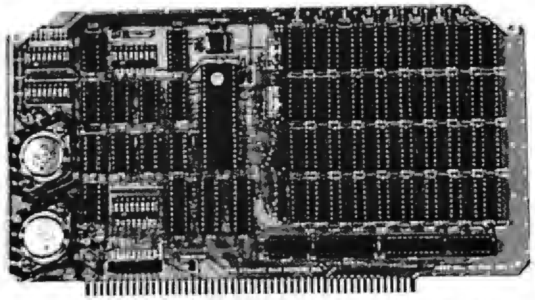

## 64K DYNAMIC RAM BOARD

- Fully S-100 bus compatible/Alpha Micro compatible
- 64K x 8 bit dynamic RAM
- Low power: + 8VDC @ 700 ma<br>+ 16VDC @ 100 ma<br>− 16VDC @ 25 ma
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- Easily Configurable to Any Type of Terminal Interface
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- Off-Board Interrupt Daisy Chain Capability
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Circle 228 on inquiry card.

*Listing 1 continued:*

```
pagin8.c        22: /* paginate - separate stream of buffers into pages */
pagin8.c        23: paginate(buf)
pagin8.c        24:   TEXT *buf;
pagin8.c        25:   {
pagin8.c        26:   BYTES date(),itob(),lenstr(),putlin();
pagin8.c        27:   static int line;       /* line number within page */
pagin8.c        28:   static int page = 0;
pagin8.c        29:   TEXT tmp[20];
pagin8.c        30:
pagin8.c        31:   if(page != 0) /*  M. A. Jackson's program inversion technique used */
pagin8.c        32:     goto resume;
pagin8.c        33:   /*  read  */
```

```
list.c                              Page: 3        24 October 1980

pagin8.c        34:   while(buf != NULL) {  /* while(!end_of_file) */
pagin8.c        35:     ++page;
pagin8.c        36:     line = skip(MARGIN1);
pagin8.c        37:     if(title != NULL) { /* output title, page # & date */
pagin8.c        38:       putlin(title,lenstr(title));
pagin8.c        39:       putlin("\t\t\t\t\t Page: ",12);
pagin8.c        40:       putlin(tmp,itob(tmp,page,0));
pagin8.c        41:       putlin("\t",1);
pagin8.c        42:       putlin(tmp,date(tmp));
pagin8.c        43:       line += skip(MARGIN2);
pagin8.c        44:       }
pagin8.c        45:     while(buf != NULL && line < page_size-MARGIN3) {
pagin8.c        46:       putlin(buf,lenstr(buf));
pagin8.c        47:       ++line;
pagin8.c        48:       /*  read  */
pagin8.c        49:       return;
pagin8.c        50: resume: ;
pagin8.c        51:       }
pagin8.c        52:     skip(page_size-line);
pagin8.c        53:     line = 0;
pagin8.c        54:     }
pagin8.c        55:   page = 0;
pagin8.c        56:   }
list.c          14:
list.c          15: #include "incl.c"
incl.c           1:
incl.c           2: /* include - include file in s */
incl.c           3: COUNT include(file,ftn)
incl.c           4:   FAST TEXT *file;
incl.c           5:   COUNT (*ftn)();
incl.c           6:   {
incl.c           7:   FAST COUNT return_code;
incl.c           8:   TEXT *buybuf();
incl.c           9:   FAST FIO *fd;
incl.c          10:   FIO *fclose(),*fopen();
incl.c          11:
incl.c          12:   return_code = NO;
incl.c          13:   fd = (FIO *) buybuf(&stdin,sizeof(FIO));
incl.c          14:   if(fopen(&stdin,file,READ) == NULL)
incl.c          15:     diagnostic(NO,"can't open ",file,NULL);
incl.c          16:   else {
```

```
incl.c          17:     return_code = (*ftn)(file);
incl.c          18:     fclose(&stdin);
incl.c          19:     }
```

```
list.c                              Page: 4       24 October 1980

incl.c          20:   cpybuf(&stdin,fd,sizeof(struct fio));
incl.c          21:   free(fd);
incl.c          22:   return(return_code);
incl.c          23:   }
list.c          16:
list.c          17: #include "filenm.c"
filenm.c         1:
filenm.c         2: TEXT *prefix = "";        /* include prefix */
filenm.c         3:
filenm.c         4: /* get_name - extract file name from line */
filenm.c         5: BYTES get_name(line,file)
filenm.c         6:   TEXT *file,*line;
filenm.c         7:   {
filenm.c         8:   TEXT *delim;
filenm.c         9:   BYTES cpybuf(),instr(),lenstr(),n;
filenm.c        10:
filenm.c        11:   while(*line == ' ' || *line == '\t')
filenm.c        12:     ++line;
filenm.c        13:   if(*line == '\n')
filenm.c        14:     n = lenstr(file);
filenm.c        15:   else {
filenm.c        16:     n = 0;
filenm.c        17:     if(*line == '"') {
filenm.c        18:       delim = "\"\n";
filenm.c        19:       ++line;
filenm.c        20:       }
filenm.c        21:     else if(*line == '<') {
filenm.c        22:       delim = ">\n";
filenm.c        23:       ++line;
filenm.c        24:       n = cpybuf(file,prefix,lenstr(prefix));
filenm.c        25:       }
filenm.c        26:     else
filenm.c        27:       delim = " \t\n";
filenm.c        28:     n += cpybuf(file+n,line,instr(line,delim));
filenm.c        29:     *(file+n) = EOS;
filenm.c        30:     }
filenm.c        31:   return(n);
filenm.c        32:   }
list.c          18:
list.c          19: #include "detab.c"
detab.c          1:
detab.c          2: /* detab - replace tabs with blanks */
detab.c          3: BYTES detab(s,d)
detab.c          4:   FAST TEXT *s,*d;
```

```
list.c                              Page: 5       24 October 1980

detab.c          5:   {
detab.c          6:   FAST BYTES i;
```

*Listing 1 continued on page 244*

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ΩMEGA SALES CO.

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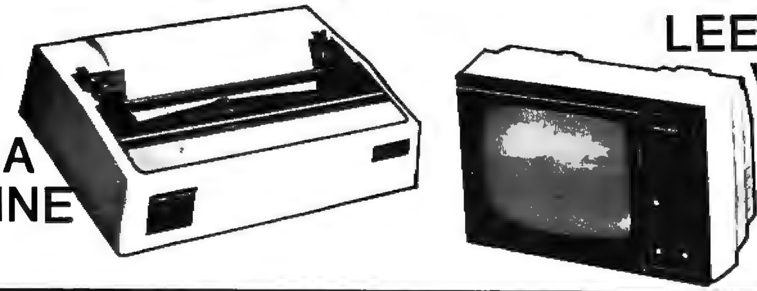

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| INTERTEC SUPERBRAIN 64K RAM | $2849 |
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| ATARI 400 8K | $399 |
| ATARI 400 16K | $499 |
| RADIO SHACK 16K Level II Model 3 | $875 |
| RADIO SHACK 64K Model 2 | $3449 |

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**ΩMEGA SALES COMPANY**

Circle 265 on inquiry card.

*Listing 1 continued:*

```
detab.c
detab.c      for(i = 0; *d = *s; ++s)
detab.c        if(*s == '\t')
detab.c          do
detab.c            *d++ = ' ';
detab.c          while(++i%8);
detab.c        else {
detab.c          ++i;
detab.c          ++d;
detab.c          }
detab.c      return(++i);
detab.c      }
list.c
list.c    /* check_include - do possible include processing */
list.c    check_include(line)
list.c      FAST TEXT *line;
list.c      {
list.c      FAST BYTES n;
list.c      TEXT file[MAXFILE+1];
list.c      int list();
list.c
list.c      for( ; iswhite(*line); ++line)          /* skip leading blanks */
list.c        ;
list.c      if(cmpbuf(line,"#include ",9)) {
list.c        n = get_name(line+9,file);
list.c        if(cmpbuf(&file[n-2],".h",2)) {       /* header file */
list.c          if(h_flag)
list.c            include(file,&list);
list.c          }
list.c        else {        /* non-header file */
list.c          if(n_flag)
list.c            include(file,&list);
list.c          }
list.c        }
list.c      }
list.c
list.c    /* list - label and print lines of "file" */
list.c    list(file)
list.c      TEXT *file;
list.c      {
list.c      BYTES getlin(),itob();
list.c      TEXT *alloc(),*buf,*line,temp[4];
```

---

```
list.c                           Page: 6        24 October 1980

list.c      FAST BYTES l,t;
list.c      FAST COUNT line_number = 0;
list.c      #define BORDER MAXFILE+7        /* assumes < 1000 lines */
list.c
list.c      buf = alloc(HARD_WIDTH+1,0);
list.c      line = alloc(MAXLINE+1,0);
list.c      fill(buf,BORDER,' ');
list.c      buf[BORDER-2] = ':';
list.c      cpybuf(buf,file,lenstr(file));
list.c      while(l = getlin(line,MAXLINE)) {
list.c        line[min(l,HARD_WIDTH-BORDER)] = EOS;
```

*Listing 1 continued on page 246*


CREATE !

*Listing 1 continued:*

```
list.c          61:      t = itob(temp,++line_number,10);
list.c          62:      cpybuf(buf+BORDER-2-t,temp,t);
list.c          63:      detab(line,buf+BORDER);
list.c          64:      paginate(buf);
list.c          65:      if(n_flag || h_flag)
list.c          66:        check_include(line);
list.c          67:      }
list.c          68:    }
list.c          69:
list.c          70: BOOL main(ac,av)          /* handles program_arguments */
list.c          71:    BYTES ac;
list.c          72:    TEXT **av;
list.c          73:    {
list.c          74:    FAST TEXT *s;
list.c          75:    TEXT buf[MAXLINE+1],*getflags();
list.c          76:
list.c          77:    if(s = getflags(&ac,&av,"h,i*,n,p#",&h_flag,&prefix,&n_flag,&page_size))
list.c          78:      diagnostic(NO,"bad flag:",s,NULL);
list.c          79:    if(ac <= 0) {
list.c          80:      list("");
list.c          81:      paginate(NULL);
list.c          82:      }
list.c          83:    else {
list.c          84:      do {
list.c          85:        title = *av;
list.c          86:        include(title,&list);
list.c          87:        paginate(NULL);
list.c          88:        } while(++av,--ac);
list.c          89:      }
list.c          90:    }
```

*Text continued from page 234:*
file, this is what the subroutine would look like in pseudocode:

```
read line;
while(not end of file) {
   do page header;
   while(not (end of file || bottom of page)) {
      print line;
      read line;
      }
   do page footer;
   }
```

For efficiency and simplicity, a *pointer* to each line is *passed* to PAGINATE instead of read from a file. A NULL pointer indicates end-of-file. The usual method is to turn the code inside out around the read statements. Jackson advocates keeping the structure the same and replacing each read statement by an assignment to a state variable, a return statement, and a label. The state variable serves as a "bookmarker," so that execution can resume where it left off. A switch statement at the subroutine entrance will jump to the proper label on the next call. This technique may not be well received by the more fanatical GOTOless programming advocates, but this was the first paginate subroutine I have written that worked perfectly on the first try. In PAGINATE, the page counter is used as the state variable. If PAGE equals 0, then execution continues at the first read statement; otherwise, it jumps to the read in the innermost loop.

LIST did not spring full-blown from an exhaustive design process but evolved over a period of time. As with most computer efforts, I had only a general idea of the requirements—features were added, removed, and generalized. The header-file exclusion option originally only affected the standard header file STD.H. Functions were moved around within the code to tighten up the structure or to generalize a subroutine. Concatenating the file name, line number, and source line was originally done in PAGINATE. Moving it out allowed PAGINATE to be used in other programs. Several extensions are being contemplated, but the cost (in time) to implement them exceeds the cost of not having them. Being able to exclude an include file by name (−x filename) would be useful on large programs with a lot of previously developed code. When the preprocessor conditional compilation statements #if and #ifdef are used, it's practical to have LIST handle them correctly. Each of these extensions would, however, require more time to implement than the existing program.■

# The UNIX Operating System and the XENIX Standard Operating Environment

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Bellevue WA 98004

Never has there been a greater demand for software that is easy to use and maintain, and independent of the hardware on which it runs. As the price of software rapidly outpaces that of computers, the need to increase software productivity and reduce duplication of effort has become paramount.

Microsoft's XENIX operating system offers one solution to the software crisis developing in the microcomputer world. Unlike the operating systems offered for 8-bit machines, the XENIX system is a powerful multiuser timesharing system with hundreds of utilities and is the basis for a highly productive software development environment and a general-purpose applications system.

The XENIX operating environment combines two key elements: the design of the widely acclaimed UNIX operating system and the inclusion of the major high-level languages that are standard within the 8-bit microcomputer world (see figure 1). Microsoft's transport of the XENIX system to major 16-bit microprocessors has made it the first hardware-independent operating system.

The heart of the XENIX system is the UNIX operating system developed at Bell Laboratories and licensed by Western Electric. The UNIX system's elegant design combines power, flexibility, and simplicity, and its vast array of software utilities greatly increases productivity. Thus, the UNIX system is an ideal candidate to serve as a solution to the software crisis.

Microsoft plans to make the XENIX operating system (which is an enhanced version of the UNIX system) into a commercial standard. And, in addition to supporting and enhancing the operating system proper, Microsoft will adapt high-level languages, such as its BASIC interpreter and compiler, FORTRAN, Pascal, and COBOL, and other software tools, such as data-base management and communications software, to run under the XENIX operating system.

**The XENIX system is one approach to solving the software crisis developing in the microcomputer world.**

To understand the elegance of the basic UNIX design and the further enhancements in the XENIX system, we must take a closer look at the software. In this article, I will describe the main features in the UNIX operating system, discuss some of its strengths and weaknesses, and conclude with a discussion of the evolution of the XENIX operating environment from the UNIX operating system, and how it can help solve critical software issues. First, a historical overview.

## Origins of the UNIX OS

The UNIX operating system was originally developed at Bell Laboratories by Ken Thompson, an employee engaged in various programming research projects. With access to an abandoned DEC PDP-7 computer that had no software, Thompson decided in 1969 to write a set of programs that would aid him in software research. Over a period of several years, and with the help of fellow researcher Dennis Ritchie, this set of programs evolved into a full operating system. By 1972, it was recoded for the DEC PDP-11 computer in a newly designed high-level language, called C. The system gained recognition within the Labs and their parent company, Western Electric.

Word of the quality of Thompson and Ritchie's UNIX operating system spread rapidly. Universities, in particular, expressed interest in obtaining UNIX, and in 1973, Western Electric agreed to distribute the system to nonprofit organizations and promptly licensed several dozen educational institutions, including Columbia University, the University of Alberta (Canada), The Children's Museum (Boston), Princeton University, and Harvard University. By 1975, UNIX had become sufficiently popular in the academic world to justify the

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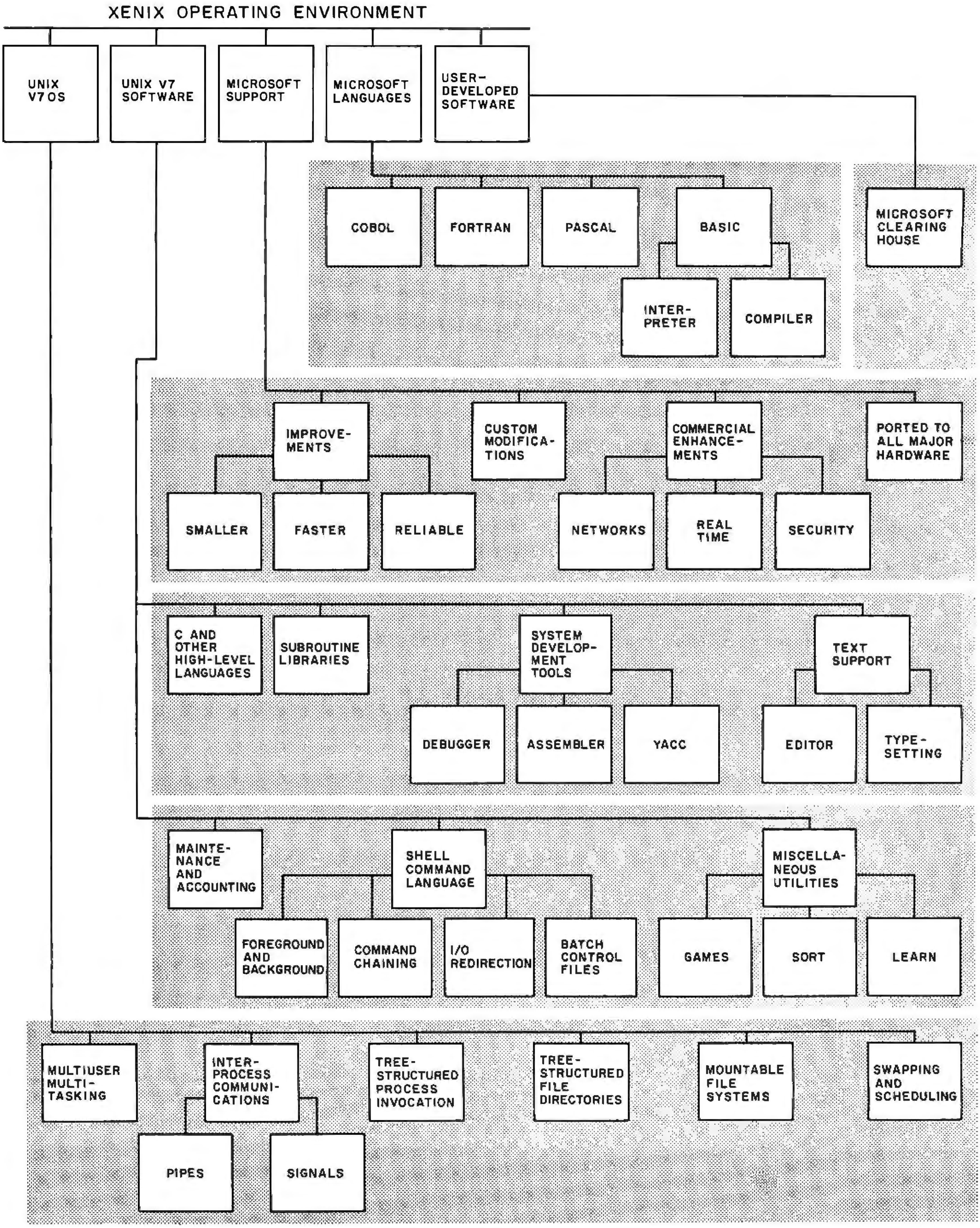


**Figure 1:** *Microsoft's XENIX operating system. The five "layers" of the XENIX software structure are shown. XENIX, a superset of Bell Laboratories' UNIX operating system developed in the early 1970s, has a hierarchical structure. Each of the five layers depends on the layers beneath it for its operation. The bottom two layers represent the latest version of UNIX (version 7). The remaining three layers are the refinements that combine to make the XENIX system.*

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creation of a UNIX users' organization, later called USENIX.

The first public release of the UNIX operating system, labeled version 5, was an unpolished snapshot of a research project that was still evolving. It was replaced in 1975 with version 6, a system that is still operating today at many sites. UNIX continued to evolve, benefitting from the feedback it received from scores of internal and external test sites.

In January 1979, Western Electric released version 7. By this time, hundreds of man-years' effort has been expended on UNIX's design and software utilities, with most of the system coded in C. Research had proven that UNIX was compatible with the concepts of memory-limited computers, machine transportability, networks, and multiple-processor designs.

Unfortunately, there was no single standard design for UNIX. Because the operating system was simple and easy to change, almost every site altered it to meet their specific needs. Harvard, the University of California at Berkeley, and the RAND Corporation each offered a set of modifications. A number of incompatible versions of UNIX existed within Western Electric.

In addition, there has been a legal impediment to the UNIX system's distribution. The system is available essentially free-of-charge for educational institutions. Legally, however, Western Electric cannot be in the software business, so the commercial world is offered the operating system under noncompetitive terms: source code as is and no warranty, support, or maintenance—a steep fee for software that was never intended to serve commercial applications outside of Western Electric.

It had become clear that the support of a commercial software company was essential if UNIX was to become a software standard. In August of 1980, Microsoft announced that it would offer and support XENIX, a commercial version of the operating system, on 16-bit microprocessors. Working closely with Western Electric and a newly formed commercial users' organization, Microsoft intends to establish a standard industry version of UNIX that can provide a highly productive environment worthy of meeting the challenges of software development in the 1980s.

## UNIX Design Goals

Two aspects of UNIX's origin have contributed to its design: (1) it was created in a few man-years by two people, and (2) the implementers were also major users of the system. The result is a polished, consistent, coherent design. UNIX achieves great power and flexibility, including compatible interfacing between all its features, without resorting to a large, complex program. An experienced system programmer can understand the entire operating system in weeks, rather than months.

The UNIX system's design goals unite various features supported by the UNIX sytem into a consistent and simple whole. The first design goal is to support a very basic level of functionality within the operating system itself, relying on normal user programs to provide sophistication. Such features as line printer queuing, login/logout, monitor commands, and file access methods are implemented as normal user programs instead of operating-system functions. This approach, which reduces the overall complexity of the system, has several advantages. Functions are more modular, and therefore easier to debug, features can be altered and upgraded without stopping the operating system, and alterations made to one feature are less likely to affect the rest of the system. Finally, individual users may create personal versions of certain features.

The second design goal is generality—that is, having a single method serve a variety of related purposes. For example, the same system calls are used to read and write disk files, devices, and interprocess message buffers. Likewise, the same naming, aliasing, and access protection mechanisms apply to data files, directories, and devices. As a final example, the same mechanism is used to trap software interrupts, user abort requests, and processor traps. The benefits of generality extend well

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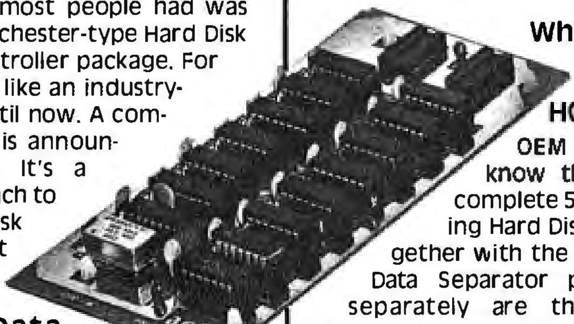

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beyond the simplicity of design; UNIX programming style is notably flexible, extensible, easily learned, and easily debugged.

The third goal is to accomplish large tasks by combining several small tasks whenever possible. UNIX's filters are an excellent example. A filter is a program that processes a single stream of input to generate one output stream. The UNIX system has a large variety of filters, including those that perform multicolumn formatting, string replacement, text processing, character translation, sorting, and graphics interfacing. Programs that generate output, such as the assembler, do not include facilities for listings; this task is accomplished by feeding programs directly to the various filters. This keeps the large programs simple to use, lets a user learn about each filter separately, and allows for special combinations of formatting without multiplying the options that each program would then have to support. It also leads to a uniform appearance of formatted output and the commands needed to produce it, and yields all the benefits of modular solutions to complex problems.

The vast number of utilities provided with the system and the ease of linking them together via pipes provide a surprising amount of functionality. For example, to find out how many people are currently using the system, you need only feed the output of the system "who" command to the utility that prints the number of lines in its input. Thus, the command line:

```
who | wc -l
```

causes the output of the who command, which might look like:

```
arw      console   Jan 30 14:20
bobg     tty00     Jan 30 01:00
henry    tty01     Jan 30 12:50
gordon   tty03     Jan 29 10:08
```

to be fed to the program "wc," for "word count." The -l option tells wc, which normally prints the number of characters, words, and lines in a file, that we only want to see the number of lines. Thus, this composite command prints a number which is the number of users on the system:

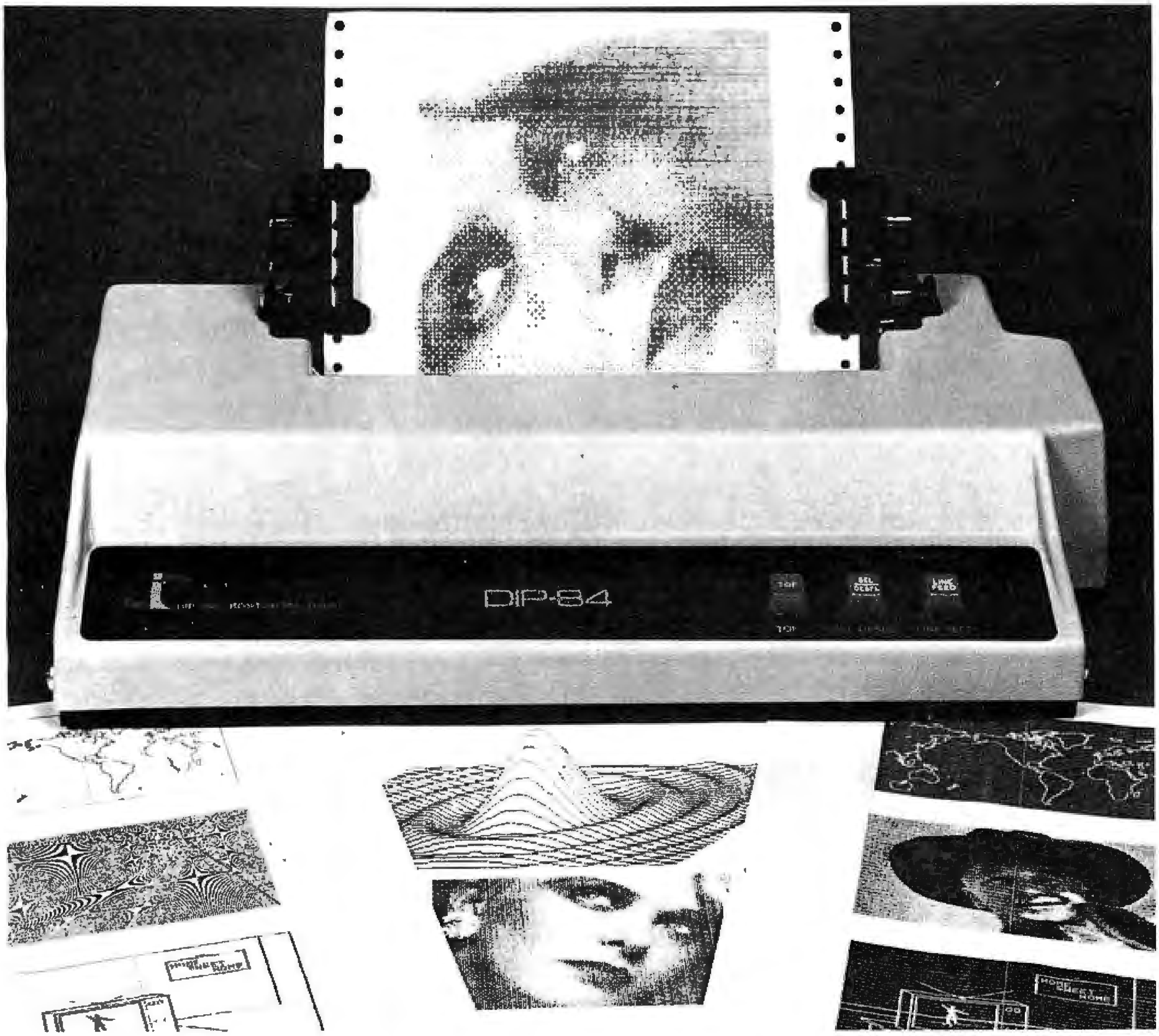
```
>who | wc -l
4
>
```

As a final step, we can create a file called "users," which contains the line:

```
who | wc -l
```

Typing "users" causes the command interpreter (or shell) to execute that line, and type the number of current users. We have now created a new system command.

A more dramatic example is shown in the following sequence: take a program that puts each text word in a file (or files) onto a separate line. Connect the output to a program that sorts lines into alphabetical order.

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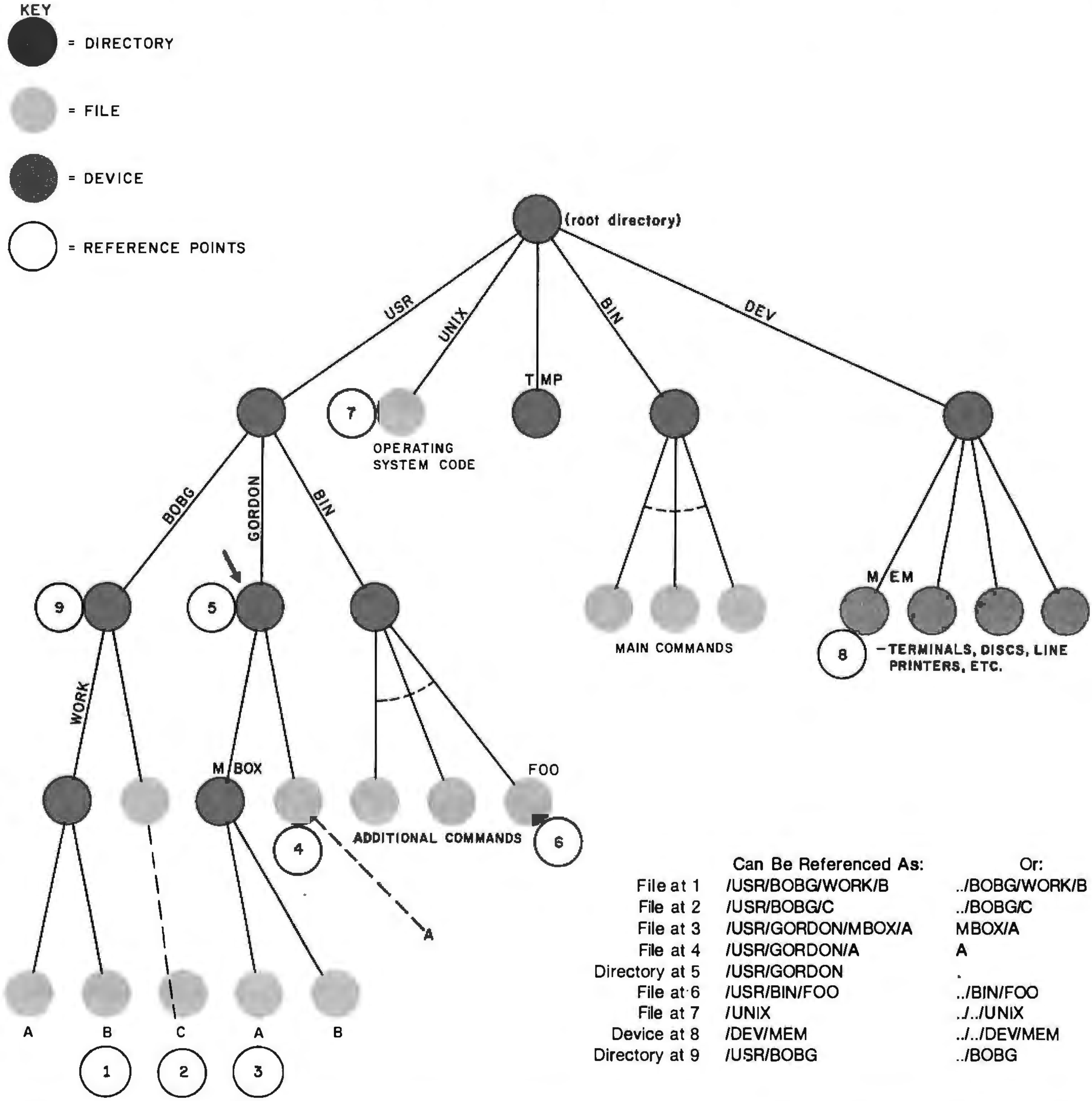
The output is a sorted list of all words in the text file(s). This list is fed to the program "uniq", which removes adjacent duplicate lines. The result is a data stream that contains one line for each different word in the original file(s). This stream is in turn connected to a program that reports differences between two files (one file being a list of 30,000 words from the dictionary). Thus, typing the line:

prep file | sort | uniq | comm wdlist

will result in a list of words present in "file" but not present in "wdlist". Without writing a line of code, you have created a simple spelling program! Now, by creating a file called "spell", which contains the line:

```
prep $* | sort | uniq | comm
/usr/dict/words
```

you have created the command "spell". Note that the "$*" is replaced by the command line interpreter with the arguments typed to the spell command. The UNIX sytem's command




| | Can Be Referenced As: | Or: |
|---|---|---|
| File at 1 | /USR/BOBG/WORK/B | ../BOBG/WORK/B |
| File at 2 | /USR/BOBG/C | ../BOBG/C |
| File at 3 | /USR/GORDON/MBOX/A | MBOX/A |
| File at 4 | /USR/GORDON/A | A |
| Directory at 5 | /USR/GORDON | . |
| File at 6 | /USR/BIN/FOO | ../BIN/FOO |
| File at 7 | /UNIX | ../../UNIX |
| Device at 8 | /DEV/MEM | ../../DEV/MEM |
| Directory at 9 | /USR/BOBG | ../BOBG |

**Figure 2:** *Hierarchical structure of the names and conventions for getting to any reference point in a typical XENIX file structure. In this example, it is assumed that the user is at reference point 5 (blue arrow). A list of instructions for getting to the various reference points appears beneath the diagram. (The file and directory labels shown here are actual labels used in the author's system.) To get to file 1, the user types "/USER/BOBG/WORK/B". XENIX then progresses down the tree from the root directory (at top) to the branches USR, BOBG, WORK, and B, arriving at point 1. Alternatively, the user can use the command "../BOBG/WORK/B", where ".." refers to the parent node of the node currently in use. In XENIX, "." refers to the node itself.*

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interpreter, the shell, is a fully interactive language in its own right.

## UNIX Operating System Design

The UNIX design introduces few new concepts because it borrows heavily from the better aspects of previously existing systems. UNIX contains numerous features found in the MULTICS and AOS operating sytems, and the language C is modeled after BCPL. However, the coherence and simplicity with which the chosen features interact result in an unusually elegant design that has great merit of its own.

The UNIX operating system supports a multiuser, multitasking environment. Each user has full access to the resources of the computer on a timesharing basis. UNIX implements scheduling and swapping algorithms that allow the processor and memory to service more tasks, seemingly simultaneously, than would otherwise be possible. UNIX also includes various protection schemes that protect each user from the others. This functionality contrasts markedly with the current microcomputer systems that simplify hardware operation by providing device drivers but make little attempt to extend the computer's utility.

The UNIX file system is a recursive structure originating from a *root directory*. The root directory contains the names of files and subdirectories; the subdirectories contain names of other files and additional subdirectories, etc. When a user logs into the system, he is assigned a specific subdirectory as his current working directory. Full path names for files consist of a possibly null sequence of subdirectories separated by a slash, beginning with either the root or the current working directory, and followed by the file name. By convention, the file in each subdirectory called ".." refers to the parent directory (see figure 2). Thus the user has a concept of local and global files neatly organized into directory groupings.

File names refer to data files, the directories themselves, character devices such as user terminals, block devices such as magnetic tape, file systems mounted onto other disk devices, and interprocess communications devices known as *multiplexed pipes*. Multiple names (called aliases) can be assigned to any of these objects. A set of information, including owner and access permissions, is stored with each object; the directory entries only specify names for the objects.

Programs communicate with their environment with read and write calls directed to a set of open files. Each program starts with three open files: *standard input*, *standard output*, and *error output*. Normally, these files are connected to the user's terminal, but a powerful command-language program, the shell, allows easy and invisible reassignment of these channels. A program can also open any other object (file, device, etc) named in the file system to which it has appropriate access permission. Using a special call, a program can create pipes, data channels that allow for communication between the program and any other programs connected to an end of the pipe.

All I/O (input/output) operations are performed as byte streams, with all channels appearing to contain a sequence of bytes until a globally defined end-of-file condition is indicated. Random access is also supported, using a call to reposition within the stream. Neither record sizes nor file types are imposed by the operating system. The system handles all interrupts and buffering, and each I/O call is suspended until the requested I/O operation can be completed. All devices, files, and pipes are treated identically (with minor exceptions), which greatly simplifies I/O routines.

A program may initiate another program by issuing a system call to duplicate itself. The two programs then operate independently, with

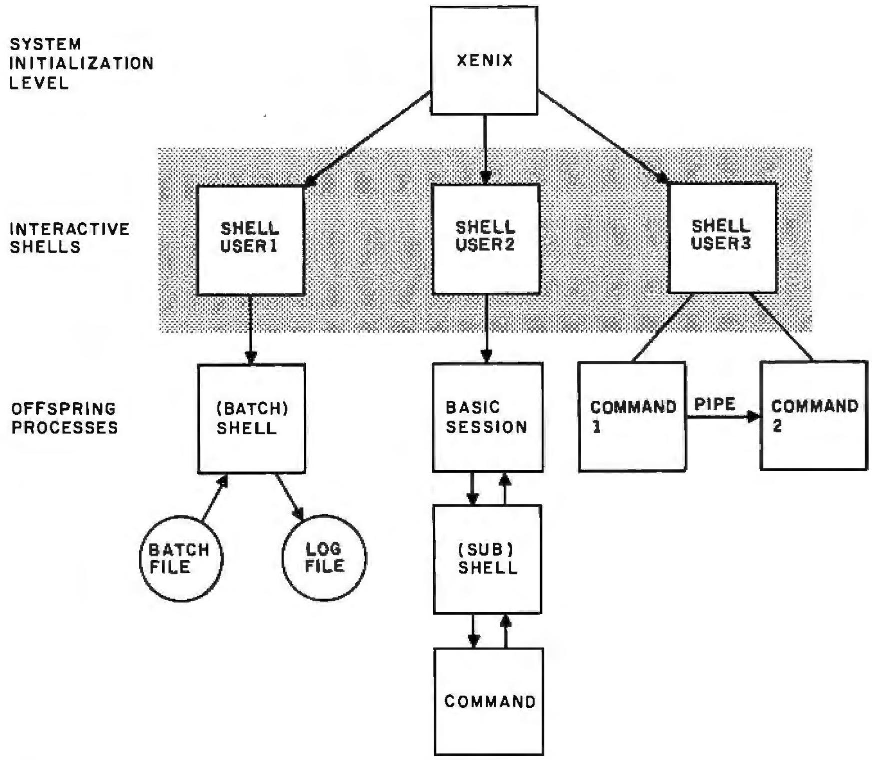
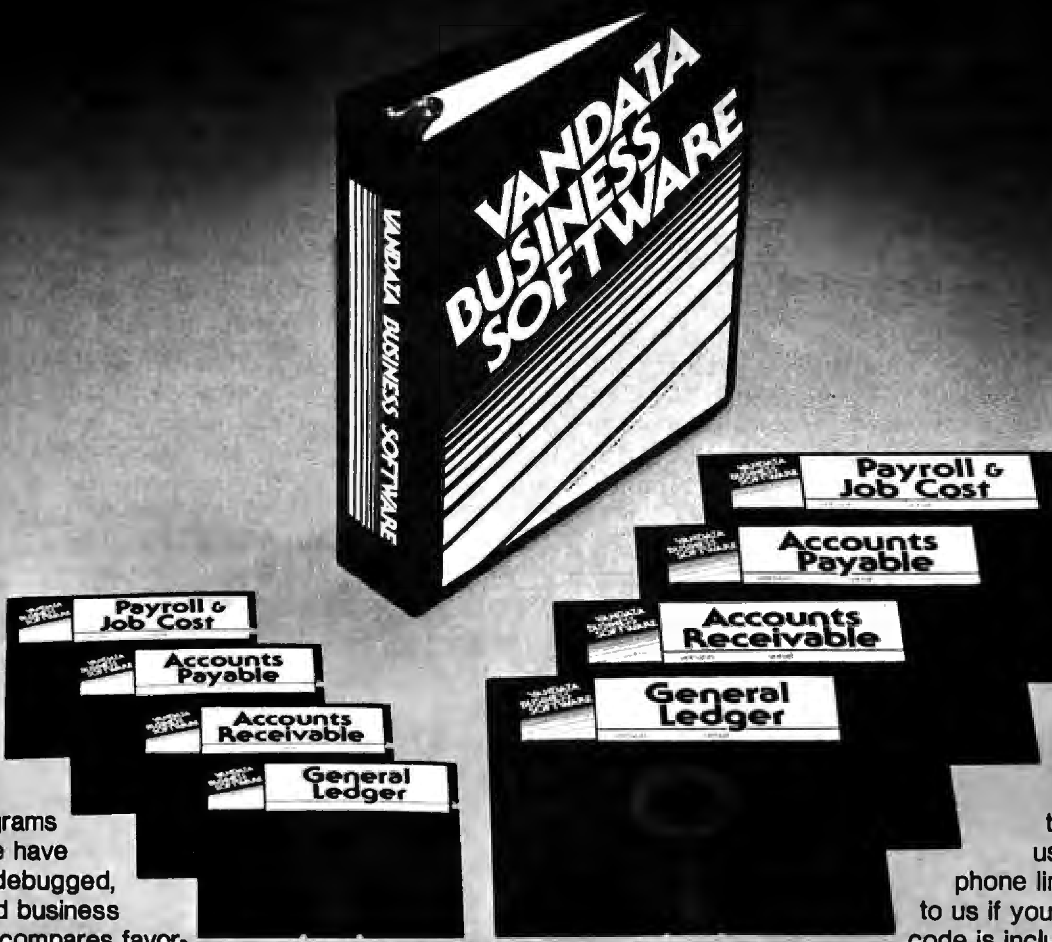



**Figure 3:** *Tree-structured process hierarchies in the XENIX system. Three users are currently on line. The term "shell" refers to that portion of the XENIX operating system program that "surrounds" the operating system and allows it to communicate with the outside world. User 1 is running a batch shell that is executing commands from a file. User 2 has suspended a BASIC session and entered a subshell to issue a command at the system-monitor level, perhaps to send a message to another user. User 2 can then return to BASIC and resume the session. User 3 has executed a command whose output is piped through a second command.*

# Account on it.

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Both the A/R and A/P systems produce aged invoice analysis listings based on user-specified time periods.

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The checks and statements fit standard forms readily available from mail-order forms suppliers. You have your choice of a number of different formats.

We are committed to the support of our users. A tech support phone line gives you access to us if you need it. Full source code is included with every system. Our money-back guarantee speaks for itself.

Minimum requirements are 48K RAM, CP/M™ or CDOS, CBASIC2, a CRT, and a 132-column printer. We can provide standard 8", NorthStar 5" double-density, or Heath/Zenith 5" diskettes — call for availability of other formats. The price is $295 per system, or $995 for the complete set of four.

For more information, write VANDATA, Suite 205, 17544 Midvale Ave. N., Seattle, Wa. 98133, or call (206) 542-7611.

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UNIX timesharing between them (see figure 3). Typically, the parent process waits for the completion of its child, and the child process executes another program in the file system by issuing a system call. However, both programs may continue execution in parallel. To synchronize their operation, they can communicate via the file system, pipes, or signals. Signals are software asynchronous interrupts that are issued by one program to another to cause the second program to interrupt its execution, process the signal, and then resume normal execution. Signals are also generated by user interrupt requests and software failures, such as divide-by-zero.

Thus, when a user compiles and links a program test.c by typing:

```
>cc test.c
```

the shell runs the C compiler (cc) as a child process. After it has spawned the child process, the shell puts itself to sleep. When the child process (the C compiler) finishes, the shell awakens and issues another prompt. However, by simply adding an ampersand character to the command line:

```
>cc test.c &
```

you can instruct the shell not to sleep, but rather to return immediately for another command. You can then edit your documenation or some further program, while the first one is compiling. Note that typing:

```
>filename
```

causes the shell to run a copy of itself as a child. This child shell then executes, one by one, the commands in "filename." By simply adding the "&" character to the following line:

```
>filename &
```

you now have the capabilities of a full batch system, for free, as a result of the UNIX system's flexibility.

This section has presented a brief overview of the UNIX system features. A more complete description is available in documents from Microsoft, Western Electric, and a number of universities. I will conclude this section with a discussion of an excellent example of UNIX's multitasking abilities.

## Multitasking

The multitasking and interprocess communication features of the UNIX system provide power that is unavailable in existing 8-bit computer systems. RITA, a large interpreter language for UNIX that I helped create for the RAND Corporation, provides an extensive example of the utility of these features. The RITA interpreter consists of over 100 K bytes of instructions and more than 64 K bytes of data—much larger than the current limit on UNIX program size. The solution was to split RITA into three separate programs that communicate though the use of five pipes, as illustrated in figure 4. Furthermore, separate programs are created by the interpreter to edit programs, read RITA news files, and perform UNIX commands, such as obtaining

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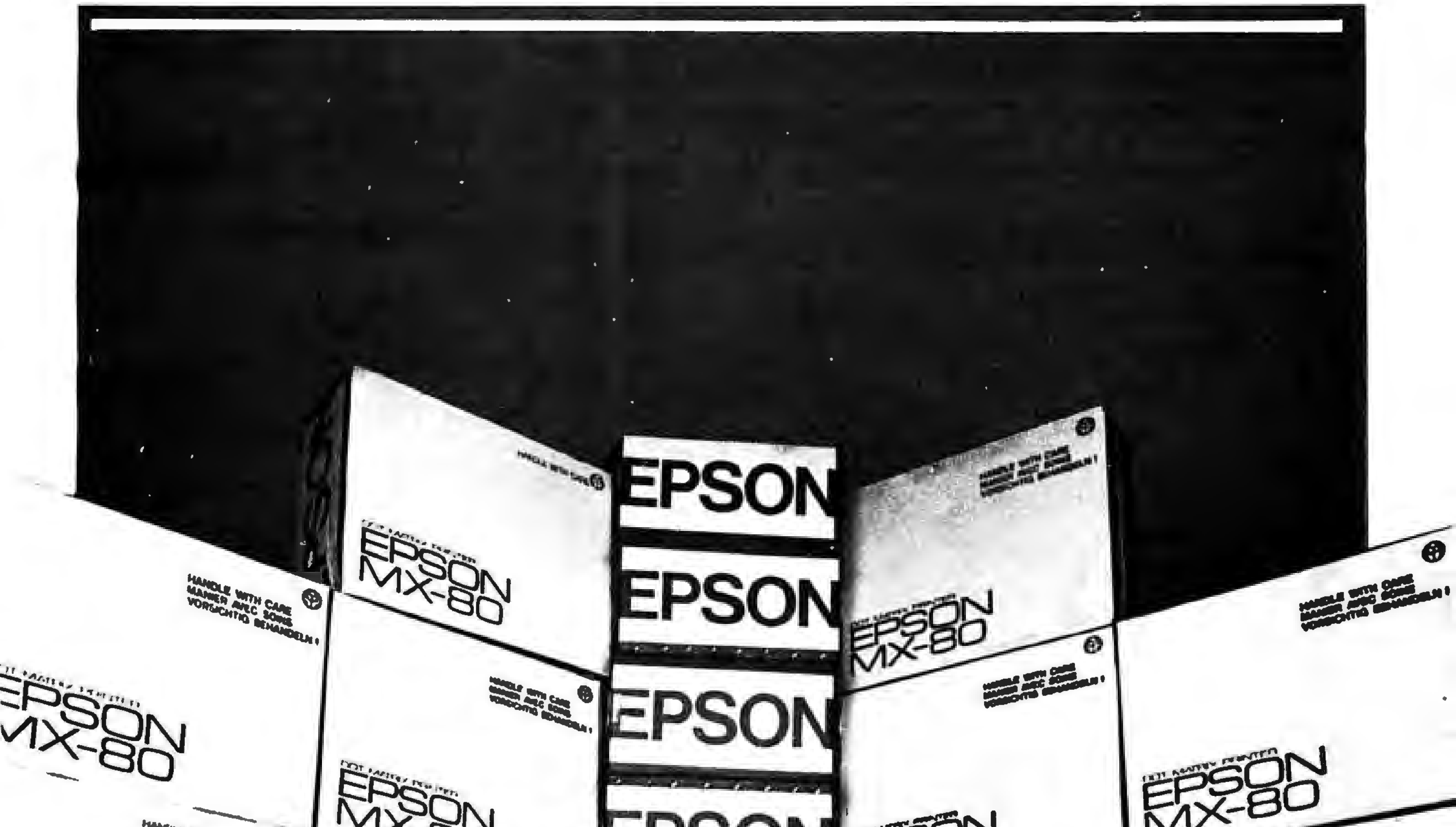


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access to networks. Several files are written for analysis by still other programs. All this multitasking takes place invisibly: the user still thinks he or she is running a single program.

A further benefit of multitasking and device-independent I/O is an unexpected feature of RITA's three-program arrangement. Normally, the first program, UFE (user front end) allows you to type and edit program statements, which are then converted to internal form by the second program, the parser, which in turn stores them in the third program, the monitor, for evaluation. The UFE also allows the statements to be entered from a disk file; however, due to the complex parser program, loading a large file is too time consuming for many applications. A slight alteration to the UFE, the program which creates the other two programs and the five pipes, provides the solution. The new UFE (now called RC for RITA compiler), which requires no changes to the parser or monitor, funnels the output of the parser, normally fed to a pipe, into a disk file. Thus, RC produces "compiled" files whose contents can be fed directly into the monitor, bypassing the parser, when later loaded by RITA's UFE.

## An Assessment of UNIX

UNIX offers unparalleled power for such a straightforward system. For the programmer, the system is easy to learn and offers immediate functionality, even for beginners. For more experienced users, the wealth of software tools leads to a more productive environment than less complete systems.

In addition, the UNIX operating system comes with hundreds of utilities and software tools that make it a complete software development environment. There is software for accounting, text editing, formatting and typesetting, high-level languages,

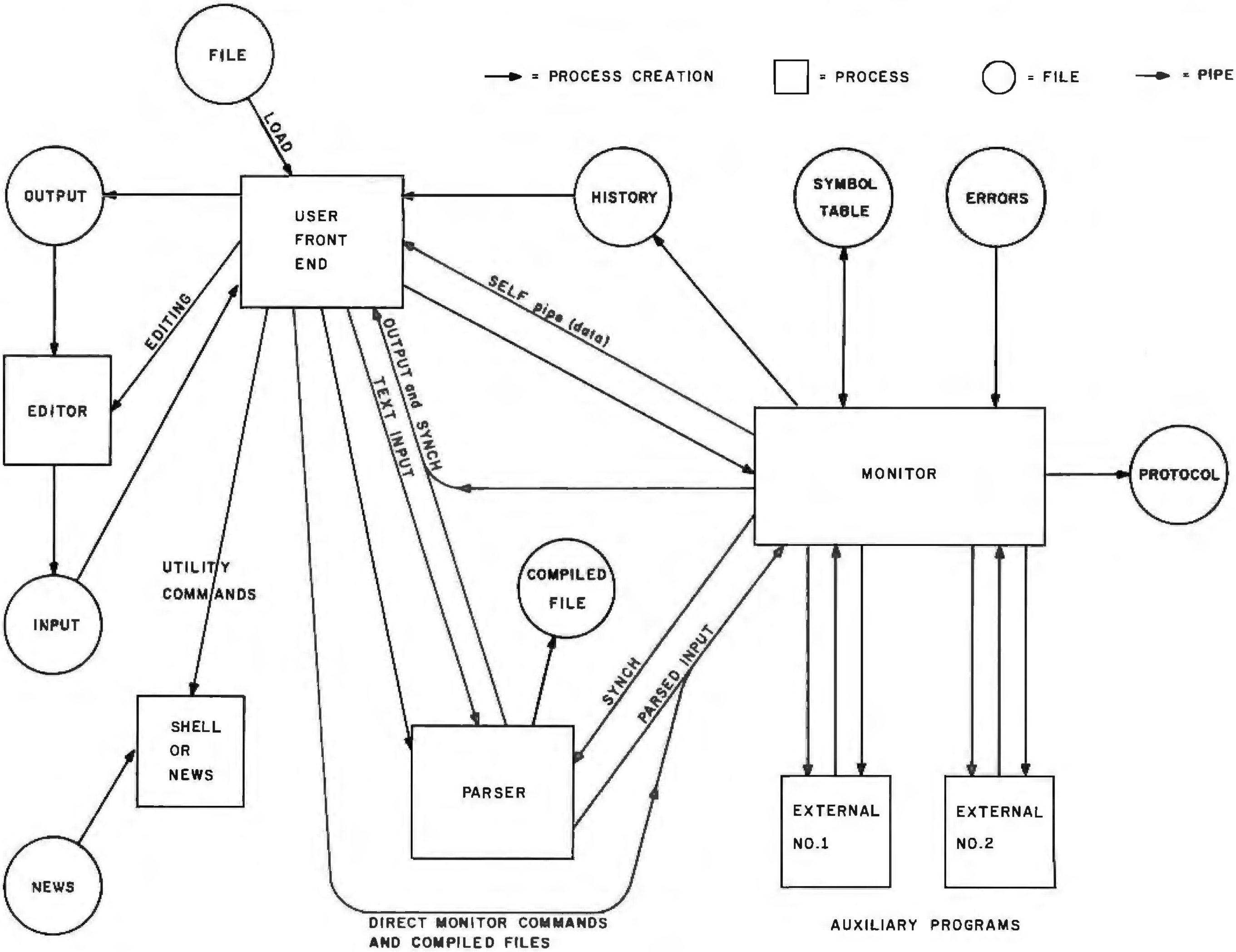


**Figure 4:** *RITA, a program designed in part by the author to illustrate the multitasking and interprocess communication features of the UNIX system. The RITA interpreter consists of over 100 K bytes of instructions and more than 64 K bytes of data: much larger than the current limits on UNIX program size. The solution to the problem is to split RITA into three separate programs that communicate through the use of five "pipes." A different UFE (user front end) program, called the RITA compiler, can refunnel the output of the parser, normally fed to the monitor, into a disk file. Thus, the RITA compiler produces "compiled" files whose contents can be fed directly into the monitor, bypassing the parser, when later loaded by RITA's user front end. This approach allows the user to load large files that might otherwise require too much time.*

# 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.

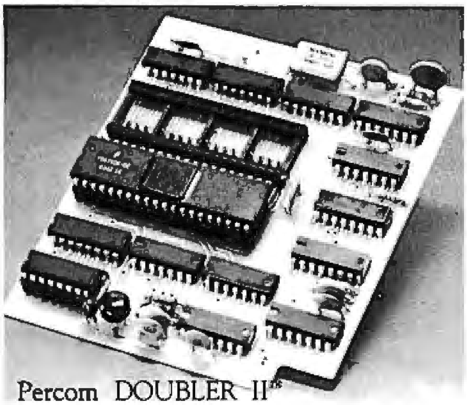
With a DOUBLER II installed, over four times more formatted data — as much as 364 Kbytes — can be stored on one side of a five-inch diskette than can be stored using a standard Tandy Model I drive system.

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.

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 1-800-527-1592.

*Ed. note:* Opening the TRS-80 Expansion Interface may void the Tandy limited 90-day warranty. Circle 288 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.

### CRC ERROR—TRACK LOCKED OUT

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.

Separator circuits that operate at lower frequencies — for example, two- or four-megahertz — were found by Percom to provide only marginally improved performance over the original Tandy circuit.

The Percom solution is a simple adapter that plugs into the drive controller of the Expansion Interface (EI).

**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 1-800-527-1592.

*Ed. note:* Opening the TRS-80 Expansion Interface may void the Tandy limited 90-day warranty. Circle 395 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.

And vice-versa.

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.

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assembly support utilities, sorters and index generators, communication facilities, tools that create parsers and lexical analyzers, graphics, games, mathematical function libraries, maintenance and performance utilities, and a host of file manipulators. Few needs cannot be met through a combination of these existing utilities.

The flexibility of UNIX allows easy alteration of its user interface. Various installations have demonstrated how easy it is to completely alter the appearance of UNIX in order to serve a different class of users. That UNIX cannot be everything to everyone is overshadowed by the fact that, as it is truly general-purpose, it can perform in almost any environment.

UNIX, as supplied by Western Electric, is not without its weaknesses. The general-purpose timesharing design limits UNIX's efficiency in real-time applications, such as process control. Its standard interface is highly terse, and though this is often considered desirable by programmers, the untamed UNIX will frighten almost everyone else. The origins of many of the command names are obscure; examples include a tape command "r" to write to a tape, command "cat" which types files, and "awk", a program for finding patterns in files. However, command names can be easily changed by the user.

UNIX has not been adapted for commercial use, where the issues of reliability, stability during hardware errors, full per-user accounting, reconfigurability for a large variety of environments, and security take on special importance. For example, less expensive disk packs for larger disk drives usually contain bad spots, and UNIX does not automatically adjust for them. In the environment for which the UNIX system was developed, it was cheaper to buy perfect packs than to write a " bad spot avoidance" routine. These issues must be addressed before UNIX can be considered a sturdy, robust, and commercial piece of software.

A crucial problem, and one not restricted to UNIX, is the lack of true applications software. Currently, there are few good accounts payable, invoicing, mailing list, income tax, or data-base management packages. UNIX provides an excellent software production environment because of its wealth of software tools utilities, but the system does not contain a similar variety of application-oriented software.

## The XENIX System

Microsoft's XENIX operating system represents an attempt to preserve the strengths of the UNIX design and also meet the needs of the commercial microprocessor industry. To achieve this goal, Microsoft used the system as it was distributed by Western Electric and then added modifications, customizations, improvements, enhancements, support, and additional software.

Modifications included those necessary to transport the UNIX system from the larger PDP-11 minicomputer to the 16-bit microprocessors. Currently scheduled machines include the DEC LSI-11/23, Zilog's Z8001 and Z8002, Intel's 8086 and 286, and Motorola's MC68000. Numerous other processors are also being considered, and Microsoft will then customize the XENIX systems to the specific hardware environments of the various computer systems built around these processors. The company is also working closely with a number of hardware manufacturers to design products that will be capable of efficiently executing the XENIX software.

Improvements will include elimination of known bugs and recoding of certain routines to produce a smaller and faster operating system. XENIX will also incorporate hardware error recovery strategies, automatic file repair after crashes, power-fail and parity-error detection, and similar features, depending on the particular hardware requirements of each XENIX system.

The planned enhancements will add a number of new features to XENIX. These features include record locking, shared data segments, synchronous writing, and improved interprocess communication—all of which are designed to make XENIX commercially viable and more compatible with the newer hardware technologies that involve distributed data processing, networking, and multiple-CPU approaches.

XENIX is a dynamic, evolving system. In its first release, its code was very close to the original UNIX version 7 source. The improvements and enhancements that I have mentioned are part of an evolving process, and the exact selection and specification of features will be developed throughout the course of 1981. Updates to XENIX will result in systems upwardly compatible from its first release.

The adaptation of Microsoft's full line of system software products to XENIX will further strengthen XENIX's role as a software standard. These products, including the BASIC interpreter and compiler, COBOL, FORTRAN, and Pascal, have already established themselves as standards within the 8-bit market; they are also compatible with corresponding ANSI (American National Standards Institute) standards. Standard high-level languages will allow the rapid introduction of existing application software into the XENIX environment.

The XENIX system will offer an ever-expanding variety of software, including data-base management, financial planning, communication, and networking packages. Microsoft is establishing a clearinghouse, wherein quality software running under XENIX may receive widespread distribution, thereby reducing duplication of effort. The combination of the UNIX operating system's strengths and Microsoft's awareness of the needs of the commercial marketplace promises to make XENIX a very powerful defense against the looming software crisis. By establishing a universal operating environment, complete with software tools to increase productivity, flexible design to widen applicability, and multiple microprocessor support to improve availability, Microsoft hopes that XENIX will become the preferred choice for software production and exchange.■

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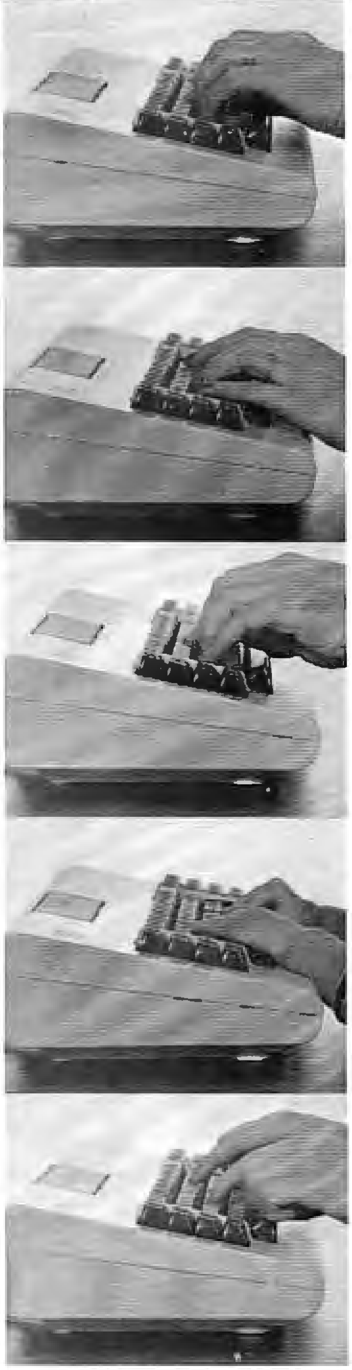
OSM's MUSE operating system—the Multi User System Executive—is **many times faster than other leading operating systems.** Each user owns a resident copy of MUSE so you don't wait for the bus or interrupt the master processor to do console I/O and applications code. MUSE finds files fast with a random directory access similar to random file access. And MUSE protects shared files from simultaneous update to the same record by different users. We designed MUSE from the start for multi-user data base environments—yet MUSE is **CP/M* compatible!**



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## Check the hardware!

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- MUSE supports standard CP/M* word processors, utilities, and languages: MBASIC, CBASIC, PASCAL, FORTRAN, COBOL, FORTH, C, PL/1, etc.

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-Peripherals.
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-An overview of the major computer languages--Assembler, FORTRAN, COBOL, PASCAL PL/1, APL, ADA, C, FORTH, LISP and more.
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-Specialized software--Data base/data management systems, etc.
D. Computer Configurations
Putting computers, terminals, etc., together in more complicated ways to improve efficiency.
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-Data communications
-Distributed processing.
E. A look at the People Side of Data Processing
What are all those people *really* doing? Functions of various types of computer personnel: programmers, systems analyst, data entry personnel, operators, etc.
F. An Overview of Computer Applications
An introduction to some of the things computers are being used for.

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The instructor for the course is Barbara Schwartz. The course lecture and workbook is all original material created by her. She is a consultant to major corporations and small businesses and is a writer on computer and data processing topics. She has taught courses for companies and schools in simple clear English.

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| All About Printers for Business | 12 |
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| The Computer as a Scientific research Tool | 12 & 14 |
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| Interfacing to the Real World | 13 & 15 |
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| Introduction to COBOL for Microcomputers | 13 & 15 |
| Using a Microcomputer for Technical Analysis of Stocks & Commodities | 13 & 14 |
| Survey of Computer-Assisted Instruction | 13 & 15 |
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| Microcomputers and Medicine | 14 |
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| 5 ☐ Consultant | 13 ☐ Lawyer | 21 ☐ Teacher |
| 6 ☐ Corporate Officer | 14 ☐ Office Manager | 22 ☐ Technician |
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# The Ins and Outs of CP/M

James Larson
3422 Union St
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CP/M (Control Program for Microprocessors) is the most commonly used 8080/8085/Z80 operating system. CP/M is easy to use and the Digital Research documentation is reasonably thorough and clear, especially by microprocessor-software standards. However, the documentation is lacking in one area: the explanation of I/O (input/output) and disk interfacing. This article will clarify and expand upon the documentation. A summary of the I/O and disk-interface routines, calling sequences, use of return codes, and typical subroutines using these will be presented. The use of file-control blocks (FCBs) and I/O buffers will also be explained. Finally, some details of the CP/M I/O functions and their workings will be presented.

## Calling CP/M Routines

The procedure for calling CP/M routines is straightforward. I/O procedures are defined as a series of functions. Each function is assigned a unique *function number*. The function number is placed in the microprocessor's C register; the data required (*entry parameter* in CP/M parlance) is placed in the E register if only 1 byte is to be sent, or in the DE register pair if a word (2 bytes) is required. Some functions have no entry parameters. Results (called *returned values*) are either returned as a byte in the A register or as a filled buffer (whose address is usually sent as an entry parameter). Table 1 summarizes the basic I/O functions and calling sequences. Once the registers are properly loaded, a call to the CP/M entry point at hexadecimal memory location 0005 is made. It is important to know that CP/M does not preserve the contents of these registers, so any routine calling CP/M routines must protect any registers to be preserved. A typical subroutine to call a CP/M-utility routine is shown in listing 1. Refer to the examples for specific applications of this sequence. The function numbers and their purpose, entry parameters, and returned-value codes are summarized in table 1 and table 2.

## I/O Routines

Listing 2 presents several useful subroutines that make calls to CP/M I/O routines. Calls to the punch device and reader device assume that these drivers exist in your version of CP/M, though they may or may not actually be driving a physical paper-tape reader/punch. As explained in the *CP/M Features and Facilities Guide*, logical devices may or may not correspond to actual physical devices. Writing and installing these drivers for CP/M is beyond the scope of this article.

Listing 3 shows the use of buffers for CP/M I/O. The address of the buffer is placed in the DE register pair and the call to the CP/M entry point is made. The contents of the print buffer are printed on the console until a dollar sign is encountered. The print buffer is not destroyed in this process. A typical print buffer is configured as:

c1  c2  c3  c4  ....  *ck* $

where *k* is the number of valid characters and $ signifies the end of the buffer. The read buffer is configured as:

*m*  *k*  c1  c2  c3  c4  ....  *ck*

where *m* is the maximum number of characters allowed in the buffer, and *k* is the number of characters actually in the buffer. CP/M places characters in the buffer until a carriage return is encountered or the maximum buffer length is reached. The maximum length, *m*, may be from 1 to 256, and is defined by the user program. The value of *k*, the number of valid characters, is initially set to 0. It is set by CP/M to reflect the number of

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characters read into the buffer from the console. The CP/M line-editing features (control R, control C, etc) may be used with this routine. Other control characters will be echoed with a leading ^ (called a circumflex), and will be inserted into the buffer. Any parity bits will be stripped by CP/M (this also applies to the single-character read functions in listing 2).

The final aspect of CP/M I/O that requires clarifying is the I/O status byte. This is a single byte at hexadecimal memory location 0003. It was apparently included in CP/M for compatibility with Intel software and must be specifically implemented by the user in BIOS (Basic I/O System). The I/O status byte, poorly described in the *Interface Guide*, is described much better in the *System Alteration Guide*, Section 6. By varying the value of this location, the user may reassign logical I/O devices without rewriting the system software.

## CP/M Disk-Interface Routines

The use of the disk-interface routines provided by CP/M is more involved. But it is not too difficult once the basic concepts are grasped.

*Text continued on page 274*

| Function Number | Function Description | Entry Parameters (placed in DE) | Returned Value (Returned in A or AB (A = LSB)) | Typical Call ** | | |
|---|---|---|---|---|---|---|
| 1 | Read a character from the console. | None | ASCII character | MVI<br>CALL | C,1<br>NTRY | ;READ FUNCTION<br>;CP/M ENTRY POINT |
| 2 | Write a character to the console. | ASCII character | None | MVI<br>MVI<br>CALL | E,CHAR<br>C,WRITE<br>NTRY | ;CHARACTER IN E<br>;WRITE FUNCTION = 2 |
| 3 | Read a character from the reader device. | None | ASCII character | MVI<br>CALL | C,RDR<br>NTRY | ;READER FUNCTION = 3 |
| 4 | Write a character to the punch device. | ASCII character | None | MVI<br>MVI<br>CALL | E,CHAR<br>C,PNCH<br>NTRY | ;CHARACTER IN E<br>;PUNCH FUNCTION = 4 |
| 5 | Write a character to the list device (usually a printer). | ASCII character | None | MVI<br>MVI<br>CALL | E,CHAR<br>C,PRNT<br>NTRY | ;WRITE TO PRINTER = 5 |
| 7 | Get I/O status.* | None | I/O status byte | | | |
| 8 | Set I/O status.* | I/O status byte | None | | | |
| 9 | Output print buffer to console. | Address of a print buffer | None | LXI<br>MVI<br>CALL | D,PBUF<br>C,BUFO<br>NTRY | ;ADDRESS OF BUFFER<br>;OUTPUT BUFFER = 9 |
| 10 | Input a character string from the console. | Address of a read buffer | The read buffer is filled to its maximum length or until a <CR> is typed. | LXI<br>MVI<br>CALL | D,RBUF<br>C,BUFI<br>NTRY | ;ADDRESS OF BUFFER<br>;INPUT BUFFER = 10 |
| 11 | Interrogate console for a character ready. | None | 01 if a character is ready | MVI<br>CALL | C,ASK<br>NTRY | ;INTERROGATE = 11 |

*If implemented
**See listings 1, 2, and 3 for subroutines and program usage. NTRY is the CP/M entry point (0005).

**Table 1:** *Summary of the basic I/O functions available on a standard CP/M system.*

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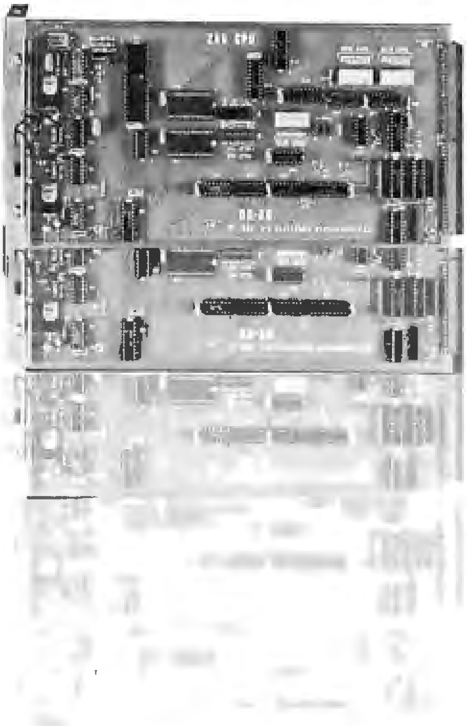

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| Function Number | Function Description | Entry Parameters and Comments (placed in DE) | Returned Value and Comments. (Returned in A or AB (A = LSB)) | Typical Call* | | |
|---|---|---|---|---|---|---|
| 12 | Lift head. | None | None—head is lifted from currently logged disk. | MVI<br>CALL | C,12<br>NTRY | ;LIFT FUNCTION<br>;CP/M ENTRY POINT |
| 13 | Initialize CP/M disk access. | None | None—disk drive A is "logged in" for access. The DMA address is set to 0080H. | MVI<br>CALL | C,13<br>NTRY | ;INITIALIZE |
| 14 | Select and log in disk. | Value corresponding to the desired disk: A = 0, B = 1, etc | None—specified disk is selected for subsequent file operations. | MVI<br>MVI<br>CALL | E,DISKNO<br>C,SELDSK<br>NTRY | ;DISK # IN E<br>;SELECT = 14 |
| 15 | Open file. | Address of FCB for the file to be opened | Byte address of the FCB in the disk directory, or 255H if file is not found—the disk map (DM) bytes in the FCB are filled by CP/M. | LXI<br>MVI<br>CALL | D,FCB<br>C,OPEN<br>NTRY | ;ADDRESS IN DE<br>;OPEN = 15 |
| 16 | Close file. | Address of FCB for the file to be closed | Byte address of the FCB in the disk directory, or 255 if not found—the disk map of the FCB is written to the directory, replacing any existing data for that file. | LXI<br>MVI<br>CALL | D,FCB<br>C,CLOSE<br>NTRY | <br>;CLOSE = 16 |
| 17 | Search for file. | Address of FCB containing name and type of file to search for. "?" matches any character. | Byte address of first FCB in directory that matches the name and type in the input FCB. If no match, 255H is returned. | LXI<br>MVI<br>CALL | D,FCB<br>C,SEARCH<br>NTRY | <br>;SEARCH = 17 |
| 18 | Search for next occurrence. | Address of FCB as in 17, but called after 17 before any other disk access | Byte address of next match. 255H if no additional match. | LXI<br>MVI<br>CALL | D,FCB<br>C,SEARN<br>NTRY | <br>;SEARN = 18 |
| 19 | Delete file. | Address of FCB of file to be deleted | None—FCB in directory is marked as deleted. (E5H is placed in ET field.) | LXI<br>MVI<br>CALL | D,FCB<br>C,DEL<br>NTRY | <br>;DEL = 19 |
| 20 | Read record. | Address of FCB containing a disk map. Normally as a result of opening the file (15) and setting NR to the record to be read. | 0 = successful read<br>1 = read past logical end of file (^Z)<br>2 = reading unwritten data<br>Data read is placed in memory at the DMA address (function 26). | LXI<br>MVI<br>CALL<br>JNZ | D,FCB<br>C,READ<br>NTRY<br>ERROR | <br>;READ = 20<br><br>;HANDLE READ ERROR |
| 21 | Write record. | Same as read, but NR is set to the record to be written | 0 = successful write<br>1 = error in extending file<br>2 = end of disk data<br>255H = no more directory space—Data written is taken from memory starting at the DMA address. | LXI<br>MVI<br>CALL<br>JNZ | D,FCB<br>C,WRITE<br>NTRY<br>ERROR | <br>;WRITE = 21<br><br>;HANDLE WRITE ERROR |
| 22 | Create file. | Address of FCB of new file, all data set to 0 except name and type | Byte address of directory entry of new file or 255H if directory is full. | LXI<br>MVI<br>CALL<br>JM | D,FCB<br>C,CREATE<br>NTRY<br>NOROOM | <br>;CREATE = 22<br><br>;HANDLE FULL<br>; DIRECTORY |
| 23 | Rename file. | Address of FCB with old file name and type in first 16 bytes and the new file name in the next 16 bytes | Directory address of old file, or 255H if not found. The file name and type are changed to that specified. | LXI<br>MVI<br>CALL<br>JM | D,FCB<br>C,RENAM<br>NTRY<br>NOFILE | <br>;RENAM = 23<br><br>;HANDLE NOT FOUND |
| 24 | Interrogate disk log-in. | None | Byte with 1 bit set for each disk logged in. LSB = disk A, etc. | | | |
| 25 | Interrogate drive number. | None | Number of disk to be used for next access. | | | |
| 26 | Set DMA address. | Address of 128-byte buffer | None—subsequent reads and writes take data to/from memory beginning at this address. | LXI<br>MVI<br>CALL | D,BUFF<br>C,26<br>NTRY | ;BUFFER ADDRESS<br>;DMA SET FUNCTION |
| 27 | Interrogate allocation. | None | Address of the current disk-allocation data. (Used by STAT—not well documented.) | | | |

*See listing 3 for subroutines and program usage.

**Table 2:** *Summary of disk-access operations and disk-utility functions available on a standard CP/M operating system.*

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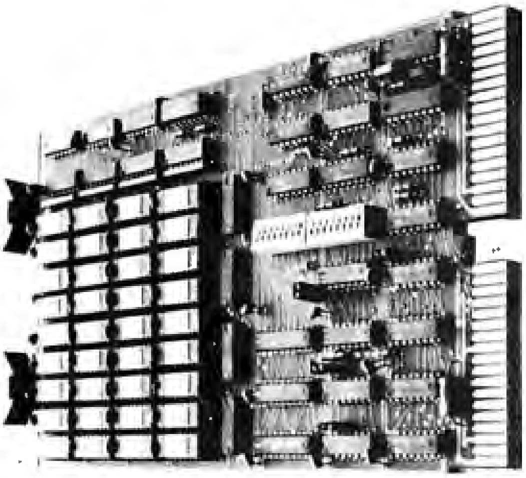

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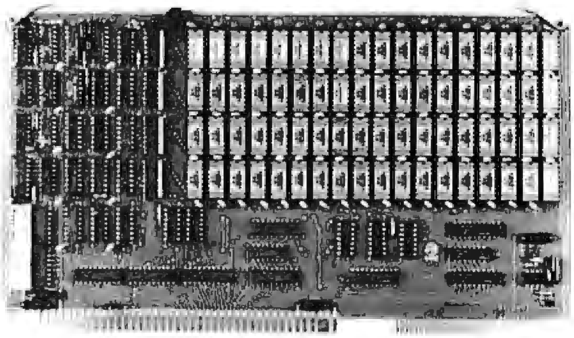

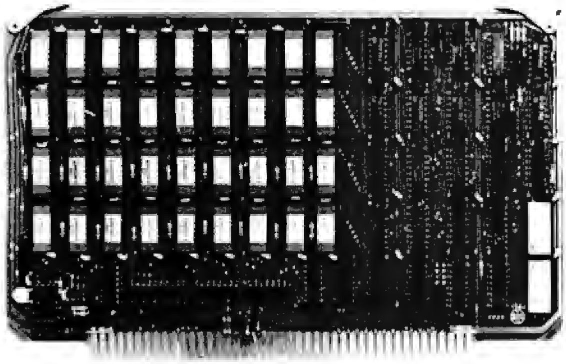

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*Text continued from page 270:*
Proper use of these routines provides powerful capabilities for file manipulation, creation, and alteration. Tasks such as reading an application program into the proper region of memory, sending instructions with a file name, or detecting which disk drive a given file resides on (if any) are readily handled by CP/M. Let us see how these tasks may be accomplished.

Before a file can be manipulated by CP/M, its name must be made known to the system. This is done via the file-control block (FCB). A file-control block contains six types of information defined with 33 contiguous bytes in memory (0 to 32):

- Entry type (ET, byte 0)—assumed 0 by CP/M. CP/M places hexadecimal E5 here to signify a deleted file.
- File name (FN, bytes 1 to 8)—ASCII characters padded with ASCII blanks.
- File type (FT, bytes 9 to 11)—ASCII characters padded with ASCII blanks.
- File extent (EX, byte 12)—in 128-record segments. If file is longer than 128 records, this byte must be incremented to access the additional records. Normally, this will be initialized to 0.
- Initialize to 0 (bytes 13 to 14) —these bits may be used by some systems (such as Micropolis), but should not be tampered with.
- Record count (RC, byte 15)—current file size in 128-byte records. Initialized to 0—correct value will be supplied by executing the OPEN statement.
- Disk allocation map (DM, bytes 16 to 31)—this map is used by CP/M to access the desired file. It is written into memory by the OPEN command, updated during access, and written back to the directory by the CLOSE command. It is not necessary to initialize this area if OPEN is used.
- Next record (NR, byte 32)—this is the number of the next record to access in the currently open extent. Normally, this will be initialized to 0 unless random access is desired or a file is to have something appended to it.

**Listing 1:** *Structure of a typical function-calling routine. The CP/M operating system does not preserve the registers.*

```
IOSBR:  PUSH REGISTERS      ;PRESERVE REGISTERS. DO NOT PUSH REGISTERS
                             IN WHICH VALUES WILL BE RETURNED.
        MVI C,FUNCTION#     ;FUNCTION # MUST BE IN REGISTER C BEFORE
                             CALLING NTRY.
        MOV E,A             ;IF A CHARACTER IS TO BE OUTPUT, IT IS OFTEN
                             CONVENIENT TO SEND IT IN THE A REGISTER
                             (ACCUMULATOR). IT MUST BE MOVED TO E
                             BEFORE CALLING NTRY.
        CALL NTRY           ;CP/M ENTRY POINT, NTRY, MUST BE PREVIOUSLY
                             DEFINED AS 0005H.
        POP REGISTERS       ;RESTORE REGISTERS—BE SURE TO USE AS MANY
                             POPS AS YOU DID PUSHES.
        RET                 ;RETURN TO CALLING ROUTINE
```

File-control blocks are written to the directory by each CLOSE command; they are read by each OPEN command. They maintain the disk-file allocation map, size (in 128-byte records), and extent (in 128-record segments). A separate FCB is maintained in the directory for each extent of the same file (each extent contains 128 128-byte records). That is, a file of 158 records will have an entry with extent=0 and record count=128 and another entry with extent=1 and record count=30, both having the same file name and file type.

The system maintains a default FCB at hexadecimal location 005C and a default buffer at hexadecimal location 0080. These are used by CP/M to pass information to a user program. This is best explained by considering what happens when the program given in listing 4 is run. After it has been assembled and loaded, it is run by typing its name, as is any compiled program running under CP/M. However, in addition to its name, the name of the file to be processed and the desired options must be entered. For this example program, the file to be processed must have a file type .DEM . This file is read into memory beginning at the first free memory location after the end of the program. The options

*Text continued on page 282*

**Listing 2:** *Examples of some simple I/O routines that utilize the CP/M I/O functions.*

```
;*************************************************************************
;
;        SUBROUTINE RCHAR—READS A SINGLE CHARACTER FROM THE
;            CONSOLE. PLACES THE CHARACTER READ INTO THE
;            ACCUMULATOR (A REGISTER).
;
;*************************************************************************
;
RFUNC    EQU    1           ;READ CONSOLE FUNCTION NUMBER
                            ;REFER TO TABLE I OF INTERFACE
                            ;GUIDE.
NTRY     EQU    0005H       ;CP/M NTRY POINT
RCHAR:   PUSH   H           ;PRESERVE REGISTERS
         PUSH   D
         PUSH   B
         MVI    C,RFUNC     ;PLACE CODE FOR READ FUNCTION
                            ;IN C REGISTER
         CALL   NTRY        ;READ A CHARACTER
         MOV    A,E         ;MOVE CHARACTER JUST READ INTO
                            ;A REGISTER.
         POP    B           ;RESTORE REGISTERS
         POP    D
         POP    H
         RET

;*************************************************************************
;
;        SUBROUTINE WCHAR—WRITES A SINGLE CHARACTER TO THE
;            CONSOLE. ASSUMES THAT THE CHARACTER TO BE
;            WRITTEN IS IN THE A REGISTER.
;
;*************************************************************************
;
WFUNC    EQU    2           ;CP/M FUNCTION NUMBER
WCHAR:   PUSH   H           ;PRESERVE ALL REGISTERS
         PUSH   D
         PUSH   B
         PUSH   PSW
         MOV    E,A         ;PLACE CHARACTER IN THE E
                            ;REGISTER BEFORE CALLING NTRY
         MVI    C,WFUNC     ;PLACE FUNCTION NUMBER IN C
         CALL   NTRY        ;WRITE HIM
         POP    PSW         ;RESTORE REGISTERS
         POP    B
         POP    D
         POP    H
         RET

;*************************************************************************
;
;        SUBROUTINE CLEAR—CLEARS THE SCREEN OF A SOROC IQ-120
;            TERMINAL. USES SUBROUTINE WCHAR TO SEND THE
;            CHARACTERS TO THE TERMINAL.
;
;*************************************************************************
;
HOME     EQU    42          ;HOMES CURSOR AND CLEARS SCREEN
CLEAR:   PUSH   PSW         ;PROTECT STATUS FROM CALLING ROUTINE
         MVI    A,27        ;SEND ESCAPE CODE
         CALL   WCHAR       ;WRITE HIM
         MVI    A,HOME      ;CLEAR SCREEN AND HOME CURSOR
         CALL   WCHAR       ;WRITE AGAIN
         POP    PSW         ;RESTORE STATUS
         RET

*************************************************************************
```

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**· FOR THE 8080 ·**

**PRACTICAL MICROCOMPUTER PROGRAMMING: THE INTEL 8080** *by Weller, Shatzel and Nice* *$23.95*

*18 chapters, 3 appendices, 318 page Smythe sewn hardcover which applies fundamental assembly language technique to this most popular of processors. The text is supported by 84 separate programming examples. The book includes a special section on the handling of complex peripheral devices and exotic typefaces. Appendices give the source for an 8080 resident debugging monitor and a minicomputer cross assembler for the 8080. Also available (not shown above) are a workbook for use with this text ($9.95) and* **AN EDITOR/ASSEMBLER SYSTEM FOR 8080/8085 BASED COMPUTERS** *($15.95) which supports the language used in the text. These three books together make a complete teaching package for the 8080.*

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**Listing 3:** *Program to prompt for input, clear the screen, and echo the characters entered using the techniques discussed in this article. Except for the clear-screen codes, this routine works on any CP/M system.*

```
                    ;*************************************************************
                    ;
                    ;     CP/M I/O UTILITIES PROGRAM
                    ;     WRITTEN BY JAMES K. LARSON
                    ;
                    ;*************************************************************
                    ;
0100                        ORG      0100H
0100 C37302                 JMP      BEGIN    ;SKIP TO START OF MAIN ROUTINE
                    ;*************************************************************
                    ;
                    ;     EQUATES AND DATA STORAGE AREA
                    ;
                    ;*************************************************************
                    ;
0005 =              NTRY    EQU      0005H    ;CPM ENTRY POINT
0009 =              PSTR    EQU      9        ;PRINT BUFFER FUNCTION
000A =              GSTR    EQU      10       ;READ BUFFER FUNCTION
0002 =              WFUNC   EQU      2        ;WRITE CONSOLE FUNCTION
002A =              HOME    EQU      42       ;HOME CURSOR AND CLEAR
000D =              CR      EQU      13       ;CARRIAGE RETURN
000A =              LF      EQU      10       ;LINE FEED
0020 =              LEN     EQU      32       ;DESIRED OUTPUT LINE LENGTH
0103                OLDSTK: DS       2        ;OLD STACK POINTER
0105                STR:    DS       257      ;INPUT STRING BUFFER
0206 454E544552PROMPT: DW       'EN','TE','R$'
020C 594F552057LEADER: DW       'YO','U ','WR','OT','E$'
                    ;*************************************************************
                    ;
                    ;    SUBROUTINE PRINT -- PRINTS A STRING ENDING IN $
                    ;        PLACE STRING BUFFER STARTING ADDRESS IN DE REGISTER
                    ;        PRESERVES REGISTER CONTENTS
                    ;
                    ;*************************************************************
                    ;
0216 E5             PRINT:  PUSH     H        ;PRESERVE REGISTERS
0217 D5                     PUSH     D
0218 C5                     PUSH     B
0219 F5                     PUSH     PSW
021A 0E09                   MVI      C,PSTR   ;PRINT FUNCTION IN C REG
021C CD0500                 CALL     NTRY     ;DO IT
021F F1                     POP      PSW      ;RESTORE REGISTERS
0220 C1                     POP      B
0221 D1                     POP      D
0222 E1                     POP      H
0223 C9                     RET
                    ;*************************************************************
                    ;
                    ;     SUBROUTINE GETBUF -- GETS A BUFFER FULL FROM CONSOLE
                    ;         PLACE INPUT BUFFER ADDRESS IN HL REGISTER - BUFFER
                    ;        SHALL HAVE THE FIRST BYTE SET TO THE MAXIMUM BUFFER
                    ;        LENGTH, THE NUMBER OF CHARACTERS PUT INTO BUFFER WILL
                    ;        BE RETURNED AS THE SECOND BYTE OF THE BUFFER.
                    ;
                    ;*************************************************************
                    ;
0224 E5             GETBUF: PUSH     H        ;PRESERVE REGISTERS
0225 D5                     PUSH     D
0226 C5                     PUSH     B
0227 F5                     PUSH     PSW
0228 EB                     XCHG              ;PLACE ADDRESS IN DE FOR CALL TO CPM
0229 0E0A                   MVI      C,GSTR   ;READ BUFFER FUNCTION
022B CD0500                 CALL     NTRY     ;GET UM
022E F1                     POP      PSW      ;RESTORE
022F C1                     POP      B
0230 D1                     POP      D
0231 E1                     POP      H
```

*Listing 3 continued on page 280*

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Circle 370 on inquiry card.

*Listing 3 continued:*

```
0232 C9                 RET
              ;*****************************************************************
              ;
              ;     SUBROUTINES WCHAR AND CLEAR FROM EXAMPLE 1 INSERTED HERE
              ;
              ;*****************************************************************
              ;
              ;*****************************************************************
              ;
              ;     SUBROUTINE WCHAR -- WRITES A SINGLE CHARACTER
              ;       CHARACTER IN A REGISTER - PRESERVES ALL REGISTERS
              ;
              ;*****************************************************************
              ;
0233 E5       WCHAR:  PUSH    H         ;PRESERVE REGISTERS
0234 D5               PUSH    D
0235 C5               PUSH    B
0236 F5               PUSH    PSW
0237 5F               MOV     E,A       ;PUT CHAR IN E REGISTER
0238 0E02             MVI     C,WFUNC   ;WRITE CHARACTER FUNCTION
023A CD0500           CALL    NTRY      ;PRINT HIM
023D F1               POP     PSW
023E C1               POP     B
023F D1               POP     D
0240 E1               POP     H
0241 C9               RET
              ;****************************************************************
              ;
              ;     SUBROUTINE CLEAR -- CLEARS SCREEN AND HOMES CURSOR ON
              ;        A SOROC IQ-120 TERMINAL - PRESERVES REGISTERS
              ;
              ;****************************************************************
              ;
0242 F5       CLEAR:  PUSH    PSW       ;PROTECT STATUS
0243 3E1B             MVI     A,27      ;SEND ESCAPE CODE
0245 CD3302           CALL    WCHAR
0248 3E2A             MVI     A,HOME    ;CLEAR SCREEN AND HOME CURSOR
024A CD3302           CALL    WCHAR
024D F1               POP     PSW
024E C9               RET
              ;****************************************************************
              ;
              ;     SUBROUTINE CRLF -- SENDS CRLF TO CONSOLE - PRESERVES REGISTERS
              ;
              ;*****************************************************************
              ;
024F F5       CRLF:   PUSH    PSW
0250 3E0D             MVI     A,CR
0252 CD3302           CALL    WCHAR
0255 3E0A             MVI     A,LF
0257 CD3302           CALL    WCHAR
025A F1               POP     PSW
025B C9               RET
              ;*******************************************************************
              ;
              ;     SUBROUTINE SAVSTK -- SAVES THE OLD STACK POINTER AND SETS
              ;       A NEW STACK AT CBASE (BASE OF CONSOLE COMMAND PROCESSOR).
              ;       CBASE IS 800H BELOW FBASE (BASE OF THE DISK OPERATING SYSTEM)
              ;       FBASE MAY BE READ AT NTRY+1.
              ;
              ;*******************************************************************
              ;
025C C1       SAVSTK: POP     B         ;GET RETURN ADDRESS
025D 210000           LXI     H,00      ;CLEAR HL
0260 39               DAD     SP        ;GET STACK POINTER
0261 220301           SHLD    OLDSTK    ;SAVE HIM
0264 2A0600           LHLD    NTRY+1    ;GET FBASE
0267 7C               MOV     A,H
0268 D608             SUI     08H       ;SUBTRACT CBASE OFFSET
```

*Listing 3 continued on page 282*

*Listing 3 continued:*

```
026A 67                 MOV     H,A
026B F9                 SPHL            ;SET NEW STACK POINTER
026C C5                 PUSH    B       ;SET RETURN ADDRESS
026D C9                 RET
           ;*********************************************************************
           ;
           ;    SUBROUTINE GETSTK -- GETS OLD STACK POINTER AND RETURNS TO CPM
           ;
           ;*********************************************************************
           ;
026E 2A0301 GETSTK: LHLD    OLDSTK  ;GET OLD STACK POINTER
0271 F9                 SPHL            ;PLUG IT IN
0272 C9                 RET             ;THIS WILL RETURN TO CPM
           ;*********************************************************************
           ;
           ;     MAIN PROGRAM -- PROMPTS FOR INPUT, CLEARS SCREEN AND ECHOS
           ;         THE INPUT STRING IN 32 CHARACTER LINES
           ;
           ;*********************************************************************
           ;
0273 CD5C02 BEGIN:  CALL    SAVSTK  ;SAVE OLD STACK POINTER
0276 110602         LXI     D,PROMPT
0279 CD1602         CALL    PRINT   ;PRINT PROMPT
027C CD4F02         CALL    CRLF
027F 3EFF           MVI     A,255
0281 320501         STA     STR     ;SET MAX BUFFER LENGTH
0284 3E00           MVI     A,00
0286 320601         STA     STR+1   ;ZERO CHARACTER COUNTER
0289 210501         LXI     H,STR
028C CD2402         CALL    GETBUF  ;GET A BUFFER FULL
028F CD4202         CALL    CLEAR   ;CLEAR SCREEN
0292 110C02         LXI     D,LEADER
0295 CD1602         CALL    PRINT   ;PRINT LEADER
0298 CD4F02         CALL    CRLF
029B 23             INX     H       ;ADDRESS STR+1
029C 46             MOV     B,M     ;NUMBER OF CHARACTERS READ IN
029D 3E20   PLIN:   MVI     A,LEN   ;LINE LENGTH
029F B8             CMP     B
02A0 D2B402         JNC     ELIN    ;PRINT LAST LINE
02A3 4F             MOV     C,A     ;PLACE LEN IN COUNTER
02A4 23     LINE:   INX     H       ;NEXT CHARACTER
02A5 7E             MOV     A,M     ;GET HIM
02A6 CD3302         CALL    WCHAR   ;WRITE HIM
02A9 05             DCR     B
02AA 0D             DCR     C
02AB C2A402         JNZ     LINE    ;KEEP PRINTING TILL DONE
02AE CD4F02         CALL    CRLF
02B1 C39D02         JMP     PLIN    ;NEXT LINE
02B4 23     ELIN:   INX     H
02B5 7E             MOV     A,M     ;GET CHARACTER
02B6 CD3302         CALL    WCHAR
02B9 05             DCR     B
02BA C2B402         JNZ     ELIN    ;PRINT TILL DONE
02BD CD4F02         CALL    CRLF
02C0 CD6E02         CALL    GETSTK  ;RETURN TO CPM
02C3                END     100H
```

*Text continued from page 274:*
available are P, which prints the file on the system printer, and D, which creates a copy of the input file having type .RES . The input file may reside on drive A or B, but it is assumed to be on A unless otherwise specified. If option D is selected, the output file will be on the same drive as the input file.

Now, let us discuss the use of the default FCB and buffer. When the command DSKUTIL TEST.PD is entered in response to the CP/M prompt, the system places TEST in bytes 1 thru 4 of the FCB beginning at location 005C. PD is placed in bytes 9 and 10. The string (as typed) is also placed in the default buffer at location 0080 in the following manner: byte 0 (that is, hexadecimal location 0080) contains the number of valid characters typed on the command line after the actual command and before a carriage return, in decimal. In this case, *b*TEST.PD (*b* represents a space—decimal ASCII 32) was typed—8 characters before a carriage return. Byte 0 of the buffer therefore

*Text continued on page 300*

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But the soul of any computer system is the software; therefore, having perfected the hardware techonology, Delta is now dedicated to the development of application packages designed to warm the cockles of a corporate executive's heart. Our "Uni-form", for example, will keep purchase orders, account statements, sales and shipping orders indexed, cross-indexed and filed in any manner required.

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You have spent five minutes reading this advertisement, at a cost of $62.40 in potential sales. Have you calculated what a Delta system can save your company? (Hint: a Delta system can pay for itself in less than 24 hours of time saved.)

Call us today for the name of your nearest Delta distributor.

*(and save thousands later)

**Listing 4:** *Program using the discussed techniques to allow a user to either copy a specified file into another file or transmit its contents to the printer.*

```
                  ;************************************************************
                  ;
                  ;        CP/M DISK UTILITIES PROGRAM
                  ;        WRITTEN BY JAMES K. LARSON
                  ;
                  ;*************************************************************
                  ;
0100                      ORG     0100H
0100 C38902               JMP     BEGIN    ;SKIP TO START OF MAIN PROGRAM
                  ;************************************************************
                  ;
                  ;        EQUATES AND DATA STORAGE AREA
                  ;
                  ;************************************************************
                  ;
0005 =            NTRY    EQU     0005H    ;CPM ENTRY POINT
0002 =            WFUNC   EQU     2        ;WRITE TO CONSOLE FUNCTION
0005 =            PFUNC   EQU     5        ;LINEPRINTER FUNCTION
0009 =            PSTR    EQU     9        ;PRINT BUFFER FUNCTION
000E =            LOGF    EQU     14       ;LOGIN AND SELECT DISK
000F =            OPENF   EQU     15       ;OPEN DISK FILE
0010 =            CLOSEF  EQU     16       ;CLOSE DISK FI E
0013 =            REMVF   EQU     19       ;DELETE A DISK FILE
0014 =            READF   EQU     20       ;READ A DISK RECORD
0015 =            WRITEF  EQU     21       ;WRITE A DISK RECORD
0016 =            MAKEF   EQU     22       ;CREATE A DISK FILE
001A =            SETF    EQU     26       ;SET DMA ADDRESS FOR NEXT READ/WRITE
0080 =            TBUFF   EQU     0080H    ;DEFAULT TEXT BUFFER
005C =            TFCB    EQU     005CH    ;DEFAULT FILE CONTROL BLOCK
0080 =            RECLEN  EQU     128      ;LENGTH OF ONE DISK RECORD
000D =            CR      EQU     13       ;CARRIAGE RETURN
000A =            LF      EQU     10       ;LI NE FEED
002A =            HOME    EQU     42       ;HOME CURSOR AND CLEAR SCREEN
0103 4445         DEM:    DW      'DE'
0105 4D00000000           DB      'M',0,0,0,0
010A 5245         RES:    DW      'RE'
010C 5300000000           DB      'S',0,0,0,0
0111 5052494E54DNMSG:     DW      'PR','IN','TI','NG',' C','OM','PL','ET','E$'
0123 50524F4345DNPRC:     DW      'PR','OC','ES','SI','NG',' C','OM','PL','ET','E$'
0137 434F4D4D41ERRMSG:    DW      'CO','MM','AN','D ','OR',' F','IL','E ','ER','RO','R$'
014D 4F50454E20OPERR:     DW      'OP','EN',' E','RR','OR','$ '
0159 5752495445WERR:      DW      'WR','IT','E ','ER','RO','R$'
0165              RCRDS:  DS      1        ;STORAGE FOR NUMBER OF RECORDS READ
0166              OLDSTK: DS      2        ;STORAGE FOR ORIGINAL STACK ADDRESS
0168 00           FLAG:   DB      00       ;INITIALIZE FLAG BITS STORAGE
0169              TFCB1:  DS      33       ;SECOND FILE CONTROL BLOCK
                  ;*************************************************************
                  ;     SUBROUTINE PRINT -- PRINTS A STRING ENDING IN $
                  ;        PLACE STRING BUFFER STARTING ADDRESS IN DE REGISTER
                  ;        PRESERVES REGISTER CONTENTS
                  ;
                  ;****************************************************************
                  ;
018A E5           PRINT:  PUSH    H        ;PRESERVE REGISTERS
018B D5                   PUSH    D
018C C5                   PUSH    B
018D F5                   PUSH    PSW
018E 0E09                 MVI     C,PSTR   ;FUNCTION IN C REGISTER
0190 CD0500               CALL    NTRY     ;DO IT
0193 F1                   POP     PSW      ;RESTORE REGISTERS
0194 C1                   POP     B
0195 D1                   POP     D
0196 E1                   POP     H
017 C9                   RET
                  ;****************************************************************
                  ;
                  ;     SUBROUTINE WCHAR -- WRITES A SINGLE CHARACTER TO THE CONSOLE
                  ;        CHARACTER IN THE A REGISTER - PRESERVES REGISTERS
```

*Listing 4 continued on page 286*

# dBASE™ II vs. the Bilge Pumps.

*by Hal Pawluk*

We all know that bilge pumps suck.

And by now, we've found out—the hard way—that a lot of software seems to work the same way.

So I got pretty excited when I ran across **dBASE II**, an assembly-language relational Database Management System for CP/M. It works! And even a rank beginner like myself got it up and running the first time I sat down with it.

If you're looking for software to deal with your data, too, here are some tips that will help:


## Tip #1: Database Management vs. File Handling:

Any list or collection of data is, loosely, a data base, but most of those "data base management" articles in the buzzbooks are really about file handling programs for specific applications. A real Database Management System gives you data and program independence (no reprogramming when data changes), eliminates data duplication and makes it easy to turn data into information.

## Tip #2: Assembly Language vs. BASIC:

This one's easy: if you're setting up a DBMS, you're going to be doing a lot of sorting, and Basic sorts are s-l-o-w. Run a benchmark on a Basic system like S*-IV against a relational DBMS like **dBASE II** and you'll see what I mean. (But watch it: I've also seen one extremely slow assembly-language file management system.)

## Tip #3: Relational vs. Hierarchal & Network DBMS.

CODASYL-like hierarchal and network systems, around since the 1960's, are being phased out on the big machines so why get stuck with an old-fashioned system for your micro? A relational DBMS like **dBASE II** eliminates the predefined sets, pointers and complex data structures of a CODASYL-type DBMS. And you don't need to be a programmer to use it.

## dBASE II vs. everything else.

**dBASE II** really impressed me.

Written in assembly language (with no need for a host language), it handles up to 65,000 records (up to 32 fields and 1000 bytes each), stores numeric data as packed strings so there are no round-off errors, has a super-fast multiple-key sort, and supports ISAM based on B* trees.

You can use it interactively with English-like commands (DISPLAY 10 PRODUCTS), or program it (so when you've set up the formats, your secretary can do the work). Its report generator and user-definable full screen operations mean that you can even use your existing forms.

And if all this makes your mouth water, but you've already got all your data on a disk, that's okay: **dBASE II** reads your ASCII files and adds the data to its own database.

Right now, I'm using **dBASE II** with my word processor for budgeting, scheduling and preparing reports for my clients.

Next come job costing, time billing and accounting.

## An Unheard-of Money-Back Guarantee.

**dBASE II** is the first software I've seen with a full money-back guarantee.

To check it out, just send $700 (plus tax in California) to Ashton-Tate, 3600 Wilshire Blvd., Suite 1510, Los Angeles, CA 90010. (213) 666-4409. Test **dBASE II** doing your jobs on your computer for 30 days. If, for some strange reason, you don't want to keep it, send it back and they'll refund your money.

No questions asked.

They know you don't need your bilge pumped.

Ashton-Tate

*Listing 4 continued:*

```
                   ;
                   ;*****************************************************************
                   ;
0198 E5            WCHAR:  PUSH    H
0199 D5                    PUSH    D
019A C5                    PUSH    B
019B F5                    PUSH    PSW
019C 5F                    MOV     E,A      ;CHARACTER IN E REGISTER
019D 0E02                  MVI     C,WFUNC
019F CD0500                CALL    NTRY
01A2 F1                    POP     PSW
01A3 C1                    POP     B
01A4 D1                    POP     D
01A5 E1                    POP     H
01A6 C9                    RET
                   ;*****************************************************************
                   ;
                   ;     SUBROUTINE PCHAR -- PRINTS A SINGLE CHARACTER ON THE PRINTER
                   ;        CHARACTER IN THE A REGISTER - PRESERVES REGISTERS
                   ;
                   ;*****************************************************************
                   ;
01A7 E5            PCHAR:  PUSH    H
01A8 D5                    PUSH    D
01A9 C5                    PUSH    B
01AA F5                    PUSH    PSW
01AB 5F                    MOV     E,A
01AC 0E05                  MVI     C,PFUNC
01AE CD0500                CALL    NTRY
01B1 F1                    POP     PSW
01B2 C1                    POP     B
01B3 D1                    POP     D
01B4 E1                    POP     H
01B5 C9                    RET
                   ;*****************************************************************
                   ;
                   ;     SUBROUTINE CLEAR -- CLEARS SCREEN AND HOMES CURSOR ON
                   ;        A SOROC IQ-120 TERMINAL -- PRESERVES REGISTERS
                   ;
                   ;*****************************************************************
                   ;
01B6 F5            CLEAR:  PUSH    PSW      ;PROTECT STATUS
01B7 3E1B                  MVI     A,27     ;SEND ESCAPE CODE
01B9 CD9801                CALL    WCHAR
01BC 3E2A                  MVI     A,HOME
01BE CD9801                CALL    WCHAR
01C1 F1                    POP     PSW
01C2 C9                    RET
                   ;*****************************************************************
                   ;
                   ;    SUBROUTINE CRLF -- SENDS CRLF TO CONSOLE
                   ;
                   ;*****************************************************************
                   ;
01C3 F5            CRLF:   PUSH    PSW
01C4 3E0D                  MVI     A,CR
01C6 CD9801                CALL    WCHAR
01C9 3E0A                  MVI     A,LF
01CB CD9801                CALL    WCHAR
01CE F1                    POP     PSW
01CF C9                    RET
                   ;*****************************************************************
                   ;
                   ;     SUBROUTINE SAVSTK -- SAVES THE OLD STACK POINTER AND SETS
                   ;        A NEW STACK AT CBASE (BASE OF THE CONSOLE COMMAND PROCESSOR).
                   ;        CBASE IS 800H BELOW FBASE (BASE OF THE DISK OPERATING SYSTEM).
                   ;        FBASE MAY BE READ AT NTRY+1.
                   ;
                   ;*****************************************************************
```

*Listing 4 continued on page 288*

NEW

# ITS MAGIC©


The System/48 is the outstanding office automation computing system for the 80's . . . it's so productive we call it MAGIC©. Look at these features:

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- Report generator
- Query processor
- Screen format generator
- Automatic interface code generator
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Circle 359 on inquiry card.

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(713) 738-2300 TWX. 910-881-3639

*Listing 4 continued:*

```
               ;
01D0 C1        SAVSTK: POP     B          ;GET RETURN ADDRESS
01D1 210000            LXI     H,00       ;CLEAR HL
01D4 39                DAD     SP         ;GET STACK POINTER
01D5 226601            SHLD    OLDSTK     ;SAVE HIM
01D8 2A0600            LHLD    NTRY+1     ;GET FBASE
01DB 7C                MOV     A,H
01DC D608              SUI     08H        ;SUBTRACT CBASE OFFSET
01DE 67                MOV     H,A
01DF F9                SPHL               ;SET NEW STACK POINTER
01E0 C5                PUSH    B          ;SET RETURN ADDRESS
01E1 C9                RET
               ;*******************************************************************
               ;
               ;    SUBROUTINE GETSTK -- GETS OLD STACK POINTER AND RETURNS TO CPM
               ;
               ;*******************************************************************
               ;
01E2 2A6601    GETSTK: LHLD    OLDSTK     ;GET OLD STACK POINTER
01E5 F9                SPHL               ;PLUG HIM IN
01E6 C9                RET                ;THIS WILL RETURN TO CPM
               ;*******************************************************************
               ;
               ;    SUBROUTINE PRT -- PRINTS THE NUMBER OF CHARACTERS IN THE B REG
               ;       ON THE LINE PRINTER. ADDRESS OF FIRST CHARACTER TO PRINT
               ;       IS IN HL.
               ;
               ;*******************************************************************
               ;
01E7 7E        PRT:    MOV     A,M        ;GET CHAR
01E8 CDA701            CALL    PCHAR      ;PRINT HIM
01EB 23                INX     H          ;NEXT, PLEASE
01EC 05                DCR     B          ;DONE?
01ED C2E701            JNZ     PRT        ;NOPE, KEEP PRINTING
01F0 C9                RET                ;DONE, GO HOME
               ;*******************************************************************
               ;
               ;    SUBROUTINE MOVCHR -- MOVES CHARACTERS BEGINNING AT LOCATION
               ;       IN HL TO LOCATION BEGINNING IN DE FOR A COUNT IN REG C.
               ;
               ;*******************************************************************
               ;
01F1 7E        MOVCHR: MOV     A,M
01F2 12                STAX    D
01F3 23                INX     H
01F4 13                INX     D
01F5 0D                DCR     C
01F6 C2F101            JNZ     MOVCHR     ;GO TILL DONE
01F9 C9                RET
               ;*******************************************************************
               ;
               ;    SUBROUTINE LOGDSK -- LOGS IN A DISK AS ACTIVE FOR I/O. REG E
               ;       CONTAINS 0 FOR DRIVE A AND 1 FOR DRIVE B.
               ;
               ;*******************************************************************
               ;
01FA E5        LOGDSK: PUSH    H
01FB D5                PUSH    D          ;PRESERVE
01FC C5                PUSH    B
01FD F5                PUSH    PSW
01FE 0E0E              MVI     C,LOGF
0200 CD0500            CALL    NTRY
0203 F1                POP     PSW
0204 C1                POP     B          ;RESTORE
0205 D1                POP     D
0206 E1                POP     H
0207 C9                RET
               ;*******************************************************************
               ;
```

*Listing 4 continued on page 290*

*Listing 4 continued:*

```
                  ;     SUBROUTINE OPEN -- OPENS FILE WHOSE FCB ADDRESS IS IN DE.
                  ;        RETURNS 255 IN REG A IF NO SUCH FILE.
                  ;
                  ;*******************************************************************
                  ;
0208 E5           OPEN:   PUSH    H           ;PRESERVE
0209 D5                   PUSH    D
020A C5                   PUSH    B
020B 0E0F                 MVI     C,OPENF
020D CD0500               CALL    NTRY
0210 C1                   POP     B
0211 D1                   POP     D
0212 E1                   POP     H
0213 C9                   RET
                  ;*****************************************************************
                  ;
                  ;     SUBROUTINE CLOSE -- CLOSES FILE WHOSE FCB ADDRESS IS IN DE.
                  ;        RETURNS 255 IN A IF NO SUCH FILE.
                  ;
                  ;******************************************************************
                  ;
0214 E5           CLOSE:  PUSH    H
0215 D5                   PUSH    D
0216 C5                   PUSH    B
0217 0E10                 MVI     C,CLOSEF
0219 CD0500               CALL    NTRY
021C C1                   POP     B
021D D1                   POP     D
021E E1                   POP     H
021F C9                   RET
                  ;******************************************************************
                  ;
                  ;     SUBROUTINE DELETE -- DELETES THE FILE WHOSE FCB IS IN DE.
                  ;
                  ;*******************************************************************
                  ;
0220 E5           DELETE: PUSH    H
0221 D5                   PUSH    D
0222 C5                   PUSH    B
0223 F5                   PUSH    PSW
0224 0E13                 MVI     C,REMVF
0226 CD0500               CALL    NTRY
0229 F1                   POP     PSW
022A C1                   POP     B
022B D1                   POP     D
022C E1                   POP     H
022D C9                   RET
                  ;*******************************************************************
                  ;
                  ;     SUBROUTINE CREATE -- CREATES THE FILE WHOSE FILENAME AND TYPE
                  ;        ARE IN THE FCB ADDRESSED BY DE. RETURNS 255 IN A IF NO
                  ;        DIRECTORY SPACE.
                  ;
                  ;********************************************************************
                  ;
022E E5           CREATE: PUSH    H
022F D5                   PUSH    D
0230 C5                   PUSH    B
0231 0E16                 MVI     C,MAKEF
0233 CD0500               CALL    NTRY
0236 C1                   POP     B
0237 D1                   POP     D
0238 E1                   POP     H
0239 C9                   RET
                  ;*******************************************************************
                  ;
                  ;     SUBROUTINE SETDMA -- SETS THE DMA ADDRESS FOR THE NEXT DISK I/O
                  ;        TO THAT IN HL.  INCREMENTS HL BY 128 (READY FOR NEXT TIME).
                  ;
```

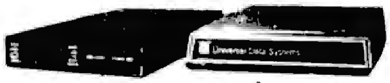
*Listing 4 continued on page 292*

## APPLE ACCESSORIES

| | |
|---|---|
| LOBO Disk II/Controller | $499. |
| LOBO Disk II | 419. |
| SUPERTERM 80 Col. Card | 329. |
| Z80 Soft Card | 295. |
| H.S. Serial Card | 179. |
| COMM. Card | 179. |
| CLOCK Calendar Card | 225. |
| ROM Plus Card/KB Filter | 175. |
| HAYES Micromodem | 319. |
| SUPERTalker | 249. |
| PARALLEL Printer Card | 149. |
| 16K Ram Card | 189. |
| GPIB IEEEE-488 Card | 259. |

## SOFTWARE

| | |
|---|---|
| VISICALC | 119.00 |
| DESKTOP Plan II | 169.00 |
| PERS Filing Syst | 80.00 |
| ADDRESS Book | 40.00 |
| SUPER Text II | 125.00 |
| CCA Data Mgmt | 85.00 |



## MODEMS

| | |
|---|---|
| UDS 103 LP, *direct* | $169. |
| 103 JLP *Auto Answer* | 219. |
| NOVATION CAT, *acoustic* | 159. |
| D-CAT, *direct* | 169. |
| Auto Cat | 219. |
| Apple Cat | 309. |
| LEXICON LX—11, *acoustic* | 147. |
| HAYES Micromodem, S100 | 349. |

### VIDEO MONITORS

| | |
|---|---|
| Sanyo 9" B/W | $169. |
| NEC 12" Green | 229. |
| Amdek 12" B/W (Leedex) | 135. |
| Amdek 13" Color | 399. |

### VIDEO TERMINALS

| | |
|---|---|
| Ampex Dialog 80 | $995. |
| Ampex Dialog 30 | 795. |
| Televideo 920C | 845. |
| Televideo 950 | 995. |
| Soroc IQ 120 | 795. |
| Soroc IQ 140 | 1,195. |

### FLOPPY DRIVES

| | |
|---|---|
| 1—SA 400 Case, power | $399. |
| 1—SA 800/801 Case, power | 995. |
| 2—SA 800/801 Case, power | 1,495. |
| 2-SA 850/851 Case, power | 1,995. |

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| | |
|---|---|
| Diablo 630 RO | $2,395. |
| Diablo 1640 RO | 2,795. |
| Diablo 1650 RO | 3,095. |
| Qume 3/45 RO | 2,195. |
| Qume 3/55 RO | 2,295. |
| Qume 5/45 RO | 2,595. |
| Qume 5/55 RO | 2,795. |
| C.Itoh Starwriter RO | 1,695. |
| TI 810 RO | 1,695. |
| TI 820 RO | 1,795. |
| Anadex DP9500/9501 | 1,345. |

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| IBM Selectric Elements | 19.00 |

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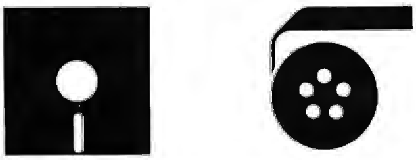
|---|---|
| NEC | $77.00/Doz. |
| QUME | 45.00/Doz. |
| DIABLO | 66.00/Doz. |
| ANADEX | 135.00/6 ea. |
| TRITEL | 95.00/Doz. |
| TI/DEC/TTY | 45.00/Doz. |
| EPSON | 13.95/ea. |
| MPI/Axiom/Base 2 | 10.00/ea. |



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|---|---|
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| | |
|---|---|
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| | |
|---|---|
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| PET/IEEE I/O Card | 55.00 |
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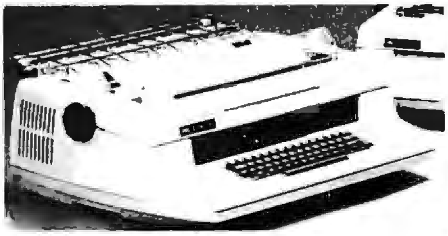
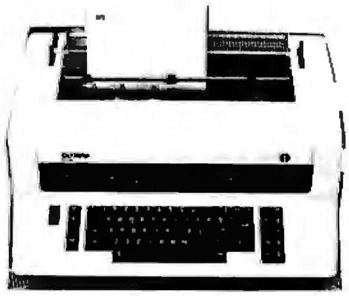
| QT Cover | 25.00 |



## NEC SPINWRITERS

| | |
|---|---|
| 5510 RO | $2,595. |
| 5520 KSR | 2,895. |

NEW!



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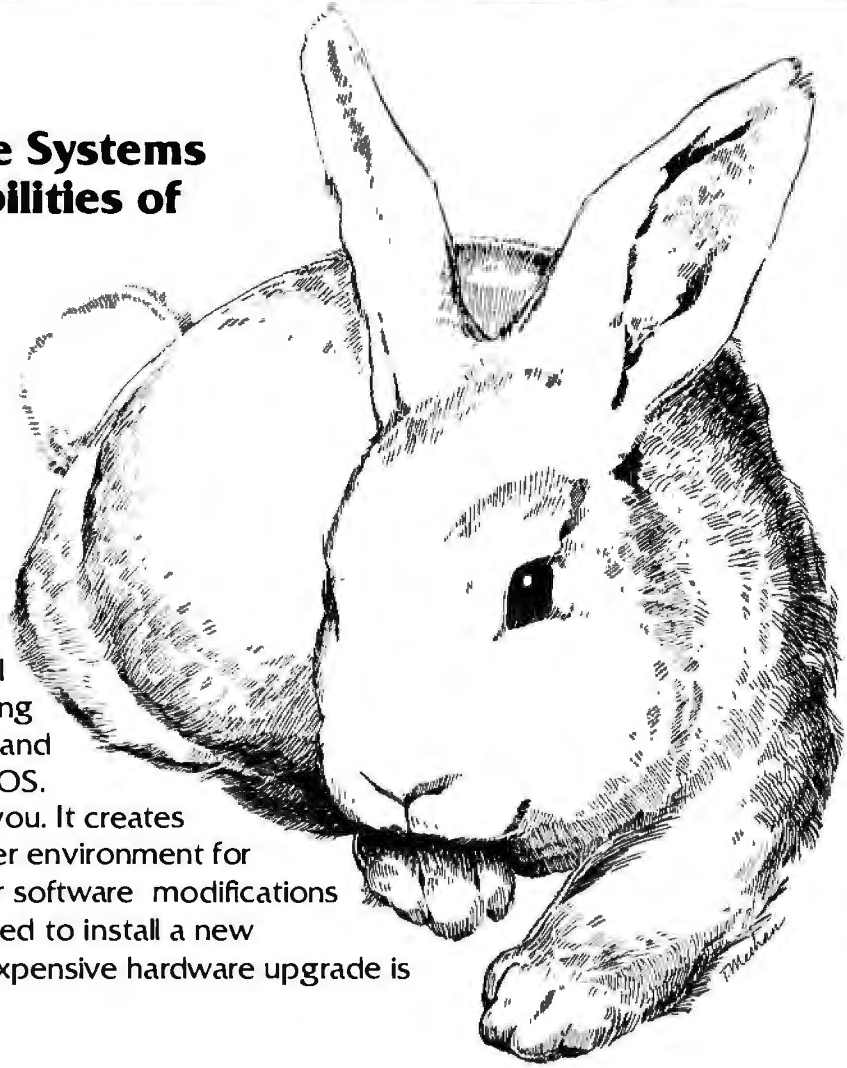
Circle 280 on inquiry card.

*Listing 4 continued:*

```
                ;***********************************************************************
                ;
023A F5         SETDMA: PUSH    PSW
023B C5                 PUSH    B
023C D5                 PUSH    D
023D E5                 PUSH    H
023E EB                 XCHG            ;ADDRESS IN DE
023F 0E1A               MVI     C,SETF
0241 CD0500             CALL    NTRY
0244 E1                 POP     H       ;MODIFY THIS GUY
0245 018000             LXI     B,128
0248 09                 DAD     B       ;ADDRESS+128
0249 D1                 POP     D
024A C1                 POP     B       ;RESTORE
024B F1                 POP     PSW
024C C9                 RET
                ;***********************************************************************
                ;
                ;    SUBROUTINE RDREC -- READS ONE RECORD FROM FILE WHOSE FCB IS IN
                ;       DE TO THE CURRENT DMA ADDRESS. RETURNS A 1 OR 2 IN REG A
                ;       IF EOF IS ENCOUNTERED. A ZERO IN REG A MEANS SUCCESSFUL READ.
                ;
                ;***********************************************************************
                ;
024D E5         RDREC:  PUSH    H
024E D5                 PUSH    D
024F C5                 PUSH    B
0250 0E14               MVI     C,READF
0252 CD0500             CALL    NTRY
0255 C1                 POP     B
0256 D1                 POP     D
0257 E1                 POP     H
0258 C9                 RET
                ;***********************************************************************
                ;
                ;    SUBROUTINE WRREC -- WRITES ONE RECORD TO FILE WHOSE FCB IS IN
                ;       DE FROM THE CURRENT DMA ADDRESS. RETURNS 0 IF A SUCCESSFUL
                ;       WRITE.
                ;
                ;***********************************************************************
                ;
0259 E5         WRREC:  PUSH    H
025A D5                 PUSH    D
025B C5                 PUSH    B
025C 0E15               MVI     C,WRITEF
025E CD0500             CALL    NTRY
0261 C1                 POP     B
0262 D1                 POP     D
0263 E1                 POP     H
0264 C9                 RET
                ;***********************************************************************
                ;
                ;    SUBROUTINE RDDSK -- READS FILE WHOSE FCB ADDRESS IS IN DE TO
                ;       MEMORY BEGINNING AT ADDRESS IN HL. ASSUMES FILE WILL FIT INTO
                ;       MEMORY. ENTIRE FILE IS READ IN.
                ;
                ;***********************************************************************
                ;
0265 CD3A02     RDDSK:  CALL    SETDMA
0268 CD4D02             CALL    RDREC
026B A7                 ANA     A       ;SET STATUS FLAGS - REG A WILL BE NON-ZERO
                                        ;   IF AN EOF WAS ENCOUNTERED
026C CA6502             JZ      RDDSK   ;READ TILL EOF
026F C9                 RET
                ;***********************************************************************
                ;
                ;    SUBROUTINE WRDSK -- WRITES TO DISK FROM MEMORY BEGINNING AT
                ;      ADDRESS IN HL. WRITES FILE WHOSE FCB IS IN DE. WRITES NUMBER
                ;       OF RECORDS IN REG B. ANY ERRORS RETURNED FROM WRREC ARE
                ;       REPORTED AND THE WRITE IS ABORTED.
```

*Listing 4 continued on page 294*



*Listing 4 continued:*

```
                 ;
                 ;*************************************************************************
                 ;
0270 CD3A02      WRDSK:  CALL    SETDMA
0273 CD5902              CALL    WRREC
0276 A7                  ANA     A       ;SET STATUS FLAGS - REG A WILL BE NON-ZERO
                                         ;    IF AN ERROR OCCURRED
0277 C27F02              JNZ     WRER    ;REPORT ERROR
027A 05                  DCR     B       ;THUMP RECORD COUNTER
027B C27002              JNZ     WRDSK   ;WRITE EM ALL
027E C9                  RET
027F 115901      WRER:   LXI     D,WERR  ;PRINT ERROR MESSAGE
0282 CD8A01              CALL    PRINT
0285 CDC301              CALL    CRLF
0288 C9                  RET
                 ;*************************************************************************
                 ;
                 ;    MAIN PROGRAM -- READS A DISK DRIVE, FILE NAME, AND OPTIONS FROM
                 ;       THE DEFAULT BUFFER . OPTIONS ALLOW THE NAMED FILE TO BE
                 ;       PRINTED OR REWRITTEN TO A NEW FILE. ASSUMES FILE TYPE .DEM
                 ;       FOR INPUT FILE AND ASSIGNS TYPE .RES TO OUTPUT FILE.
                 ;
                 ;*************************************************************************
                 ;
0289 CDD001      BEGIN:  CALL    SAVSTK  ;SAVE OLD STACK POINTER
028C CDB601              CALL    CLEAR
028F 218000              LXI     H,TBUFF ;COMMAND LINE IS HERE
0292 3E00                MVI     A,0
0294 BE                  CMP     M
0295 CAA303              JZ      ERR     ;ERROR IF NO VALID CHARACTERS
0298 46                  MOV     B,M     ;GET NUMBER OF VALID CHARACTERS
0299 3E3A                MVI     A,':'   ;DISK SPECIFIED?
029B 23                  INX     H
029C 23                  INX     H
029D 23                  INX     H       ;COLON IS HERE IF A LABEL IS SPECIFIED
029E BE                  CMP     M
029F CAA802              JZ      LDSK    ;LOG PROPER DISK
02A2 2B                  DCX     H
02A3 2B                  DCX     H
02A4 05                  DCR     B       ;ASSUME FIRST CHARACTER BLANK
02A5 C3BF02              JMP     TARG    ;SKIP IF NOT NEEDED
02A8 05          LDSK:   DCR     B       ;THUMP COUNTER
02A9 05                  DCR     B
02AA 05                  DCR     B
02AB 3E42                MVI     A,'B'   ;DRIVE B?
02AD 2B                  DCX     H       ;BACK UP ONE
02AE BE                  CMP     M
02AF CAB602              JZ      DRB     ;DRIVE B IT IS
02B2 23                  INX     H       ;ASSUME DRIVE A
02B3 C3BF02              JMP     TARG
02B6 3A6801      DRB:    LDA     FLAG    ;FLAG DRIVE B
02B9 F604                ORI     00000100B
02BB 326801              STA     FLAG
02BE 23                  INX     H
02BF 3E2E        TARG:   MVI     A,'.'   ;TARGET IS END OF FILE NAME
02C1 23          NCHAR:  INX     H       ;NEXT CHAR
02C2 05                  DCR     B       ;THUMP COUNTER
02C3 CAA303              JZ      ERR     ;ERROR IF NO COMMANDS
02C6 BE                  CMP     M
02C7 C2C102              JNZ     NCHAR   ;KEEP LOOKING
02CA 23                  INX     H
02CB 3E50        INSTR:  MVI     A,'P'   ;PRINT HIM?
02CD BE                  CMP     M
02CE C2DC02              JNZ     DTST
02D1 3A6801              LDA     FLAG    ;SET PRINT FLAG
02D4 F601                ORI     00000001B
02D6 326801              STA     FLAG
02D9 C3EA02              JMP     NXTINS
02DC 3E44        DTST:   MVI     A,'D'   ;CREATE NEW DISK FILE?
02DE BE                  CMP     M
```

*Listing 4 continued on page 296*

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Circle 333 on inquiry card.

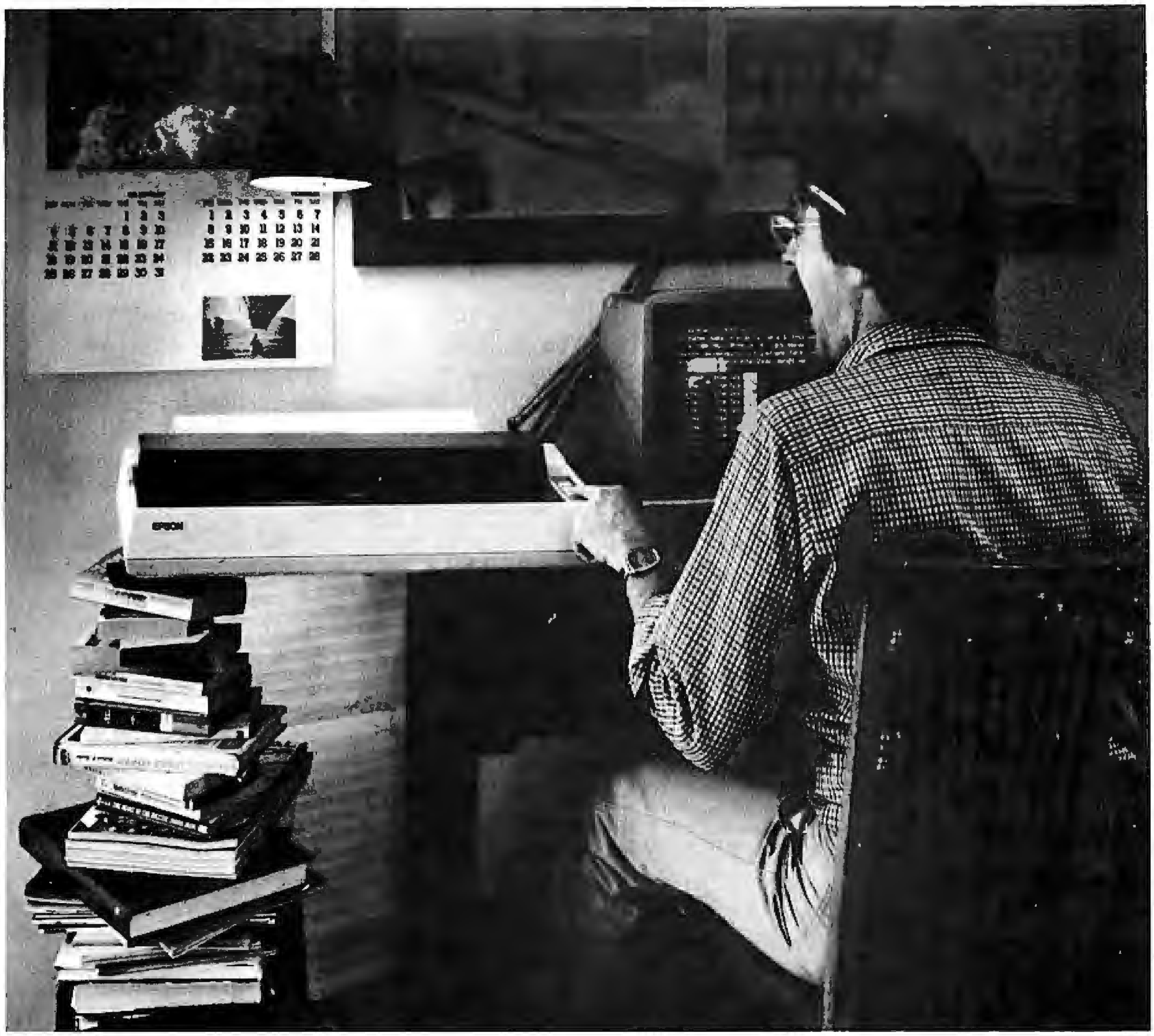
*Listing 4 continued:*

```
02DF C2EA02           JNZ    NXTINS  ;INVALID INSTRUCTIONS ARE SKIPPED
02E2 3A6801           LDA    FLAG    ;SET FILE FLAG
02E5 F602             ORI    00000010B
02E7 326801           STA    FLAG
02EA 23      NXTINS:  INX    H
02EB 05               DCR    B
02EC C2CB02           JNZ    INSTR   ;KEEP READING INSTRUCTIONS
                                     ;
                                     ;LOG PROPER DRIVE
                                     ;
02EF 1E00             MVI    E,00    ;SET DEFAULT DRIVE A
02F1 3A6801           LDA    FLAG
02F4 E604             ANI    00000100B       ;WHICH DRIVE?
02F6 CAFB02           JZ     LOG     ;LOG DRIVE A
02F9 1E01             MVI    E,01    ;LOG DRIVE B
02FB CDFA01  LOG:     CALL   LOGDSK
                                     ;
                                     ;SET FILE TYPE .DEM
                                     ;
02FE 210301           LXI    H,DEM
0301 116500           LXI    D,TFCB+9
0304 0E07             MVI    C,7     ;MOVE 7 CHARACTERS -- .DEM AND ZEROS
0306 CDF101           CALL   MOVCHR
0309 AF               XRA    A       ;CLEAR A
030A 327C00           STA    TFCB+32 ;ZERO NEXT RECORD
                                     ;
                                     ;READ IN FILE
                                     ;
030D 115C00           LXI    D,TFCB
0310 CD0802           CALL   OPEN
0313 3C               INR    A       ;ERROR TEST - A CONTAINS 255 IF ERROR
0314 C22303           JNZ    RDSK    ;OK- GO ON
0317 114D01           LXI    D,OPERR ;PRINT OPEN ERROR
031A CD8A01           CALL   PRINT
031D CDC301           CALL   CRLF
0320 C39703           JMP    DONE
0323 21AF03  RDSK:    LXI    H,FINIS ;LOCATION OF FIRST OPEN MEMORY LOCATION
                                     ;DE ALREADY CONTAINS THE FCB ADDRESS
0326 CD6502           CALL   RDDSK   ;READ HIM IN
0329 3A6B00           LDA    TFCB+15 ;NUMBER OF RECORDS READ IN
032C 326501           STA    RCRDS
032F CD1402           CALL   CLOSE   ;TFCB IS STILL IN DE
                                     ;
                                     ;PRINT ON LINE PRINTER IF FLAG SET
                                     ;
0332 3A6801           LDA    FLAG
0335 E601             ANI    00000001B
0337 CA5803           JZ     FILE    ;TEST FOR FILE FLAG
033A 3A6501           LDA    RCRDS   ;NUMBER OF RECORDS TO PRINT
033D 4F               MOV    C,A
033E 0D               DCR    C
033F 21AF03           LXI    H,FINIS ;FIRST CHARACTER
0342 118000           LXI    D,128   ;INCREMENT
0345 0680    PRTMOR:  MVI    B,RECLEN        ;SET RECORD LENGTH
0347 CDE701           CALL   PRT     ;PRINT ONE RECORD
034A 19               DAD    D       ;INCREMENT CHAR COUNT
034B 0D               DCR    C
034C C24503           JNZ    PRTMOR  ;PRINT MORE
034F 111101           LXI    D,DNMSG ;PRINT COMPLETION MESSAGE
0352 CD8A01           CALL   PRINT
0355 CDC301           CALL   CRLF
                                     ;
                                     ;IF FILE FLAG SET, CREATE NEW FILE
                                     ;
0358 3A6801  FILE:    LDA    FLAG
035B E602             ANI    00000010B
035D CA9703           JZ     DONE
                                     ;
                                     ;IF FILE .RES EXISTS, DELETE IT - THEN CREATE IT
                                     ;
```

*Listing 4 continued on page 298*

*Listing 4 continued:*

```
0360 215C00          LXI    H,TFCB   ;MOVE FILE NAME
0363 116901          LXI    D,TFCB1
0366 0E09            MVI    C,9
0368 CDF101          CALL   MOVCHR
036B 210A01          LXI    H,RES    ;FILE TYPE .RES
036E 117201          LXI    D,TFCB1+9
0371 0E07            MVI    C,7      ;SET TYPE AND ZERO REST OF FCB
0373 CDF101          CALL   MOVCHR
0376 AF              XRA    A        ;CLEAR A
0377 328901          STA    TFCB1+32 ;ZERO NEXT RECORD
037A 116901          LXI    D,TFCB1  ;DESTINATION FILE
037D CD0802          CALL   OPEN
0380 3C              INR    A        ;DOES FILE EXIST?
0381 C28703          JNZ    MAKUM    ;NOPE, LETS CREATE
0384 CD2002          CALL   DELETE   ;YUP, LETS DELETE
0387 CD2E02   MAKUM: CALL   CREATE   ;FCB IS STILL IN DE
                                     ;FILE NOW EXISTS - WRITE TO HIM
038A 3A6501          LDA    RCRDS    ;NUMBER OF RECORDS TO WRITE
038D 47              MOV    B,A
038E 21AF03          LXI    H,FINIS  ;LOCATION OF FIRST CHARACTER TO WRITE
0391 CD7002          CALL   WRDSK    ;WRITE HIM
0394 CD1402          CALL   CLOSE
0397 112301   DONE:  LXI    D,DNPRC  ;PRINT COMPLETION MESSAGE
039A CD8A01          CALL   PRINT
039D CDC301          CALL   CRLF
03A0 CDE201          CALL   GETSTK   ;RETURN TO CPM
03A3 213701   ERR:   LXI    H,ERRMSG
03A6 CD8A01          CALL   PRINT
03A9 CDC301          CALL   CRLF
03AC C39703          JMP    DONE
03AF          FINIS: END    100H
```



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*Text continued from page 282:*

contains 8. The next 8 characters are the exact line as typed: *b*TEST.PD. This buffer may now be scanned for valid commands by the user program; listing 4 illustrates a method of doing this.

If a second file name and file type had been specified, they would have been placed in the second 16 bits of the default FCB and written into the buffer. Any data placed in the buffer or FCB in this manner must be read by the user program before doing any disk access, or it will be lost. The first file name/file type may be left in the default FCB, but the second one must be moved elsewhere before accessing any file utilities (including directory utilities). In listing 4, valid commands are searched for, then the file type .DEM is placed in the FCB and bytes 12 thru 15 and 32 are zeroed. The file may now be opened and accessed.

Listing 4 illustrates one other important point about the FCB: the method of creating additional FCBs. TFCB1 is thirty-three reserved locations that serve as a second FCB in the same manner as the default FCB. The file name is moved into bytes 1 thru 8, the file type .RES is placed in bytes 9 thru 11, and the remaining bytes are defined in a similar manner to the default FCB. Using this method, additional FCBs may be created as needed. The address of the FCB of the file to be operated on is sent in the call to the CP/M entry point in register pair DE.

One other important consideration in actually reading and writing to a disk file is the need to set the DMA (direct memory access) address. This is the beginning memory address for the next disk access. The 128-byte record read from (or written to) the disk is placed into (or taken from) memory beginning at this location. When the disk system is initialized, using functions 13 or 14, the DMA address is set to hexadecimal 0080, the default buffer. It is possible to read one record to this buffer and then transfer the data to where it is needed; however, there is a simpler way illustrated in listing 4. Set the DMA address to the desired destination address and read a record. Put this function in a loop to read an entire file. Files may also be written in a similar manner (see listing 4).

## Possibilities

In the course of experimenting with CP/M—trying to discover the hidden meaning in commands not thoroughly explained in the manuals—I discovered a few interesting features. These features often have no explanation in the manual. First, the directory of any disk can be read by placing ???????? and ??? in the file-name and file-type bytes of an FCB, then doing a SEARCH and SEARCH NEXT (functions 17 and 18). These two functions write directory information into the default buffer at hexadecimal location 0080, where it may be accessed for printout.

The OPEN function first finds a file name/file type match, then copies the disk map into the FCB. If a disk map is supplied with an extent, record count, and next record, the READ or WRITE functions will work without first using OPEN. The CLOSE statement merely matches the file name/file type and writes the FCB disk map to the directory.

These last two items should suggest some interesting but dangerous possibilities. The fact that CP/M marks a file as deleted by placing the hexadecimal character E5 in the entry-type field suggests a possible way to protect a file simply by making it disappear. The FCB still appears in the directory, but no longer matches any search string. This one needs more experimentation, since writing to a disk with files erased in this manner can result in destroying files only meant to be hidden.

## Conclusion

This article has presented the use of the CP/M-utility routines, typical calling sequences, applications subroutines, sent and returned values, and examples of their uses. Although written specifically for CP/M, it illustrates the general method of using utility routines supplied with an operating system. In addition, some possibilities for further experimentation with CP/M have been suggested. It is not meant to supplant the Digital Research manuals, but to supplement and clarify a portion of them. You should refer to the manuals for additional information. ■

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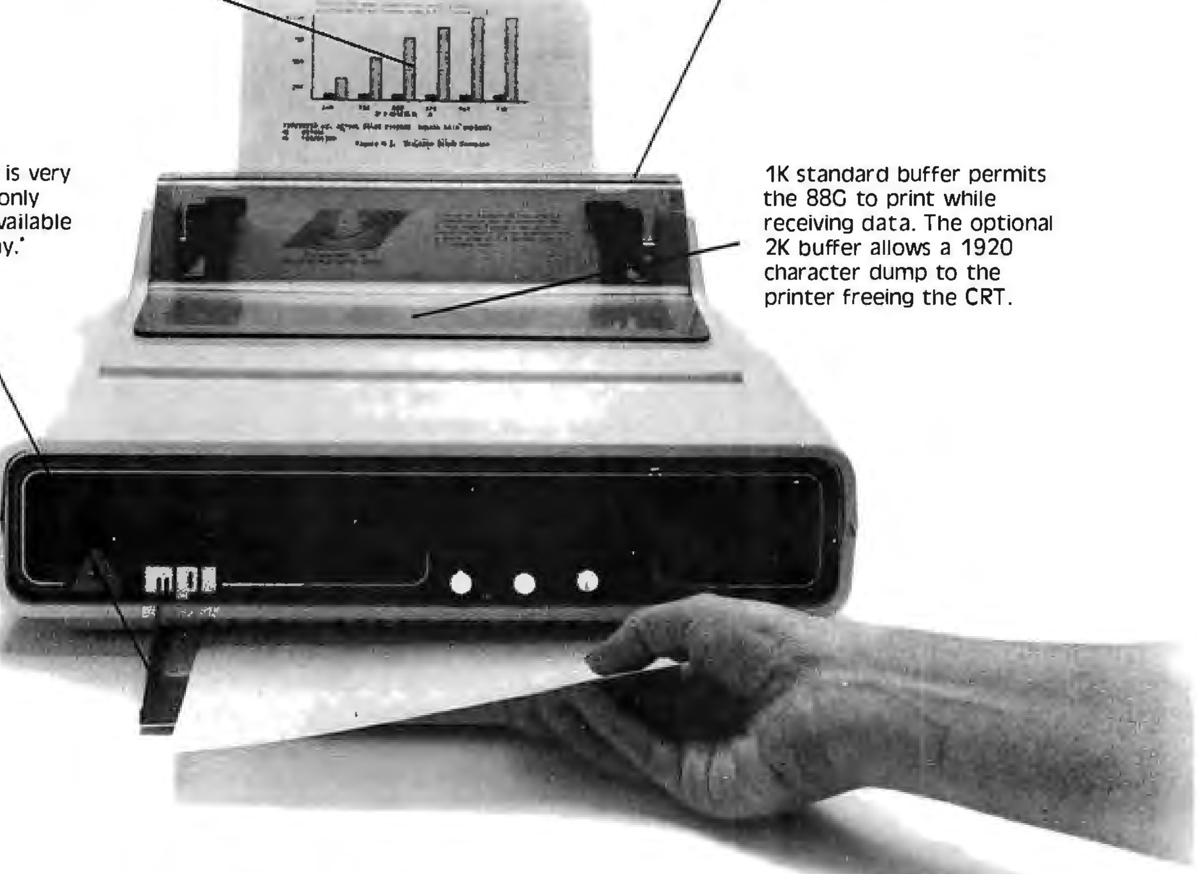

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# Build a Super Simple Floppy-Disk Interface
## Part 2: Software

James Nicholson and Roger Camp
1046 Gaskill
Ames IA 50010

The first part of this article presented basic floppy-disk technology and a description of a simple controller design with its circuit details. This controller provides a great deal of function and flexibility when combined with some simple software.

### Software

The software shown in listing 1 provides disk-formatting, reading, writing, and error-recovery functions. The software can be reassembled to allow relocation of program or page zero variables. Various entry points are shown in table 4.

Before using the FD1771 to read and write data within the sectors on the floppy disk, the disk must be formatted to conform to a certain structure. A program (entry point FORMAT) is supplied that formats all 77 tracks of a standard 8-inch disk in a standard IBM-compatible 128-bytes-per-sector arrangement (each track contains 26 sectors).

The program, when called, initializes all 6520 and 1771 electronic interfaces before writing the standard track. The initialization process guarantees that the head is positioned over the outermost track. Each track is written from a standard pattern contained in programmable memory. A 40 ms delay is generated following a step-in function to move the head to the next track. This guarantees the proper head-settling time required by the floppy-disk drive. This process continues until all tracks have been formatted.

Sector sizes other than 128 bytes can be selected by initializing the 1771 differently. (A sector size other than 128 can lead to incompatibilities with *other* floppy-disk systems.) For sector lengths greater than 128, the FORMAT program must be rewritten to use an entire track image in memory. This is required because of an indexing limit of 256 using the 6502 microprocessor. Our system, using sixteen 256-byte sectors per track, has proven to be a convenient alternative.

When a disk is properly formatted, the basic I/O (input/output) program (entry point FDENT) can be used. If the system has just been turned on, entry point FDENT should be called first to initialize all interface and drive electronics. To perform disk operations, certain variables must be set up before calling FDENT. They include the desired *command, track number,* and *sector number,* as well as the address in memory used for data transfer (see table 5).

The program begins by analyzing the command to determine which segment of the program must be used in response. There are three basic command types:

- head movement
- read/write sectors
- read/write raw tracks

In the case of read/write commands, the program ascertains if the head is positioned properly and, if necessary, provides the seek command to move it.

Following execution of the command by the 1771, completion

| Name | Purpose |
|---|---|
| FORMAT | Write proper track format on all 77 tracks |
| FDINT | Initialize 6520 and 1771 interface |
| FDENT | Perform basic floppy-disk operations using established variables |
| FDIO | Uses FDENT, followed by error checking and retry |

**Table 4:** *Entry points for various floppy-disk controller operations.*

| Name | Length in Bytes | Purpose |
|---|---|---|
| DVCODE | 1 | Device-selection byte 00 = DVC 0, 80 = DVC 1 |
| ERRCDE | 1 | FF = Error, 00 = Normal Set by FDIO |
| COMMAND | 1 | 1771 Command byte |
| STATUS | 1 | 1771 Completion status |
| TRACK | 1 | Desired track value |
| SECTOR | 1 | Desired sector value |
| FDBUF | 2 | Address of data buffer |

**Table 5:** *Variables used to perform floppy-disk operations. All values are listed in hexadecimal.*

*The numbering of all nontext material is continued from part 1 of this article.*

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analysis is performed to read back and store the status, track number, and sector number from the 1771. The status can then be examined by the user program to determine if the operation was successful. No registers are saved by any of the routines previously discussed.

Although the hardware design has proven to be very reliable, an error occasionally occurs. Since it would be a great burden for each application to concern itself with error recovery, another program has been provided. Using entry point FDIO, a user program can add the error-recovery function to that provided by FDENT.

After storing all the registers, FDIO calls FDENT to perform the requested operation. Following completion, FDIO examines the status to determine if an error occurred, and, if so, the operation may be retried. Generally, read/write operations will be retried up to five times before assuming a "hard" (ie: nontransient) error.

A nonrecoverable error is indicated with hexadecimal FF in the ERRCDE variable (see listing 2). This condition generally causes the application program to terminate so the error can be researched. The STATUS variable provides details about the specific problem.

Certain nonrecoverable conditions will not be retried. For example, a *busy* or *device not ready* condition causes an error condition without retry. The program can be altered to increase the sophistication to any level desired. Errors can be cataloged and recorded on another floppy disk to provide a history of all abnormal conditions.

| | | Variables (all values in hexadecimal) | | | |
|---|---|---|---|---|---|
| COMMAND | TRACK | SECTOR | BUFADR | BUFADR+1 | TEST |
| 02 | — | — | — | — | RESTORE |
| 1A | 20 | — | — | — | SEEK |
| 16 | 10 | — | — | — | VERIFY |
| 8C | 10 | 01 | 00 | 10 | READ |

**Table 6:** *Values to be set in variables for testing the controller (with the routine in listing 3). All values are listed in hexadecimal.*

## Testing

After completing construction of the controller circuit and verifying the proper timing of the 74123 components, some simple tests can be performed to verify proper operation. These tests can be conducted with the aid of a simple program (listing 3) and table (table 6). Set your monitor to begin execution at INIT. When the break occurs, set the variables as shown for each specific test and allow program execution to continue. This procedure requires you to load the software previously discussed. Initial testing requires a *preformatted* IBM-compatible disk. Examination of the status byte following each test helps diagnose any existing problems.

The restore-drive procedure should generate stepping pulses that move the head to the track 0 position. The head-drive lead screw can be moved manually off the track 0 position to verify proper operation.

Directing the head to seek to a specific track requires the desired track value to be set in the data register of the 1771. This test also loads the head but does not attempt to perform a track verification. This test can be repeated several times with different track values to determine if the 1771 properly seeks in both directions.

If the controller moves the head correctly, the third test performs a track verification. Following the seek movement, the head is loaded, and the 1771 reads the address information recorded on the track to verify that it has located the proper track.

The fourth test attempts to read a specific sector. The data is stored beginning at location hexadecimal

*Text continued on page 340*

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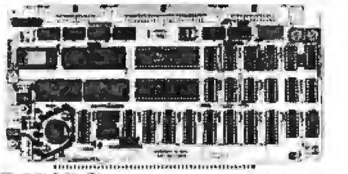

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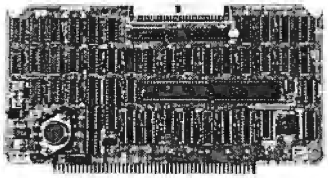

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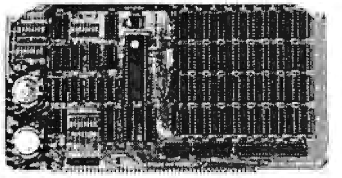

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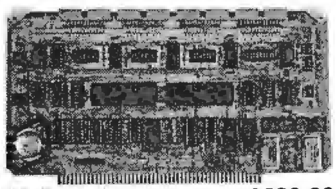

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ANADEX DP8000
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ANADEX DP9501
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| Scotch 5¼" (10-sec) | 744-10 | $33.00 |
| Scotch 5¼" (16-sec) | 744-16 | $33.00 |
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| Scotch 8" DS (soft) | 743-0 | $49.95 |
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## MAIN/FRAME & DISK DRIVE CABINETS from INTEGRAND

**MODEL X5 — Desktop Mainframe - 5 Cards - Small Power Supply** **$200**
Cabinet size 9 4"w x 16"d x 7 5"h Cabinet painted dove grey, front panel is black No optional colors! 5-position motherboard, 5 connectors installed, card cage with all guides. Reset switch on front panel Power switch, 4 DB25 cutouts, 1 BNC mounting hole, 70CFM fan, EMI filter, 6' power cord, line fuse, and clamped flat cable exit on rear panel PX/5 power supply (+8@10A, +16@1 5A, −16@1 5A) Power supply is a removable module

**MODEL 700D — Horizontal Desktop Disk/Cover - 2 Eight Inch Drives - Drives Horizontal** **$250**
Cabinet size 20"w x 23"d x 7 5"h Cabinet painted dove grey, front panel is black Mounting for 2 eight-inch Shugart SA801R Floppy Disk Drives (or mechanical equivalent) Drive mounting brackets supplied Drives not supplied 70CFM fan, 6' three-wire line cord, power switch, line fuse, EMI filter and clamped flat cable exit on rear panel P794 power supply +5@4A, +24@5A—6A peak, −5@ 75A All voltages regulated Power supply is a removable module

**MODEL8000 — Desktop Main/Frame - 15 Cards - Standard Power Supply** **$255**
Cabinet size 17"w x 20 5"d x 7 5"h. Cabinet painted dove grey, front panel is black (other color schemes optional) 15-position IEEE compatible motherboard (will accept T801 terminator kit, optional), card cage with all guides Reset switch on front panel Power switch, 8 DB25 cutouts, 2 BNC mounting holes, 70CFM fan, EMI filter, 6' power cord, line fuse, and clamped flat cable exit on rear panel P800 power supply (+8@15A, +16@3A, −16@3A) Power supply is a removable module Motherboard connectors optional

**MODEL 700DS — Vertical Desktop Disk/Cover - 2 Eight Inch Drives - Drives Vertical** **$260**
Cabinet size 13 5"w x 23"d x 11"h Cabinet painted dove grey, front panel is black Mounting for 2 eight-inch Shugart SA801R Floppy Disk Drives (or mechanical equivalent) Drive mounting brackets supplied Drives not supplied 70CFM fan, 6' three-wire line cord power switch line fuse, EMI filter and clamped flat cable exit on rear panel P794 power supply +5@4A +24@5A—6A peak −5@ 75A All voltages regulated Power supply is a removable module

Circle 27 on inquiry card.

**Listing 1:** *Software to provide fundamental high-level operations for the disk controller (written for the 6502 microprocessor).*

```
FD400/FD1771B FLOPPY DISK CONTROL                                  PAGE    1

CARD # LOC      CODE       CARD  10        20        30        40        50        60        70
       0000                    .OPT  CNT,XREF,MEM,LIST,ERR,GEN
       0000               ;
       0000               ;  J.H.NICHOLSON 1-22-79
       0000               ;
       0000               ;
       0000               ;   THIS SEGMEMT PROVIDES BASIC CONTROL FUNCTIONS FOR EXECUTING
       0000               ;  COMMANDS TO A PERTEC FD400 FLOPPY DISK DRIVE CONTROLED WITH
       0000               ;  A WESTERN DIGITAL FD1771B-01 FLOPPY DISK CONTROLLER. THE BASIC
       0000               ;  ROUTINES PROVIDE AN INTERFACE VIA A 6520 PIA TO THE FD400/FD1771B
       0000               ;  SYSTEM.
       0000               ;   THE FD1771B COMMAND, TRACK, AND SECTOR VALUES ARE PROVIDED IN
       0000               ;  PAGE ZERO VARIABLES. THE COMMAND AND OTHER NECESSARY DATA IS
       0000               ;  WRITTEN TO THE FD1771B AND THE COMMAND IS EXECUTED. FOLLOWING
       0000               ;  THE COMPLETION OF THE COMMAND(INTRQ FROM FD1771B) THE STATUS,
       0000               ;  TRACK, AND SECTOR VALUES ARE READ FROM THE FD1771B. NO ERROR
       0000               ;  RECOVERY IS PERFORMED BY THIS SEGMEMT. IF THE DEVICE IS BUSY
       0000               ;  WHEN THIS SEGMENT IS GIVEN CONTROL, NORMAL COMPLETION ANALYSIS
       0000               ;  WILL BE DONE.
       0000               ;   TWO ENTRY POINTS TO THIS SEGMENT PROVIDE COMMAND EXECUTION AND
       0000               ;  PIA INITIALIZATION.
       0000               ;     FDENT.....ENTRY FOR FD1771B COMMAND EXECUTION.
       0000               ;     FDINT.....ENTRY FOR INITIALIZATION OF FD400/FD1771B.
       0000               ;
       0000               ;
       0000               ;   ALL FD1771B COMMANDS ARE VALID AND ARE LISTED BELOW BY FUNCTIONAL
       0000               ;  CATAGORY AS WELL AS TYPE GROUPS.
       0000               ;
       0000               ;   BASIC :  RESTORE                TYPE 1.  RESTORE
       0000               ;            STEP                            SEEK
       0000               ;            STEP IN                         STEP
       0000               ;            STEP OUT                        STEP IN
       0000               ;            FORCE INTRQ                     STEP OUT
       0000               ;
       0000               ;   READ  :  READ SECTOR            TYPE 2.  READ SECTOR
       0000               ;            READ TRACK                      WRITE SECTOR
       0000               ;            READ ADDR
       0000               ;                                   TYPE 3.  READ ADDR
       0000               ;   WRITE :  WRITE SECTOR                    READ TRACK
       0000               ;            WRITE TRACK                     WRITE TRACK
       0000               ;
       0000               ;   SEEK  :  SEEK                   TYPE 4.  FORCE INTRQ
```

```
FD400/FD1771B FLOPPY DISK CONTROL                                  PAGE    2

CARD # LOC      CODE       CARD  10        20        30        40        50        60        70
       0000               ;
       0000               ;
       0000               ;   WHEN GIVEN CONTROL, THIS SEGMENT ANALYZES THE COMMAND TYPE
       0000               ;  TO DETERMINE THE FUNCTIONS WHICH MUST BE PERFORMED. THE COMMANDS
       0000               ;  CAN BE SEGMENTED INTO FOUR LOGICAL FUNCTION GROUPS WHICH ARE
       0000               ;  SIMILAR TO THE FD1771B COMMAND TYPES.
       0000               ;
       0000               ;
       0000               ;   CMD TYPE                  FUNCTION
       0000               ;   --------                  --------
       0000               ;   TYPE 1(EX.SEEK)           BASIC FUNCTION
       0000               ;
       0000               ;   TYPE 1(SEEK)              WRITE NEW TRACK, THEN BASIC
       0000               ;
       0000               ;   TYPE 2                    WRITE SECTOR REGISTER
       0000               ;                             SPLIT TO READ OR WRITE
       0000               ;
       0000               ;   TYPE 3                    SPLIT TO READ OR WRITE
       0000               ;
       0000               ;   TYPE 4                    BASIC FUNCTION
       0000               ;
```

*Listing 1 continued on page 308*

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*Listing 1 continued:*

```
0000              ;
0000              ;    BASIC FUNCTION :
0000              ;      1. WRITE COMMAND TO THE FD1771B.
0000              ;      2. WAIT FOR COMPLETION(INTRQ).
0000              ;      3. COMPLETION ANALYSIS(READ STATUS, TRACK, AND SECTOR)
0000              ;      4. EXIT
0000              ;
0000              ;    SEEK FUNCTION :
0000              ;      1. WRITE NEW TRACK TO DATA REGISTER.
0000              ;      2. WRITE SECTOR TO SECTOR REGISTER.
0000              ;      3. GO TO BASIC FUNCTION.
0000              ;
0000              ;    READ FUNCTION :
0000              ;      1. SEEK TO PROPER TRACK IF NECESSARY
0000              ;      2. WRITE SECTOR TO SECTOR REGISTER.
0000              ;      3. WRITE COMMAND TO FD1771B.
0000              ;      4. WAIT & LOOP FOR DRQ/INTRQ READING DATA ON DRQ.
0000              ;      5. ON INTRQ DO COMPLETION ANALYSIS(BASIC FCTN, STEP 3)
0000              ;
0000              ;    WRITE FUNCTION :
0000              ;      1. SEEK TO PROPER TRACK IF NECESSARY
0000              ;      2. WRITE SECTOR TO SECTOR REGISTER.
0000              ;      3. WRITE COMMAND TO FD1771B.
0000              ;      4. WAIT & LOOP FOR DRQ/INTRQ WRITING DATA ON DRQ.
0000              ;      5. ON INTRQ DO COMPLETION ANALYSIS(BASIC FCTN, STEP 3)
```



```
CARD # LOC    CODE      CARD  10        20        30        40        50        60        70
       0000             ;
       0000             ;  ******* 6520 PIA
       0000             ;
       0000             SADD   =$CC0C          6520 PIA A DATA DIRECTION
       0000             SAD    =$CC0C          6520 PIA A DATA REGISTER
       0000             CRA    =$CC0D          6520 PIA A CONTROL REGISTER
       0000             SBDD   =$CC0E          6520 PIA B DATA DIRECTION
       0000             SBD    =$CC0E          6520 PIA B DATA REGISTER
       0000             CRB    =$CC0F          6520 PIA B CONTROL REGISTER
       0000             ;
       0000             ;  ******* PIA CONNECTIONS
       0000             ;
       0000             ;   CA1 <-- UNUSED
       0000             ;   CA2 --> PULSE(¬RE CLR)
       0000             ;     PA7 <-> DAL7
       0000             ;     PA6 <-> DAL6
       0000             ;     PA5 <-> DAL5
       0000             ;     PA4 <-> DAL4
       0000             ;     PA3 <-> DAL3
       0000             ;     PA2 <-> DAL2
       0000             ;     PA1 <-> DAL1
       0000             ;     PA0 <-> DAL0
       0000             ;
       0000             ;     PB7 <-- INTRQ
       0000             ;     PB6 <-- DRQ
       0000             ;     PB5 --> READ
       0000             ;     PB4 --> WRITE
       0000             ;     PB3 --> ¬MR
       0000             ;     PB2 --> A1
       0000             ;     PB1 --> A0
       0000             ;     PB0 --> ¬ENABLE R/W
       0000             ;   CB1 <-- UNUSED
       0000             ;   CB2 --> DEVICE SELECT
       0000             ;
       0000             ;  ******* FD1771B COMMANDS
       0000             ;
       0000             FDRST  =$02            RESTORE
       0000             FDSK   =$12            SEEK
       0000             FDST   =$22            STEP
       0000             FDSTI  =$42            STEP IN
       0000             FDSTO  =$62            STEP OUT
       0000             FDRD   =$80            READ SECTOR
       0000             FDWT   =$A0            WRITE SECTOR
```

*Listing 1 continued on page 310*

*Listing 1 continued:*

```
0000              FDRDA  =$C4         READ ADDRESS
0000              FDRDT  =$E4         READ TRACK
0000              FDWTT  =$F4         WRITE TRACK
0000              FDFI   =$D0         FORCE INTERUPT
0000              ;
0000              ;  ******* COMMAND QUALIFIERS
0000              ;
0000              QV     =$04         VERIFY
0000              QH     =$08         LOAD HEAD
0000              QU     =$10         UPDATE TRK REG
0000              QM     =$10         MULTIPLE RECORDS
0000              QB     =$08         IBM FORMAT

  FD400/FD1771B FLOPPY DISK CONTROL                         PAGE   4

CARD # LOC    CODE      CARD  10     20     30     40     50     60     70
       0000             QS     =$01         NOT SYNC TO AM
       0000             QI0    =$01         NR TO R TRANS.
       0000             QI1    =$02         R TO NR TRANS.
       0000             QI2    =$04         INDEX PULSE
       0000             QI3    =$08         EACH 10 MS.
       0000             QE     =$04         ENABLE HLD + HLT DELAY
       0000             QFB    =$00         FB DATA MARK
       0000             QFA    =$01         FA DATA MARK
       0000             QF9    =$10         F9 DATA MARK
       0000             QF8    =$11         F8 DATA MARK
       0000             ;
       0000             ;  ******* INITIALIZATION CTL BYTES
       0000             ;
       0000             QCRC   =$F7         WRITE CRC
       0000             QIAM   =$FC         INDEX ADDR MARK
       0000             QIDM   =$FE         ID ADDR MARK
       0000             QAFB   =$FB         FB DATA MARK
       0000             QAFA   =$FA         FA DATA MARK
```

*Listing 1 continued on page 312*

# MULTI-USER OASIS HAS THE FEATURES PROS DEMAND. READ WHY.

## (THEN COMPARE.)

***Computer experts (the pros) usually have big computer experience. That's why when they shop system software for Z80 micros, they look for the big system features they're used to. And that's why they like Multi-User OASIS. You will too.***

### DATA INTEGRITY: FILE & AUTOMATIC RECORD LOCKING

The biggest challenge for any multi-user system is co-ordinating requests from several users to change the same record at the same time.

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Our File and Automatic Record Locking features solve these problems.

For example: normally all users can view a particular record at the same time. But, if that record is being updated by one user, automatic record locking will deny all other users access to the record until the up-date is completed. So records are always accurate, up-to-date and integrity is assured.

Pros demand file & automatic record locking. OASIS has it.

### SYSTEM SECURITY: LOGON, PASSWORD & USER ACCOUNTING

Controlling who gets on your system and what they do once they're on it is the essence of system security.

Without this control, unauthorized users could access your programs and data and do what they like. A frightening prospect isn't it?

And multi-users can multiply the problem.

But with the Logon, Password and Privilege Level features of Multi-User OASIS, a system manager can specify for each user which programs and files may be accessed— and for what purpose.

Security is further enhanced by User Accounting—a feature that lets you keep a history of which user has been logged on, when and for how long.

Pros insist on these security features. OASIS has them.

### EFFICIENCY: RE-ENTRANT BASIC

A multi-user system is often not even practical on computers limited to 64K memory.

OASIS Re-entrant BASIC makes it practical.

How?

Because all users use a single run-time BASIC module, to execute their compiled programs, less memory is needed. Even if you have more than 64K, your pay-off is cost saving and more efficient use of all the memory you have available—because it services more users.

Sound like a pro feature? It is. And OASIS has it.

### AND LOTS MORE...

Multi-User OASIS supports as many as 16 terminals and can run in as little as 56K memory. Or, with bank switching, as much as 784K.

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☐ UPS C.O.D. ☐ Mastercharge
Card Number ____________
Expiration Date ____________
**Signature** ____________

Circle 292 on inquiry card.

*Listing 1 continued:*

```
0000              QAF9   =$F9             F9 DATA MARK
0000              QAF8   =$F8             F8 DATA MARK
0000              ;
0000              ;  ******* PIA CONTROL COMMANDS(-MR ON)
0000              ;
0000              READ   =$29             READ FD1771B
0000              WRITE  =$19             WRITE FD1771B
0000              STAT   =$00             A1=0,A0=0   STATUS REGISTER
0000              TRK    =$02             A1=0,A0=1   TRACK REGISTER
0000              SECT   =$04             A1=1,A0=0   SECTOR REGISTER
0000              DATA   =$06             A1=1,A0=1   DATA REGISTER
0000              CMD    =$00             A1=0,A0=0   COMMAND REGISTER
0000              ;
0000              ;  ******* PAGE ZERO VARIABLES/EQUATES
0000              ;
0000              TIME1  *=*+1
0001              TIME2  *=*+1
0002                     *=$E0
00E0              DVCODE *=*+1            DVC/FILE CODE
00E1              ERRCDE *=*+1            ERROR CODE
00E2              COMAND *=*+1 FD1771B COMMAND
00E3              STATUS *=*+1         STATUS
00E4              TRACK  *=*+1         TRACK
00E5              SECTOR *=*+1         SECTOR
00E6              FDBUF  *=*+2         BUFFER PTR
00E8              ;
00E8                     *=$200
```

```
FD400/FD1771B FLOPPY DISK CONTROL                                PAGE    5

CARD # LOC     CODE       CARD  10       20       30       40       50       60       70
       0200               ;
       0200               ;  ******* TYPE 1 COMMANDS
       0200               ;
       0200    A5 E2      TYPE1  LDA   COMAND     IF NOT SEEK
       0202    C9 20             CMP   #$20        ASSUME
       0204    B0 3A             BCS   BASIC        BASIC
       0206    C9 10             CMP   #$10       IF RESTORE
       0208    90 36             BCC   BASIC       ASSUME BASIC
       020A    A9 1F             LDA   #WRITE+DATA PIA CTL CMD
       020C    20 DE 02          JSR   SETUP      SET-UP PIA
       020F    A5 E4             LDA   TRACK      TRACK ADDR
       0211    C9 4D             CMP   #$4D       IF PAST END
       0213    B0 33             BCS   CMPANL      RETURN
       0215    20 CD 02          JSR   PULSE      WRITE TRACK
       0218    A9 1D             LDA   #WRITE+SECT PIA CTL CMD
       021A    20 DE 02          JSR   SETUP      SET-UP PIA
       021D    A5 E5             LDA   SECTOR     SECTOR ADDR
       021F    20 CD 02          JSR   PULSE      WRITE SECTOR
       0222    4C 40 02          JMP   BASIC      CONTINUE
       0225               ;
       0225               ;  ******* COMMAND ENTRY ANALYSIS
       0225               ;
       0225    A9 29      FDENT  LDA   #READ+STAT PIA CTL CMD          ** ENTRY **
       0227    20 DE 02          JSR   SETUP      SET-UP PIA
       022A    20 CD 02          JSR   PULSE      READ STATUS
       022D    6A                ROR   A          IF DEVICE BUSY
       022E    B0 18             BCS   CMPANL      DO COMPLETION
       0230               ;
       0230               ;  ******* DETERMINE COMMAND TYPE
       0230               ;
       0230    A9 10             LDA   #$10       CMD MASK
       0232    24 E2             BIT   COMAND     CHECK FOR
       0234    10 CA             BPL   TYPE1       TYPE 1
       0236    50 23             BVC   TYPE2       TYPE 2
       0238    F0 4A             BEQ   RDATA       TYPE 3 READ
       023A    A9 20             LDA   #$20       SEPERATE
       023C    24 E2             BIT   COMAND      FORCE INTRQ FROM
       023E    D0 63             BNE   WDATA       TYPE 3 WRITE
       0240               ;
       0240               ;  ******* BASIC COMMAND PROCESS
       0240               ;
       0240    20 C2 02   BASIC  JSR   WRTCMD     WRITE CMD TO FD1771B
       0243    2C 0E CC          BIT   SBD        WAIT FOR
```

*Listing 1 continued on page 314*

# Computers Designed for the Professional

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Circle 36 on inquiry card.

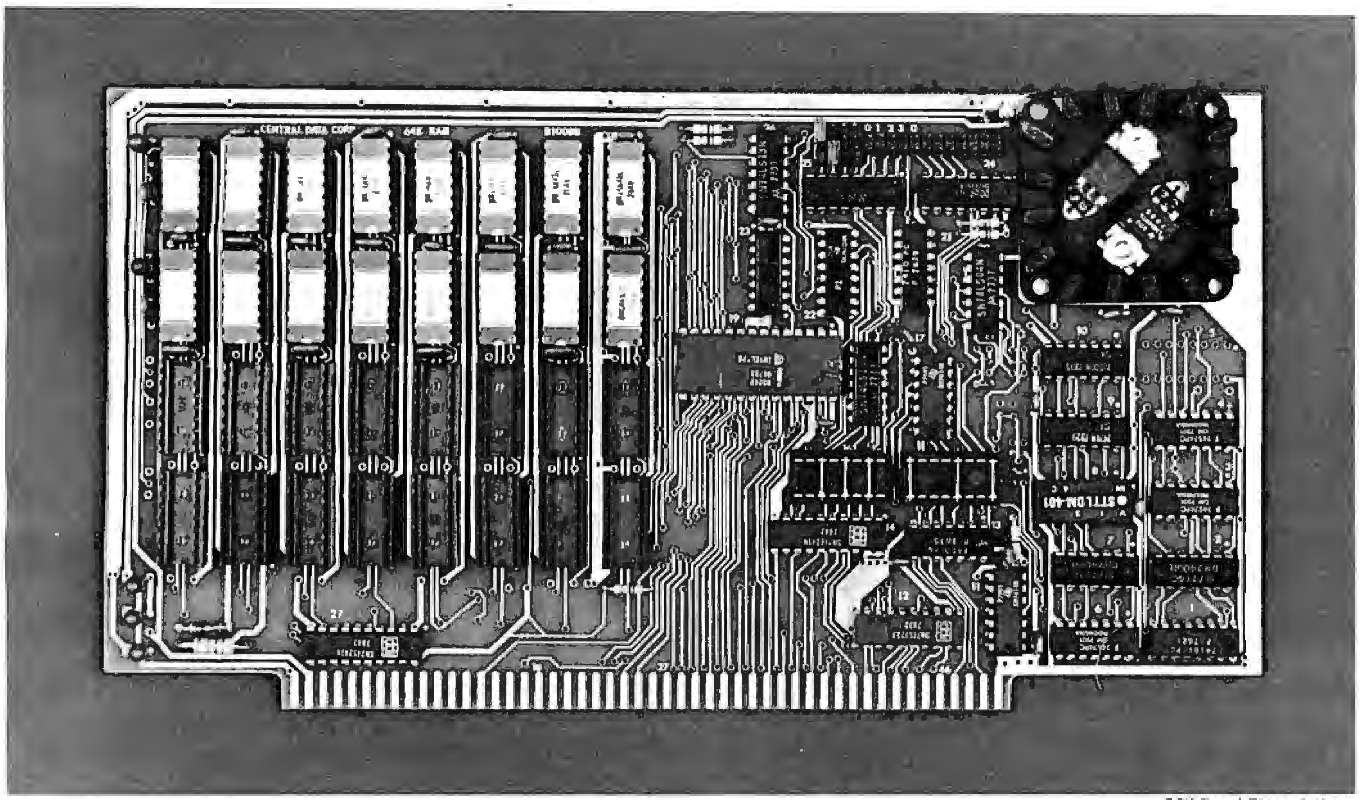
*Listing 1 continued:*

```
0246  10 FB             BPL   *-3          INTRQ
0248                ;
0248                ;  ******* COMPLETION ANALYSIS
0248                ;
0248  A0 02     CMPANL  LDY   #2           LOOP CNT + INDEX
024A  98        CPLP    TYA                USE INDEX TO
024B  0A                ASL   A             SET A1,A0
024C  09 29             ORA   #READ        SET READ
024E  20 DE 02          JSR   SETUP        SET-UP PIA
0251  20 CD 02          JSR   PULSE        READ REGISTER
0254  99 E3 00          STA   STATUS,Y     STORE DATA
0257  88                DEY                DECR INDEX


   FD400/FD1771B FLOPPY DISK CONTROL                                    PAGE    6

CARD # LOC     CODE       CARD  10        20         30         40         50         60         70
0258  10 F0             BPL   CPLP         CONTINUE
025A  60                RTS                RETURN
025B                ;
025B                ;  ******* TYPE 2 VERIFY TRACK
025B                ;
025B  A9 2B     TYPE2   LDA   #READ+TRK PIA CTL CMD
025D  20 DE 02          JSR   SETUP        SET-UP PIA
0260  20 CD 02          JSR   PULSE        READ TRACK
0263  C5 E4             CMP   TRACK        IF NOT EQUAL
0265  F0 0D             BEQ   TYPE2A        SEEK TO TRACK
0267  A5 E2             LDA   COMAND       SAVE COMMAND
0269  48                PHA                 FOR LATER
026A  A9 12             LDA   #FDSK        SEEK COMMAND
026C  85 E2             STA   COMAND       SET IT
026E  20 25 02          JSR   FDENT        DO SEEK
0271  68                PLA                RESTORE
0272  85 E2             STA   COMAND        COMMAND
0274                ;
0274                ;  ******* TYPE 2 COMMANDS
0274                ;
0274  A9 1D     TYPE2A  LDA   #WRITE+SECT PIA CTL CMD
0276  20 DE 02          JSR   SETUP        SET-UP PIA
0279  A5 E5             LDA   SECTOR       SECTOR ADDR
027B  20 CD 02          JSR   PULSE        WRITE SECTOR
027E  A9 20             LDA   #$20         SEPERATE
0280  24 E2             BIT   COMAND        READ
0282  D0 1F             BNE   WDATA          FROM WRITE
0284                ;
0284                ;  ******* READ DATA
0284                ;
0284  20 C2 02  RDATA   JSR   WRTCMD       WRITE COMMAND
0287  A0 00             LDY   #0           BUFFER INDEX
0289  A9 2F             LDA   #READ+DATA PIA CTL CMD
028B  20 DE 02          JSR   SETUP        SET-UP PIA
028E  2C 0E CC  RDL     BIT   SBD          WAIT FOR          4
0291  30 B5             BMI   CMPANL        INTRQ OR         2
0293  50 F9             BVC   RDL            DRQ             2
0295  AD 0C CC          LDA   SAD          GET DATA BYTE     4      25 CYCLES
0298  49 FF             EOR   #$FF         INVERT DATA       2
029A  91 E6             STA   (FDBUF),Y    SAVE BYTE         6
029C  C8                INY                INCR BUFFER PTR   2
029D  D0 EF             BNE   RDL          IF ZERO           3 2
029F  E6 E7             INC   FDBUF+1       INCR BASE AND      5    + 9 CYCLES
02A1  D0 EB             BNE   RDL            CONTINUE          3
02A3                ;
02A3                ;  ******* WRITE DATA
02A3                ;
02A3  20 C2 02  WDATA   JSR   WRTCMD       WRITE COMMAND
02A6  A0 00             LDY   #0           BUFFER INDEX
02A8  A9 1F             LDA   #WRITE+DATA PIA CTL CMD
02AA  20 DE 02          JSR   SETUP        SET-UP PIA
02AD  B1 E6     WTL     LDA   (FDBUF),Y    GET DATA BYTE     6
02AF  49 FF             EOR   #$FF         INVERT DATA       2
02B1  8D 0C CC          STA   SAD          WRITE IT          4
02B4  2C 0E CC  WTL1    BIT   SBD          WAIT FOR          4      25 CYCLES
```

*Listing 1 continued on page 317*



32K Board Pictured Above

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**Central Data**

Circle 53 on inquiry card.

*Listing 1 continued:*

```
FD400/FD1771B FLOPPY DISK CONTROL                                    PAGE    7

LOC     CODE         CARD  10        20         30        40        50        60        70
02B7   30 8F               BMI    CMPANL      INTRQ OR          2
02B9   50 F9               BVC    WTL1         DRQ              2
02BB   C8                  INY                INCR BUFFER PTR   2
02BC   D0 EF               BNE    WTL         IF ZERO           3 2
02BE   E6 E7               INC    FDBUF+1      INCR BASE AND      5    + 9 CYCLES
02C0   D0 EB               BNE    WTL           CONTINUE          3
02C2                ;
02C2                ;
02C2                ;  ******* WRITE COMMAND TO FD1771B
02C2                ;
02C2   A9 19        WRTCMD LDA    #WRITE+CMD  PIA CTL CMD
02C4   20 DE 02            JSR    SETUP       SET-UP PIA
02C7   A5 E2               LDA    COMAND      GET COMMAND
02C9   20 CD 02            JSR    PULSE        AND WRITE IT
02CC   60                  RTS                RETURN
02CD                ;
02CD                ;  ******* ENABLE FD1771B READ/WRITE
02CD                ;            (TRANSFER DATA)
02CD                ;
02CD   49 FF        PULSE  EOR    #$FF        INVERT DATA
02CF   8D 0C CC            STA    SAD         DATA OUT
02D2   CE 0E CC            DEC    SBD         ENABLE
02D5   EE 0E CC            INC    SBD         READ/WRITE
02D8   AD 0C CC            LDA    SAD         DATA IN
02DB   49 FF               EOR    #$FF        INVERT DATA
02DD   60                  RTS                CONTINUE
02DE                ;
02DE                ;  ******* SET UP PIA FOR READ/WRITE
02DE                ;
02DE   A2 00        SETUP  LDX    #$00        ASSUME READ
02E0   8D 0E CC            STA    SBD         SET DVC CTL REG
02E3   0A                  ASL    A           CHECK
02E4   0A                  ASL    A            IF READ AND
02E5   30 01               BMI    SET1          SET FOR INPUT
02E7   CA                  DEX                ADJUST DIR TO OUTPUT
02E8   A9 00        SET1   LDA    #0          SET CTL FOR
02EA   8D 0D CC            STA    CRA          DIR REGISTER
02ED   8E 0C CC            STX    SADD        SET DATA DIRECTION
02F0   A9 2C               LDA    #$2C        RESET PIA CTL
02F2   8D 0D CC            STA    CRA          TO DATA REG
02F5   60                  RTS                RETURN
02F6                ;
02F6                ;  ******* DEVICE INITIALIZATION
```

*Listing 1 continued on page 318*

*Listing 1 continued:*

```
02F6                ;
02F6  A2 00         FDINT  LDX   #$00       A DIR AS INPUT      ** ENTRY **
02F8  20 E8 02             JSR   SET1       SET-UP A SIDE
02FB  AD 0C CC             LDA   SAD        CLEAR -RE
02FE  A0 04                LDY   #$04       CTL FOR B SIDE
0300  8C 0F CC             STY   CRB         DATA REGISTER
0303  86 E0                STX   DVCODE     CLEAR DEVICE CODE
0305  E8                   INX              SET B SIDE
0306  8E 0E CC             STX   SBD         DATA REGISTER
0309  CA                   DEX              CTL FOR B SIDE
030A  8E 0F CC             STX   CRB         DIR REGISTER
030D  A2 3F                LDX   #$3F       SET B SIDE
```

```
     FD400/FD1771B FLOPPY DISK CONTROL                              PAGE    8

CARD # LOC     CODE        CARD  10        20        30        40        50        60        70
       030F  8E 0E CC             STX   SBDD        DIR REGISTER
       0312  A2 3C                LDX   #$3C       SELECT
       0314  8E 0F CC             STX   CRB         DEVICE 1
       0317  A9 02                LDA   #FDRST     RESTORE CMD
       0319  85 E2                STA   COMAND     SAVE IT
       031B  20 40 02             JSR   BASIC      RESTORE DEVICE 1
       031E  A2 34                LDX   #$34       SELECT
       0320  8E 0F CC             STX   CRB         DEVICE 0
       0323  4C 40 02             JMP   BASIC      RESTORE DEVICE 0
       0326                ;
       0326                ;
```

```
     FLOPPY DISK I/O & ERROR RECOVERY                               PAGE    9

CARD # LOC     CODE        CARD  10        20        30        40        50        60        70
       0326                ;
       0326                ;
       0326                ;
       0326                ;  THIS SEGMENT PROVIDES FLOPPY DISK I/O OPERATIONS, USING
       0326                ; THE FDENT ROUTINE, AND ERROR RECOVERY IS PERFORMED PRIOR TO
       0326                ; RETURNING. COMMAND, TRACK, SECTOR, AND BUFFER ADDRESS ARE
       0326                ; SET AS IF FDENT WERE TO BE USED. FDIO WILL SAVE ALL REGISTERS
       0326                ; AS WELL AS PERFORMING ERROR RECOVERY. IF A COMMAND IS
       0326                ; CONSIDERED RECOVERABLE, IT WILL BE RETRIED 5 TIMES PRIOR TO
       0326                ; RETURNING A PERMANENT ERROR INDICATION IN ERRCODE($FF).
       0326                ; A ZERO INDICATES A NORMAL COMPLETION OF THE I/O ACTIVITY.
       0326                ; ADDITIONALLY THE PROPER FLOPPY DRIVE WILL BE SELECTED USING
       0326                ; THE HIGH BIT OF DVCODE.
       0326                ;
       0326                ;  TYPE     MASK       ERROR
       0326                ;
       0326                ;  TYPE1    00011000   SEEK ERROR
       0326                ;  WRITE    01111000   WRITE PROTECT/FAULT
       0326                ;  READ     00011100   ID/REC NOT FOUND
       0326                ;                      CRC ERROR
       0326                ;                      LOST DATA
       0326                ;
       0326                ; ******* INITIALIZE AND EXEC CMD
       0326                ;
       0326  48            FDIO   PHA              SAVE ACC            ** ENTRY **
       0327  98                   TYA              SAVE Y
       0328  48                   PHA               REGISTER
       0329  8A                   TXA              SAVE X
       032A  48                   PHA               REGISTER
       032B  A9 05                LDA   #5         SET ERROR
       032D  85 E1                STA   ERRCDE      COUNT
       032F  A9 34                LDA   #$34       START W/DVC 0
       0331  24 E0                BIT   DVCODE     IF NOT 0
       0333  50 02                BVC   SETDVC      SET TO ONE
       0335  09 08                ORA   #$08       SET DVC 1
       0337  8D 0F CC      SETDVC STA   CRB        SET PIA
       033A  A5 E7         RETRY  LDA   FDBUF+1    SAVE ADDR HIGH
       033C  48                   PHA               FOR RECOVERY
       033D  A5 E5                LDA   SECTOR     SAVE SECTOR
       033F  48                   PHA               FOR RECOVERY
       0340  20 25 02             JSR   FDENT      EXEC CMD
```

*Listing 1 continued on page 320*

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| Ohio Scientific C3 | A3 |
| OKI IF-800 | RZ |
| Onyx C8001 | T2 |
| Pertec PCC 2000 | A1 |
| Processor Technology Helios II | B2 |
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*Listing 1 continued:*

```
0343  38             SEC                 ASSUME ERROR
0344               ;
0344               ;  ******* CHECK FOR BUSY/NOT READY
0344               ;
0344  A9 01          LDA   #$01          CHECK
0346  24 E3          BIT   STATUS         FOR
0348  D0 3F          BNE   ER1              BUSY OR
034A  30 3D          BMI   ER1                NOT READY
034C               ;
034C               ;  ******* DETERMINE CMD TYPE
034C               ;
034C  A9 10          LDA   #$10          CMD MASK
034E  24 E2          BIT   COMAND        SPLIT INTO
0350  10 19          BPL   TYP1           TYPE 1
```

```
 FLOPPY DISK I/O & ERROR RECOVERY                                   PAGE   10

CARD # LOC     CODE       CARD  10       20        30        40        50        60        70
0352  50 29          BVC   TYP2           TYPE 2
0354  F0 37          BEQ   RDT            TYPE 3 READ
0356  A9 20          LDA   #$20          SEPERATE
0358  24 E2          BIT   COMAND         FORCE INTRQ FROM
035A  D0 27          BNE   WRT              TYPE 3 WRITE
035C               ;
035C               ;  ******* RETURN
035C               ;
035C  18       RTN1  CLC                 NO ERROR
035D  A9 00          LDA   #0            CLEAR
035F  85 E1    RTN2  STA   ERRCDE         ERROR CODE
0361  68             PLA                 CLEAR STACK
0362  85 E5          STA   SECTOR         OF SECTOR
0364  68             PLA                    AND ADDR HIGH
0365  68       RTN3  PLA                 RESTORE X
0366  AA             TAX                  REGISTER
0367  68             PLA                 RESTORE Y
0368  A8             TAY                  REGISTER
0369  68             PLA                 RESTORE ACC
036A  60             RTS                 RETURN
036B               ;
036B               ;  ******* TYPE 1 RECOVERY
036B               ;
036B  A9 18    TYP1  LDA   #$18          CHECK FOR
036D  25 E3          AND   STATUS         BOTH CRC AND
036F  F0 EB          BEQ   RTN1
0371  C9 18          CMP   #$18             NOT FOUND
0373  F0 14          BEQ   ER1                ERRORS
0375  A9 30          LDA   #$30          STOP IF
0377  24 E2          BIT   COMAND         STEP IN
0379  D0 0E          BNE   ER1              OR STEP OUT
037B  F0 26          BEQ   RDT1          RETRY SEEK AND RESTORE
037D               ;
037D               ;  ******* TYPE 2 SEPERATION
037D               ;
```

*Listing 1 continued on page 322*

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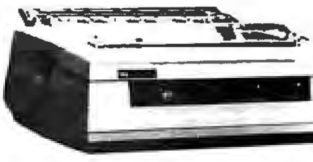

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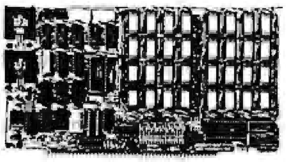
*With our normal fast shipping, we have time to test; expedited shipment may preclude testing.
**A.E.I. does not wish to imply that any of these fine organizations endorse A.E.I., merely that A.E.I. is proud to have them as customers.



| S.S.M. | KIT | ASM |
|---|---|---|
| CB2 Z80 CPU | $200 | $265 |
| VB1C VIDEO | 140 | 190 |
| VB2 VIDEO | 155 | 210 |
| VB3 VIDEO | 375 | 440 |
| IO4 INTERFACE | 165 | 225 |
| SB1 SYNTHESIZER | 195 | 270 |

**MEASUREMENT SYSTEMS MEMORY**

| | |
|---|---|
| DM3200 32K 4MHZ | 480 |
| DM6400 64K 4MHZ | 595 |
| DMB3200 32K 4MHZ BANK SELECT | 630 |
| DMB6400 64K 4MHZ BANK SELECT | 745 |

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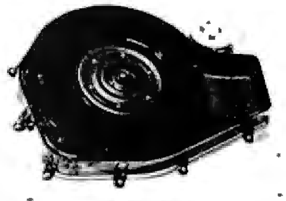

**MORROW**

| | |
|---|---|
| DECISION 1 BASIC | $1550 |
| DISCUS-1 2 DRIVE | 1550 |
| DISCUS 2D 1 DRIVE | 935 |
| DISCUS 2D 2 DRIVE | 1550 |
| DISCUS 2+2 1 DRIVE | 1250 |
| DISCUS 2+2 2 DRIVE | 2190 |
| DISC JOCKEY 2D | 350 |
| DISCUS M26 HARD DISC | 3925 |
| ADDITIONAL HARD DISC | 3685 |
| DISCUS M10 | 2990 |

**MISCELLANEOUS**

| | |
|---|---|
| NEC THIMBLES | $16 |
| NEC RIBBONS | 7 |
| RS2332 CABLE 5' | 20 |
| RS 232 CABLE 10" | 25 |
| LEDEX MONITOR | 145 |
| NOVATION CAT | 145 |

**SOFTWARE**

| | |
|---|---|
| WORDSTAR | $330 |
| MAILMERGE | 100 |
| DATASTAR | 250 |
| N.S. PASCAL | 160 |
| MAGIC WAND | 290 |
| C BASIC | 100 |

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|---|---|
| JOB COSTING | $700 |
| INVENTORY | 475 |
| CASH REG. | 475 |
| APARTMENT | 475 |
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ADDITIONAL SOFTWARE DISCOUNTS WITH SYSTEM PURCHASE

**DISCS—BOX OF 10**

| | |
|---|---|
| VERBATUM 5¼ 1 SIDE | $27 |
| VERBATUM 5¼ 2 SIDE | 45 |
| VERBATUM 8 1 SIDE | 35 |
| VERBATUM 8 2 SIDE | 55 |
| OTHERS | CALL |
| PLASTIC STORAGE BOXES | 3 |

**OUR SYSTEMS WORK!**

All systems normally tested and configured in our repair facility before delivery. Service contracts available. Prompt repairs and warranties.

Circle 32 on inquiry card.

*Listing 1 continued:*

```
037D  A9 20     TYP2  LDA   #$20        SEPERATE
037F  24 E2           BIT   COMAND       READ
0381  F0 0A           BEQ   RDT           FROM WRITE
0383            ;
0383            ;  ******* WRITE RECOVERY
0383            ;
0383  A9 60     WRT   LDA   #$60        ERROR MASK
0385  24 E3           BIT   STATUS      STOP IF WRITE
0387  F0 04           BEQ   RDT          PROTECT/FAULT
0389  A9 FF     ER1   LDA   #$FF        SET ERROR CODE
038B  D0 D2           BNE   RTN2        RETURN
038D            ;
038D            ;  ******* COMMON RECOVERY
038D            ;
038D  A9 0C     RDT   LDA   #$0C        ERROR MASK
038F  24 E3           BIT   STATUS      IF ERROR
0391  D0 10           BNE   RDT1         RETRY
0393  A9 10           LDA   #$10        CHECK FOR
0395  24 E3           BIT   STATUS       NOT FND
0397  F0 C3           BEQ   RTN1          NONE RETURN
```



```
CARD # LOC    CODE      CARD  10      20        30        40        50        60        70
0399            ;                       IF MULTIPLE
0399  24 E2           BIT   COMAND       SECTOR OPERATION
039B  F0 06           BEQ   RDT1          CHECK
039D  A9 1B           LDA   #$1B           FOR END OF
039F  C5 E5           CMP   SECTOR          TRACK
03A1  F0 B9           BEQ   RTN1        CALL IT NORMAL
03A3            ;
03A3            ;  ******* CHECK ERROR COUNT
03A3            ;
03A3  C6 E1     RDT1  DEC   ERRCDE      DECR ERROR CNT
03A5  10 05           BPL   RDT2        RETURN
03A7  68              PLA                WITH
03A8  68              PLA                 ERROR
03A9  4C 65 03        JMP   RTN3           CONDITION
03AC            ;
03AC            ;  ******* RETRY OPERATION
03AC            ;
03AC  68        RDT2  PLA               RESTORE
03AD  85 E5           STA   SECTOR       SECTOR
03AF  68              PLA               RESTORE
03B0  85 E7           STA   FDBUF+1      ADDR HIGH
03B2  4C 3A 03        JMP   RETRY       RETRY
```

*Listing 1 continued on page 324*

Circle 229 on inquiry card.

*Listing 1 continued:*

```
   FD400/FD1771B FLOPPY DISK FORMAT                                         PAGE   12

CARD # LOC     CODE        CARD  10        20        30        40        50        60        70
       03B5               ;
       03B5               ;
       03B5               ;  THIS SEGMENT FORMATS AN ENTIRE FLOPPY DISKETTE IN IBM COMPATIBLE
       03B5               ; SOFT SECTORING WITH 128 BYTE SECTORS. EACH SECTOR CONTAINS 80
       03B5               ; BYTES OF ASCII BLANK(X'20') FOLLOWED BY HEX ZEROS FOR THE
       03B5               ; REMAINDER OF THE SECTOR.
       03B5               ;
       03B5               ;
       03B5               ;
       03B5               ; ******* INITIALIZE
       03B5               ;
       03B5   20 F6 02    FORMAT JSR   FDINT       INIT SYSTEM         ** ENTRY **
       03B8   A2 00              LDX   #0          A SIDE
       03BA   8E 0D CC           STX   CRA          DIRECTION
       03BD   CA                 DEX               SET TO
       03BE   8E 0C CC           STX   SADD         OUTPUT
       03C1   A2 2C              LDX   #$2C        A SIDE
       03C3   8E 0D CC           STX   CRA          DATA
       03C6               ;
       03C6               ; ******* SET UP RECORD
       03C6               ;
       03C6   A9 4C              LDA   #$4C        SET
       03C8   8D 00 05           STA   REND         TRACK COUNT
       03CB   A9 FF              LDA   #$FF        SET TRK
       03CD   8D B3 05           STA   RTN          TO ZERO
       03D0   A9 FE       GO     LDA   #$FE        SET SECTOR
       03D2   8D B1 05           STA   RSN          TO ONE
       03D5   A2 1A              LDX   #$1A        SECTOR CNT
       03D7   A0 FD              LDY   #RSTRT-REND WRITE LENGTH
       03D9               ;
       03D9               ; ******* ISSUE WRITE TRACK
       03D9               ;
       03D9   A9 0B              LDA   #255-FDWTT STOR FD1771B
       03DB   8D 0C CC           STA   SAD          COMMAND
       03DE   A9 19              LDA   #WRITE+CMD STORE PIA
       03E0   8D 0E CC           STA   SBD          COMMAND
       03E3   CE 0E CC           DEC   SBD         ENABLE
       03E6   EE 0E CC           INC   SBD          READ/WRITE
       03E9   A9 1F              LDA   #WRITE+DATA STORE PIA
       03EB   8D 0E CC           STA   SBD          COMMAND
       03EE               ;
       03EE               ; ******* RECORD TRANSFER
       03EE               ;
       03EE   EE FE 05    WDT    INC   RSTRT+1     DELAY 6 CYCLES
       03F1   B9 00 05           LDA   REND,Y      STORE A
       03F4   8D 0C CC           STA   SAD          DATA BYTE
       03F7   2C 0E CC    WLP    BIT   SBD         WAIT FOR
       03FA   30 12              BMI   NEXT         INTRQ
       03FC   50 F9              BVC   WLP           OR DRQ
       03FE   88                 DEY               DECR INDEX
       03FF   D0 ED              BNE   WDT         CONTINUE
       0401   CE B1 05           DEC   RSN         INC SECTOR
       0404   A0 BA              LDY   #RNORM-REND INDEX VALUE
       0406   CA                 DEX               DECR SECTOR CNT
       0407   D0 E8              BNE   WDT+3       CONTINUE

   FD400/FD1771B FLOPPY DISK FORMAT                                         PAGE   13

CARD # LOC     CODE        CARD  10        20        30        40        50        60        70
       0409               ;
       0409               ; ******* WAIT FOR COMPLETION
       0409               ;
       0409   2C 0E CC    TRKEND BIT   SBD         WAIT FOR
       040C   10 FB              BPL   TRKEND       INTRQ
       040E               ;
       040E               ; ******* MOVE TO NEXT TRACK
       040E               ;
       040E   20 35 04    NEXT   JSR   DELAY       DELAY 40 MS.
       0411   A9 B5              LDA   #255-FDSTI-QH STORE FD1771B
       0413   8D 0C CC           STA   SAD          COMMAND
       0416   A9 19              LDA   #WRITE+CMD STORE PIA
```

*Listing 1 continued on page 326*

# LSI II/23® COMPUTER WITH 256KB MEMORY $5175.00


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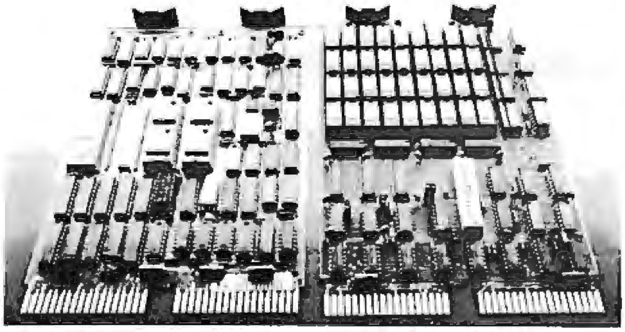

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**10 Megabyte** Cartridge Disk System **$4995**

**1 Megabyte** RX02 Floppy Disk System **$2950**

**RT11 V4** Operating System. **$1085**

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Circle 60 on inquiry card.

*Listing 1 continued:*

```
  569  0418  8D 0E CC             STA   SBD        COMMAND
  570  041B  CE 0E CC             DEC   SBD        ENABLE
  571  041E  EE 0E CC             INC   SBD        READ/WRITE
  572  0421  2C 0E CC    SLP      BIT   SBD        WAIT FOR
  573  0424  10 FB                BPL   SLP        INTRQ
  574  0426  20 35 04             JSR   DELAY      DELAY 40 MS.
  575  0429  CE B3 05             DEC   RTN        INCR TRACK
  576  042C  CE 00 05             DEC   REND       DEC TRK CNT
  577  042F  10 9F                BPL   GO         CONTINUE
  578  0431  20 F6 02             JSR   FDINT      RESTORE DRIVE
  579  0434  60                   RTS              STOP
  580  0435              ;
  581  0435              ;   ******* DELAY 40 MS.
  582  0435              ;
  583  0435  A9 40       DELAY    LDA   #$40       MAJOR LOOP VALUE
  584  0437  85 00                STA   TIME1      MAJOR LOOP CNT
  535  0439  A9 4A       DL2      LDA   #$4A       MINOR LOOP VALUE
  586  043B  85 01                STA   TIME2      MINOR LOOP CNT
  587  043D  C6 01       DL1      DEC   TIME2      DECR MINOR CNT
  588  043F  D0 FC                BNE   DL1        CONTINUE
  589  0441  C6 00                DEC   TIME1      DECR MAJOR CNT
  590  0443  D0 F4                BNE   DL2        CONTINUE
  591  0445  60                   RTS              RETURN


   FD400/FD1771B FLOPPY DISK FORMAT                                   PAGE   14

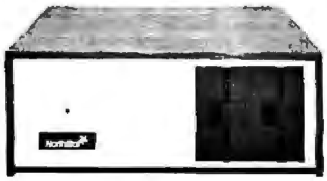
CARD # LOC     CODE       CARD  10        20        30        40        50        60        70
  593  0446                       *=*+255/256*256
  594  0500              ;
  595  0500              ;   ******* RECORD FORMAT
  596  0500              ;           (REVERSED AND INVERTED)
  597  0500  00          REND     .BYTE $00
  598  0501  00                   .BYTE $00,$00,$00,$00,$00,$00,$00,$00
  598  0502  00
  598  0503  00
  598  0504  00
  598  0505  00
  598  0506  00
  598  0507  00
  598  0508  00
  599  0509  00                   .BYTE $00,$00,$00,$00,$00,$00,$00,$00
  599  050A  00
  599  050B  00
  599  050C  00
  599  050D  00
  599  050E  00
```

*Listing 1 continued on page 328*



# LOWEST PRICE - BEST QUALITY

## NORTH STAR



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| HORIZON RAM ASSM | 16K = $389. | 32K = $579 |
| HORIZON RAM KIT SALE! | 16K = $314 | 32K = $469 |
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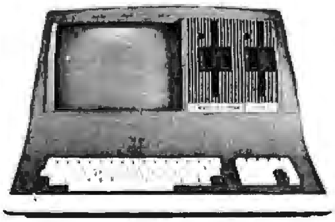

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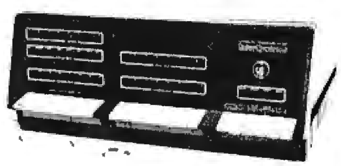

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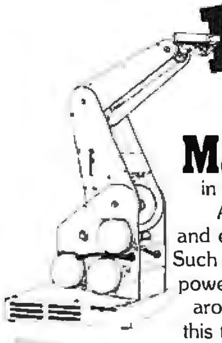
Circle 20 on inquiry card.

*Listing 1 continued:*

```
599   050F   00
599   0510   00
600   0511   00                .BYTE $00,$00,$00,$00,$00,$00,$00,$00
600   0512.  00
600   0513   00
600   0514   00
600   0515   00
600   0516   00
600   0517   00
600   0518   00
601   0519   00                .BYTE $00,$00,$00
601   051A   00
601   051B   00
602   051C   08                .BYTE $08                          DATA CRC
603   051D   FF                .BYTE $FF,$FF,$FF,$FF,$FF,$FF,$FF,$FF
603   051E   FF
603   051F   FF
603   0520   FF
603   0521   FF
603   0522   FF
603   0523   FF
603   0524   FF
604   0525   FF                .BYTE $FF,$FF,$FF,$FF,$FF,$FF,$FF,$FF
604   0526   FF
604   0527   FF
604   0528   FF
604   0529   FF
604   052A   FF
604   052B   FF
604   052C   FF
605   052D   FF                .BYTE $FF,$FF,$FF,$FF,$FF,$FF,$FF,$FF
605   052E   FF
605   052F   FF
605   0530   FF
605   0531   FF
605   0532   FF
```

*Listing 1 continued on page 330*

Circle 316 on inquiry card.



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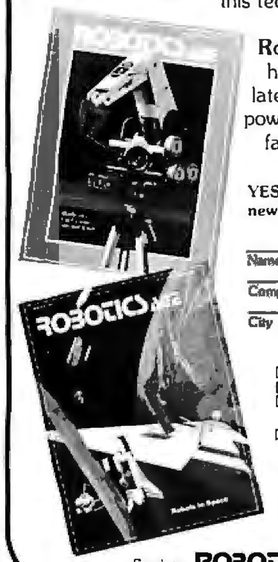


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|---|---|
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Circle 262 on inquiry card.

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*Listing 1 continued:*

```
   FD400/FD1771B FLOPPY DISK FORMAT                                          PAGE   15

CARD # LOC      CODE        CARD  10         20         30         40         50         60         70
  605  0533   FF
  605  0534   FF
  606  0535   FF                 .BYTE $FF,$FF,$FF,$FF,$FF,$FF,$FF,$FF
  606  0536   FF
  606  0537   FF
  606  0538   FF
  606  0539   FF
  606  053A   FF
  606  053B   FF
  606  053C   FF
  607  053D   FF                 .BYTE $FF,$FF,$FF,$FF,$FF,$FF,$FF,$FF
  607  053E   FF
  607  053F   FF
  607  0540   FF
  607  0541   FF
  607  0542   FF
  607  0543   FF
  607  0544   FF
  608  0545   FF                 .BYTE $FF,$FF,$FF,$FF,$FF,$FF,$FF,$FF
  608  0546   FF
  608  0547   FF
  608  0548   FF
  608  0549   FF
  608  054A   FF
  608  054B   FF
  608  054C   FF
  609  054D   DF                 .BYTE $DF,$DF,$DF,$DF,$DF,$DF,$DF,$DF
  609  054E   DF
  609  054F   DF
  609  0550   DF
  609  0551   DF
  609  0552   DF
  609  0553   DF
  609  0554   DF
  610  0555   DF                 .BYTE $DF,$DF,$DF,$DF,$DF,$DF,$DF,$DF
  610  0556   DF
  610  0557   DF
  610  0558   DF
  610  0559   DF
  610  055A   DF
  610  055B   DF
  610  055C   DF
  611  055D   DF                 .BYTE $DF,$DF,$DF,$DF,$DF,$DF,$DF,$DF
  611  055E   DF
  611  055F   DF
  611  0560   DF
  611  0561   DF
  611  0562   DF
  611  0563   DF
  611  0564   DF
  612  0565   DF                 .BYTE $DF,$DF,$DF,$DF,$DF,$DF,$DF,$DF
  612  0566   DF
  612  0567   DF
  612  0568   DF
  612  0569   DF


   FD400/FD1771B FLOPPY DISK FORMAT                                          PAGE   16

CARD # LOC      CODE        CARD  10         20         30         40         50         60         70
  612  056A   DF
  612  056B   DF
  612  056C   DF
  613  056D   DF                 .BYTE $DF,$DF,$DF,$DF,$DF,$DF,$DF,$DF
  613  056E   DF
  613  056F   DF
  613  0570   DF
  613  0571   DF
  613  0572   DF
  613  0573   DF
  613  0574   DF
```

*Listing 1 continued on page 332*

*Listing 1 continued:*

```
  614   0575   DF              .BYTE $DF,$DF,$DF,$DF,$DF,$DF,$DF,$DF
  614   0576   DF
  614   0577   DF
  614   0578   DF
  614   0579   DF
  614   057A   DF
  614   057B   DF
  614   057C   DF
  615   057D   DF              .BYTE $DF,$DF,$DF,$DF,$DF,$DF,$DF,$DF
  615   057E   DF
  615   057F   DF
  615   0580   DF
  615   0581   DF
  615   0582   DF
  615   0583   DF
  615   0584   DF
  616   0585   DF              .BYTE $DF,$DF,$DF,$DF,$DF,$DF,$DF,$DF
  616   0586   DF
  616   0587   DF
  616   0588   DF
  616   0589   DF
  616   058A   DF
  616   058B   DF
  616   058C   DF
  617   058D   DF              .BYTE $DF,$DF,$DF,$DF,$DF,$DF,$DF,$DF
  617   058E   DF
  617   058F   DF
  617   0590   DF
  617   0591   DF
  617   0592   DF
  617   0593   DF
  617   0594   DF
  618   0595   DF              .BYTE $DF,$DF,$DF,$DF,$DF,$DF,$DF,$DF
  618   0596   DF
  618   0597   DF
  618   0598   DF
  618   0599   DF
  618   059A   DF
  618   059B   DF
  618   059C   DF
  619   059D   04              .BYTE $04                            DATA AM
  620   059E   FF              .BYTE $FF,$FF,$FF,$FF,$FF,$FF        DATA FLD SYNC
  620   059F   FF
  620   05A0   FF


    FD400/FD1771B FLOPPY DISK FORMAT                              PAGE   17

CARD # LOC     CODE       CARD  10        20        30        40        50        60        70
  620   05A1   FF
  620   05A2   FF
  620   05A3   FF
  621   05A4   00              .BYTE $00,$00,$00,$00,$00,$00        DATA
  621   05A5   00
  621   05A6   00
  621   05A7   00
  621   05A8   00
  621   05A9   00
  622   05AA   00              .BYTE $00,$00,$00,$00,$00             GAP
  622   05AB   00
  622   05AC   00
  622   05AD   00
  622   05AE   00
  623   05AF   08              .BYTE $08                            ADDR CRC
  624   05B0   FF        RSL   .BYTE $FF                            SECTOR LENGTH
  625   05B1   FE        RSN   .BYTE $FE                            SECTOR ADDR
  626   05B2   FF              .BYTE $FF                            ZERO
  627   05B3   FF        RTN   .BYTE $FF                            TRACK ADDR
  628   05B4   01              .BYTE $01                            ID AM
  629   05B5   FF              .BYTE $FF,$FF,$FF,$FF,$FF,$FF        ADDR SYNC
  629   05B6   FF
  629   05B7   FF
  629   05B8   FF
  629   05B9   FF
```

*Listing 1 continued on page 334*

# Does timesharing on a small system make sense?


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The file management system has fast, byte-addressable random-and sequential-access files. The tree-structured multiple directory system lets you create separate disk directories for each user, project, or application. Command line I/O file redirection means you specify what device and/or files a program will use when you run it, not when you write it.

### Efficiency and hardware versatility

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Circle 239 on inquiry card.

*Listing 1 continued:*

```
  629  05BA  FF
  630  05BB              RNORM   =*-1
  631  05BB  00                  .BYTE $00,$00,$00,$00,$00,$00,$00,$00
  631  05BC  00
  631  05BD  00
  631  05BE  00
  631  05BF  00
  631  05C0  00
  631  05C1  00
  631  05C2  00
  632  05C3  00                  .BYTE $00,$00,$00,$00,$00,$00,$00,$00
  632  05C4  00
  632  05C5  00
  632  05C6  00
  632  05C7  00
  632  05C8  00
  632  05C9  00
  632  05CA  00
  633  05CB  00                  .BYTE $00,$00,$00,$00,$00,$00,$00,$00
  633  05CC  00
  633  05CD  00
  633  05CE  00
  633  05CF  00
  633  05D0  00
  633  05D1  00
  633  05D2  00
  634  05D3  00                  .BYTE $00,$00
  634  05D4  00
  635  05D5  03                  .BYTE $03                      INDEX MARK
  636  05D6  00                  .BYTE $00,$00,$00,$00,$00,$00,$00,$00

   FD400/FD1771B FLOPPY DISK FORMAT                              PAGE   18

CARD # LOC    CODE      CARD  10        20        30        40        50        60        70
  636  05D7  00
  636  05D8  00
  636  05D9  00
  636  05DA  00
  636  05DB  00
  636  05DC  00
  636  05DD  00
  637  05DE  00                  .BYTE $00,$00,$00,$00,$00,$00,$00,$00
  637  05DF  00
  637  05E0  00
  637  05E1  00
  637  05E2  00
  637  05E3  00
  637  05E4  00
  637  05E5  00
  638  05E6  00                  .BYTE $00,$00,$00,$00,$00,$00,$00,$00
  638  05E7  00
  638  05E8  00
  638  05E9  00
  638  05EA  00
  638  05EB  00
  638  05EC  00
  638  05ED  00
  639  05EE  00                  .BYTE $00,$00,$00,$00,$00,$00,$00,$00
  639  05EF  00
  639  05F0  00
  639  05F1  00
  639  05F2  00
  639  05F3  00
  639  05F4  00
  639  05F5  00
  640  05F6  00                  .BYTE $00,$00,$00,$00,$00,$00,$00,$00
  640  05F7  00
  640  05F8  00
  640  05F9  00
  640  05FA  00
  640  05FB  00
  640  05FC  00
  640  05FD  00
  641  05FE              RSTRT   =*-1
  642  05FE                      .END
```

*Listing 1 continued on page 336*

*Listing 1 continued:*

```
END OF MOS/TECHNOLOGY 650X ASSEMBLY VERSION 5
NUMBER OF ERRORS =    0,  NUMBER OF WARNINGS =    0


        SYMBOL TABLE

SYMBOL    VALUE   LINE DEFINED        CROSS-REFERENCES

BASIC     0240          233   197  199  210  362  365
CMD       0000          175   312  536  568
CMPANL    0248          239   204  218  282  302
COMAND    00E2          184   195  223  228  257  260  263  272  314  361  422
                              427  453  460  480
CPLP      024A          240   247
CRA       CC0D           96   338  341  515  519
CRB       CC0F           99   350  355  359  364  404
DATA      0006          174   200  279  296  540
DELAY     0435          583   565  574
DL1       043D          587   588
DL2       0439          585   590
DVCODE    00E0          182   351  401
ERRCDE    00E1          183   399  434  488
ER1       0389          468   416  417  451  454
FDBUF     00E6          188   286  289  298  306  405  499
FDENT     0225          214 . 261  409
FDFI      00D0          137  ****
FDINT     02F6          346   513  578
FDIO      0326          393  ****
FDRD      0080          132  ****
FDRDA     00C4          134  ****
FDRDT     00E4          135  ****
FDRST     0002          127   360
FDSK      0012          128   259
FDST      0022          129  ****
FDSTI     0042          130   566
FDSTO     0062          131  ****
FDWT      00A0          133  ****
FDWTT     00F4          136   534
FORMAT    03B5          513  ****
GO        03D0          527   577
NEXT      040E          565   549
PULSE     02CD          321   205  209  216  244  254  270  315
QAFA      00FA          163  ****
QAFB      00FB          162  ****
QAF8      00F8          165  ****
QAF9      00F9          164  ****
QB        0008          145  ****
QCRC      00F7          159  ****
QE        0004          151  ****
QFA       0001          153  ****
QFB       0000          152  ****
QF8       0011          155  ****
QF9       0010          154  ****
QH        0008          142   566
QIAM      00FC          160  ****
QIDM      00FE          161  ****
QIO       0001          147  ****
QI1       0002          148  ****
QI2       0004          149  ****
QI3       0008          150  ****
QM        0010          144  ****
QS        0001          146  ****


SYMBOL   VALUE   LINE DEFINED        CROSS-REFERENCES

QU        0010          143  ****
QV        0004          141  ****
RDATA     0284          277   226
RDL       028E          281   283  288  290
RDT       038D          473   425  461  467
RDT1      03A3          488   455  475  481
RDT2      03AC          496   489
READ      0029          169   214  242  252  279
```

*Listing 1 continued on page 338*

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Circle 191 on inquiry card.

*Listing 1 continued:*

```
REND      0500      597   524   546   576   530   554
RETRY     033A      405   500
RNORM     05BA      630   554
RSL       05B0      624   ****
RSN       05B1      625   528   553
RSTRT     05FD      641   530   545
RTN       05B3      627   526   575
RTN1      035C      432   449   478   484
RTN2      035F      434   469
RTN3      0365      438   492
SAD       CC0C       95   284   300   322   325   348   535   547   567
SADD      CC0C       94   339   517
SBD       CC0E       98   234   281   301   323   324   332   353   537   538   539
                          541   548   560   569   570   571   572
SBDD      CC0E       97   357
SECT      0004      173   206   267
SECTOR    00E5      187   208   269   407   436   483   497
SETDVC    0337      404   402
SETUP     02DE      331   201   207   215   243   253   268   280   297   313
SET1      02E8      337   335   347
SLP       0421      572   573
STAT      0000      171   214
STATUS    00E3      185   245   415   448   466   474   477
TIME1     0000      179   584   589
TIME2     0001      180   586   587
TRACK     00E4      186   202   255
TRK       0002      172   252
TRKEND    0409      560   561
TYPE1     0200      195   224
TYPE2     025B      252   225
TYPE2A    0274      267   256
TYP1      036B      447   423
TYP2      037D      459   424
WDATA     02A3      294   229   273
WDT       03EE      545   552   556
WLP       03F7      548   550
WRITE     0019      170   200   206   267   296   312   536   540   568
WRT       0383      465   428
WRTCMD    02C2      312   233   277   294
WTL       02AD      298   305   307
WTL1      02B4      301   303
```

```
INSTRUCTION  COUNT

    ADC         0
    AND         1
    ASL         3
    BCC         1
    BCS         3
    BEQ        11
    BIT        19
    BMI         5
    BNE        15
    BPL         8
    BRK         0
    BVC         6
    BVS         0
    CLC         1
    CLD         0
    CLI         0
    CLV         0
    CMP         6
    CPX         0
    CPY         0
    DEC         9
    DEX         4
    DEY         2
    EOR         4
    INC         6
    INX         1
    INY         2
    JMP         4
    JSR        27
    LDA        52
    LDX         8
    LDY         6
```

*Listing 1 continued on page 340*

*Listing 1 continued:*

```
        LSR          0
        NOP          0
        ORA          2
        PHA          6
        PHP          0
        PLA         10
        PLP          0
        ROL          0
        ROR          1
        RTI          0
        RTS          7
        SBC          0
        SEC          1
        SED          0
        SEI          0
        STA         27
        STX         10
        STY          1
        TAX          1
        TAY          1
        TSX          0
        TXA          1
        TXS          0
        TYA          2

 # SYMBOLS =  101 (LIMIT =  800)      # BYTES =  837 (LIMIT = 8192)


# LINES =  853 (LIMIT = 3000)      # XREFS =  257 (LIMIT = 1600)
```

**Listing 2:** *Example of a routine that reads disk track 3 into memory, starting at location hexadecimal 1000. This routine also illustrates the use of the ERRCDE variable.*

```
JSR FDINT          Initialize
LDA #$9C           Read multiple
STA COMMAND           sector command
LDA #$03           Request track
STA TRACK             number 3
LDA #0             Set buffer
STA FDBUF             address
LDA #$10                 at
STA FDBUF + 1                  hexadecimal 1000
JSR FDIO           Do I/O
LDA STATUS            check for
BNE ERROR                error
   .
   .
   .
```

**Listing 3:** *Simple testing program for a disk controller/6502 microprocessor combination. When the BRK (break) occurs, the variables listed in table 6 can be set to test the various controller functions.*

```
INIT    JSR FDINT
        BRK
        BRK
GO      JSR FDENT
        BRK
        BRK
        JMP GO
```

*Text continued from page 304:*

1000. The status byte indicates if the read operation was successful. If the read test appears good, various other commands should be attempted to increase your familiarity with the 1771 and drive operation.

## Extensions

With the addition of an external multiplexing circuit to switch the floppy-disk control lines, multiple drives can be controlled. Multiple drives, however, add a new software-control problem. Since the 1771 retains the current head location, it is necessary to update the track register when switching between drives. A memory variable to contain the head location of each drive can be used to adjust the 1771's register.

A simplified version of the floppy-disk controller can be used to operate 5-inch disk drives in either single- or dual-density. In addition, this disk design is extensible to a more elaborate controller that uses a dedicated 6502 to communicate over a parallel or serial interface to a host computer.

## Conclusion

Floppy-disk drives provide sufficient capacity and performance to meet the needs of most microcomputer users. By combining hardware and software, a floppy-disk system can be constructed economically without sacrificing any function or performance. The 6502 microprocessor, with a few hundred bytes of program, can control head movement and data transfer by utilizing the 1771 controller. The software provides a flexible, yet economic, solution to mass-storage problems.■

Circle 110 on inquiry card.

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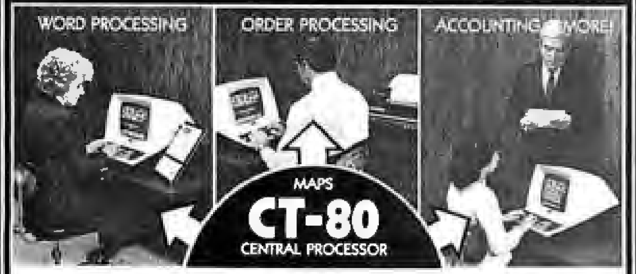


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Circle 127 on inquiry card.

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# Ask BYTE

Conducted by Steve Ciarcia

### Easy Data Entry?

Dear Steve,

I enjoyed your article "Build a Low-Cost, Remote Data-Entry Terminal." (See the September 1980 BYTE, page 26.) Your idea is close to the type of device I need: a simple data-entry terminal that has a ten-character display and can be used to record data, ten characters at a time, using an audio-cassette recorder. Is there an easy way to use your device for this?

**Roy Pittman**
**Stillwater OK**

*The remote data-entry terminal described in that article will do some of the things you want, but not everything. It cannot support more than an 8-bit display without circuit modification. It can, however, easily store and send up to fourteen characters entered sequentially on the keypad (refer to the last paragraph, on page 32 of the article).*

*Although it is a little involved and requires some extra button pushes to load the characters, the data-entry terminal could be used as you have suggested. To do it, you first press the Control-Escape to enter the storage mode (the remote terminal sends a hexadecimal FA output to the recorder). Decoding the FA code will allow automatic turn-on of the recorder. The next one to fourteen keys pressed will be stored. They are automatically sent as a single message when a Control-semicolon is typed.*

*As designed, the data rate is 1200 bps (bits per second). To lower the data rate to something more manageable, say 300 bps, you simply lower the crystal frequency proportionately. To remotely switch a tape recorder on and off, you can use the keyboard function decoder that I described in a previous article. (See "Build a Keyboard Function Decoder," July 1978 BYTE, page 98.)* . . . **Steve**

### Backup Supplies

Dear Steve,

Allow me to add another request for backup power supplies. I want to use a computer for Bible translating for tribal people, but our electric power not only blacks out for a few minutes to several days, but when the local welder starts work, the lights dim each time he strikes an arc.

My son had a computer damaged when a copying machine was turned on, so I wonder about the welder. I had decided on a solution similar to the ideas you have mentioned, but I felt that I couldn't design a sine-wave inverter and that a computer probably wouldn't accept the square wave from a Heathkit inverter. How about the motor/generator rigs used by the military for B+ power supplies? A 1974 McMaster-Carr catalog shows that they were available in 24, 28, 32, 63, and 110 VDC input and 250 to 2000 W output at 115 V 60 Hz. Prices ranged from $200 to $600.

Of course, this wouldn't be as efficient as a solid-state inverter, and would need maintenance (since the rigs have brushes) but it might be easier and cheaper to buy equipment on the surplus market.

Also, who publishes *Digital Design* ?

**Russell Reed**
**Pinamalayan, Oriental Mindoro, Philippines**

*Motor/generator combinations are definitely a reasonable backup power system. That was all there was before solid-state converters. I cannot speak for the condition of a World War II surplus unit, but if it operates, it can be an economical solution to your problem. In fact, many computer manufacturers (such as Control Data) frequently use motor/generators in their installations. Be careful to monitor the output frequency as well as the voltage when you first start it. The years may have taken their toll on the regulator section.*

Digital Design *is published by Benwill Publishing Corporation, 1050 Commonwealth Ave, Boston MA 02215. The issue covering uninterruptible power supplies was February 1980 (Volume 10, Number 2).* . . . **Steve**

### Bank Switching

Dear Steve,

With the recent price reduction of dynamic memory circuits, a 64 K-byte memory system can be built with 32 devices (at $96) or 128 devices (for $64). I read BYTE and other fine publications and I keep coming across an interesting concept called bank switching. What exactly is bank switching? Also, an idea I have is to latch the data at a port bus to provide a

Circle 37 on inquiry card.





Circle 70 on inquiry card.



Circle 179 on inquiry card.

total address bus of 24 bits. Can I do this?

**Simon Chapman**
**Petaluma CA**

*Memory is indeed becoming inexpensive these days. Many personal computers will soon contain more than 64 K bytes of memory. To use the extra memory, they must, of course, use bank switching.*

*A bank of memory is some portion of memory that can be directly addressed by the processor. If you had an Apple II computer with 48 K bytes of memory, all 64 K bytes (including read-only memory) would be in the same bank of memory. Addressing the 64 K requires 16 address bits. If you were to add another 64 K of directly addressable memory, 17 bits would be required. Since the 6502 microprocessor (and the Z80 for that matter) has only 16 address bits, the additional bit must be created under program control.*

*The typical method is to dedicate a latched output port to this function. To access this second bank of memory, a program in the first bank sets the port output high, simulating the seventeenth address bit. The computer then works exclusively in the second bank. To return to the first bank, a program in the second bank resets the port to a low level.*

*As you can see, it can get complicated switching back and forth. Mirror images of the operating-system software would have to be resident in both banks. The solution to this problem is to bank-switch memory in 32 K-byte increments rather than 64 K bytes. The typical system would have the first 32 K-byte bank contain the operating system and switch up to eight individual 32 K banks occupying the second 32 K range. Activation of one of the eight boards is handled by setting a bit on an output port (each bit is a separate memory-bank enable) through the always resident operating system. In most cases, the bank-switching is transparent to the user and takes only a few instructions.*

*Perhaps as soon as I get some of the new 64 K-byte integrated circuits, I'll discuss this topic in greater depth in an article. . . .* **Steve**

## Computer Stores

Dear Steve,

I have a degree in electronics and my fiancée has a degree in business management. We live in a small town and would like to open a computer store, for small businesses, homes, and industry. Where can I get some help and ideas on getting started? There are no computer-related jobs around here, and I feel like I'm being left out.

**Bill Bass**
**Bristol TN**

*Starting a computer store is a costly and tough job. When you first open a computer store, most personal-computer manufacturers will only ship cash-on-delivery, and many items must be in stock for you to sell them. When hobbyists walk into a computer store, rather than ask if you sell it, most will ask if you have it in stock. Your advantage is not price—mail-order houses are generally much cheaper—so it must be demonstration and availability that sells your products.*

*Turnover of stock is the key to success. Make sure there is a large enough market in your area before committing to this endeavor, and only believe about a quarter of the people who say they will buy something from you if you open a store.*

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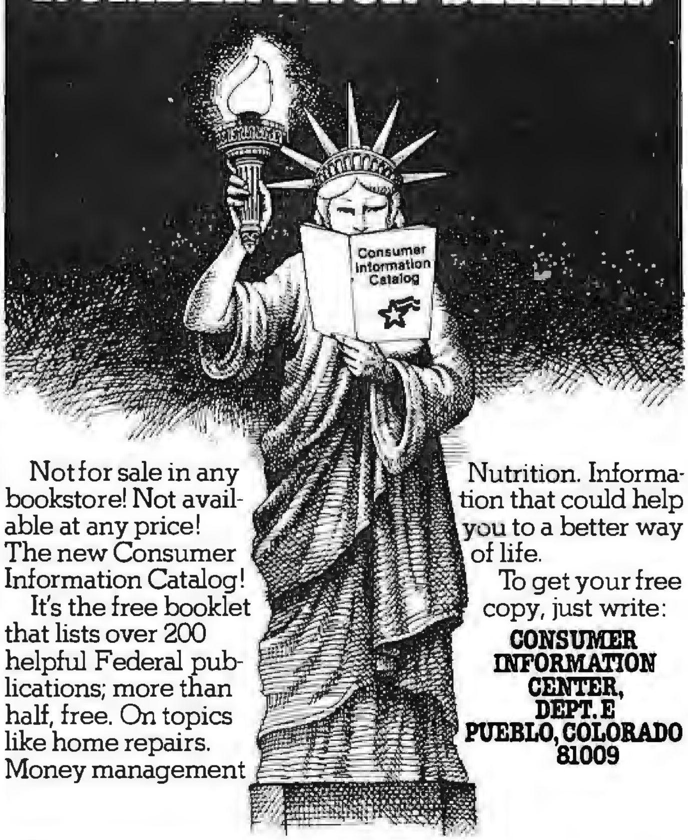


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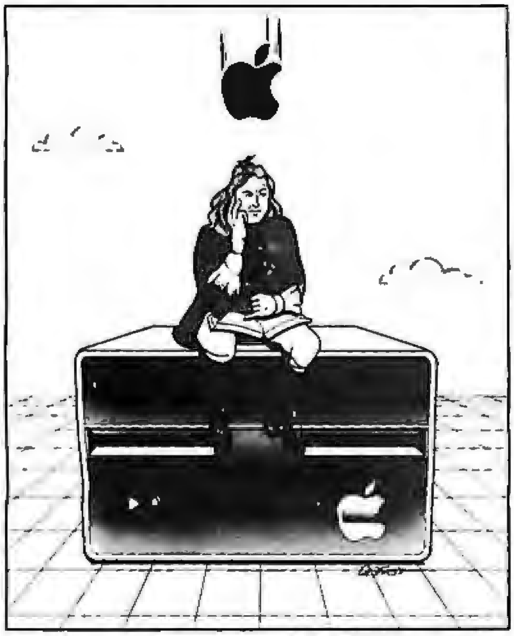

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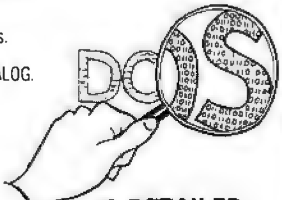


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*puter store is to visit one in another town (make sure it's not close enough to be a competitor) and ask the owner the questions you are posing to me. This is a new field and, unfortunately, there are as many failures as there are successes. Be careful, but don't hesitate to strike out on your own. . . .* **Steve**

## Double Characters

Dear Steve,

I would like to acquire a home terminal, since terminal time at school is sometimes difficult to get. Is it possible to build a circuit to connect between the output of a TRS-80 Color Computer or a Videotex and my television or monitor that would double the number of characters per line that these machines display?

The Videotex seemed like the answer to my problems, but I need more than 32 characters to log on to the system I use.

**Eric Lutz**
**Columbia PA**

*When you buy a computer, you get what you pay for. The hardware to produce 32 characters is cheaper than that to produce 64. While it's quite possible that some hobbyist will design a circuit to do the conversion you suggest, it hasn't happened yet. Also, I wouldn't buy equipment on the presumption that you can easily redesign it.*

*As for logging onto a computer, the number of characters displayed on the screen is usually immaterial. The software-terminal program used with the computer should "wrap around" at the end of 32 characters onto the next line (even though you haven't hit the carriage-return key yet). The length of the line you send is entirely determined by when you type a carriage return (after 50, 75, or any number characters).*

*I wouldn't be especially concerned about a 32-character display given the price/performance ratio of the machine. . . .* **Steve**

## Comparing Frequency

Dear Steve,

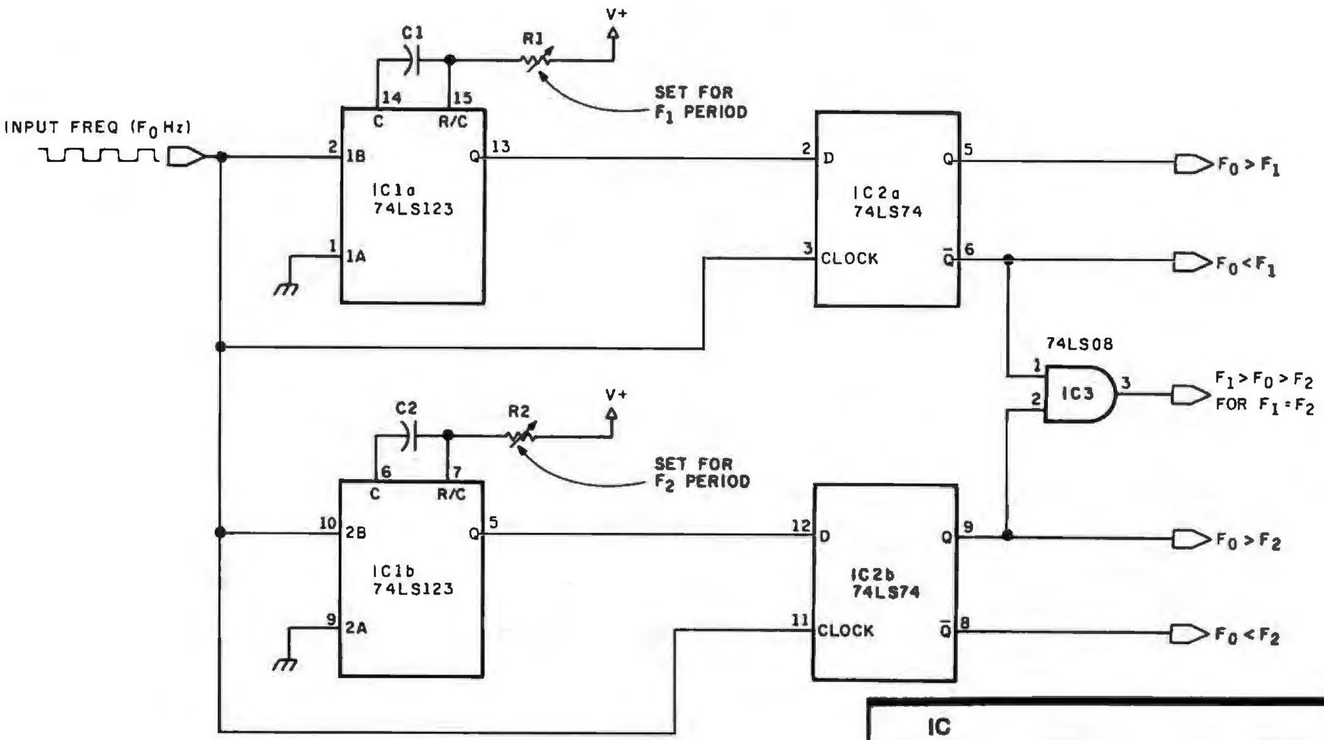
I am looking for a circuit that compares two input signals and detects which has the greater frequency. The project I am building has a +5 V supply, so it would be handy to use TTL (transistor-transistor logic). Are there single integrated circuits to perform this function?

**Marvin Green**
**Tualatin OR**

*There are various ways to compare frequencies. The comparison can be either analog or digital. One analog method is to use frequency-to-voltage converters and simple "window" comparators. (This technique is reliable only at lower frequencies.)*

*Since you mentioned +5 V, you're probably more interested in a digital-frequency comparator. Generally this is accomplished by comparing the phases of the two signals. An integrated circuit specifically designed for this purpose is the Motorola MC4044 Phase Comparator. (Determining A>B or B>A requires additional circuitry.)*

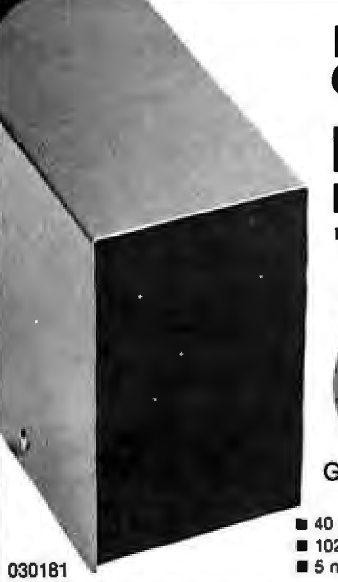
*If you know the ranges of the frequencies that you wish to compare, often it is easier to compare one unknown to some preset limits. (See figure 1.) Two retriggerable one-shots have their periods set for the upper limit (F1) and lower limit (F2) of the capture range. When the unknown frequency (F0) is applied, it is gated through the remaining circuitry to provide logic outputs such as F0>F1, F0>F2, F0<F1, or F0<F2. ...***Steve**■




| IC Number | Type | +5 | GND |
|---|---|---|---|
| IC1 | 74LS123 | 16 | 8 |
| IC2 | 74LS74 | 14 | 7 |
| IC3 | 74LS08 | 14 | 7 |

Figure 1

Circle 240 on inquiry card.



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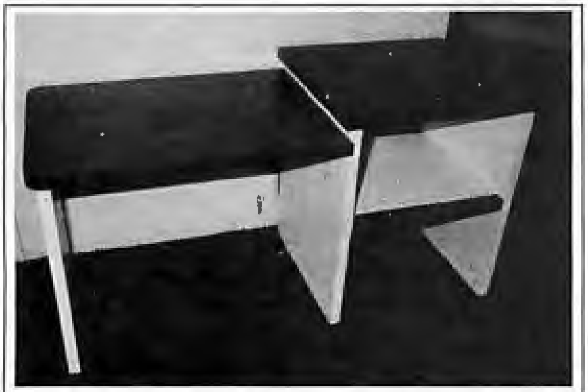

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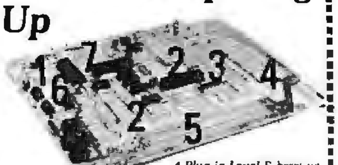

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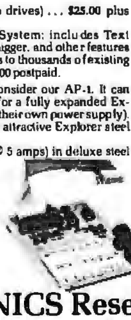

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# Software Received

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.

## Apple

**Address Book,** name and address file and telephone dialer for the Apple II. Floppy disk, $49.95. Muse Software Company, 330 N Charles St, Baltimore MD 21201.

**Data Fixer,** disk software-repair utility for the Apple II. Floppy disk, $29.95. Image Computer Products, 615 Academy Dr, Northbrook IL 60062.

**Data Plot,** on-screen data-graphing program for the Apple II. Floppy disk, $59.95. Muse Software Company, (see above).

**Invasion Force,** graphics game for the Apple II. Cassette, $19.95. Compu-Things, 708 Broadway, Chelsea MA 02150.

**Monitor Extender,** machine-language utility for the Apple II. Cassette, $19.95. Image Computer Products (see above).

**Spelling,** three educational games for the Apple II. Floppy disk, $21.95. Software by Witzel, POB 2123, Littleton CO 80161.

**Super Bar and Wine Guide,** wine selection guide and bar recipe program for the Apple II. Floppy disk, $24.95. Cine-Aero Productions, 1821 N Frederic St, Burbank CA 91505.

**Super Text Form Letter Module,** add-on module to Super Text II word-processing package for the Apple II. Floppy disk, $100. Muse Software Company (see above).

**Super Text II,** word processor for the Apple II. Floppy disk, $150. Muse Software Company (see above).

## Atari

**Shuttle Ascent Simulation,** space-shuttle simulation for the Atari 800. Cassette, $9.95. Starbound Software, POB 214, Cocoa Beach FL 32931.

## Commodore

**Addition,** educational program for the Commodore PET. Cassette, $20. Teaching Tools, POB 12679, Research Triangle Park NC 27709.

**Create-A-Base,** data-base management program for the Commodore CBM. Floppy disk, $360. Micro Computer Industries Ltd, 1520 E Mulberry, Fort Collins CO 80524.

**Subtraction,** educational program for the Commodore PET. Cassette, $20. Teaching Tools (see above).

## Exidy

**Toolkit,** screen editor and enhancements for the Exidy Sorcerer. Cassette, $69.95. North American Software, POB 1173 Station B, Downsview, Ontario, M3H 5V6, Canada.

**Sword,** word processor for the Exidy Sorcerer. Cassette, $34.95. North American Software (see above).

**Super Graphic Scratch Pad Version 2.2,** graphics utilities for the Exidy Sorcerer. Cassette, $24.95. North American Software (see above).

## Radio Shack

**Aviation,** aviation-calculation package for the TRS-80 Pocket Computer. Cassette, $24.95. Radio Shack, 1 Tandy Ctr, Fort Worth TX 76102.

**Cheaptalk,** voice-output routines for the TRS-80 Model I. Cassette, $19.95. Alan Saville, POB 5190, San Diego CA 92105.

**Income Property Analysis System,** business-analysis program for the TRS-80 Model I or III. Floppy disk, $225. Advanced Business Microsystems, 5801 Marvin D Love Fwy, #103, Dallas TX 75237.

**LDOS,** disk operating system for the TRS-80 Model I. Floppy disk, $149. Galactic Software Ltd, 11520 N Port Washington Rd, Mequon WI 53092.

**Olympic Decathlon,** multi-player graphics game for the TRS-80 Model I. Floppy disk, $24.95. Microsoft Consumer Products, 400 108th Ave NE, Suite 200, Bellevue WA 98004.

**RSM Patch,** modification package to Small Systems Software's RSM for the TRS-80 Model III. Cassette, $9.95. Remarkable Software, POB 1192, Muskegon MI 49443.

**SECS,** full-screen editor for the TRS-80 Color Computer. Cassette, $29.95. Datasoft Inc, 16600 Schoenborn St, Sepulveda CA 91343.

**SIGMON,** machine-language monitor for the TRS-80 Color Computer. Cassette, $29.95. Datasoft Inc (see above).■

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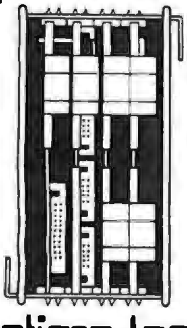

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*BASIC, A Hands-On Method, Second Edition,* Herbert D Peckham. New York: McGraw-Hill, 1981; 17.5 by 23.5 cm, 306 pages, softcover, ISBN 0-07-049160-7, $12.95.

*BASIC-Pack Statistics Programs for Small Computers,* Dennie Van Tassel. Englewood Cliffs NJ: Prentice-Hall, 1981; 21 by 28 cm, 230 pages, softcover, ISBN 0-13-066381-6, $16.95.

*Basically Speaking, A Guide to BASIC Programming for the Interact Computer,* Micro Video Corporation. Ann Arbor MI: Micro Video Corporation, POB 7357, 1980; 23 by 28 cm, 201 pages, softcover, ISBN-none, $14.95.

*Data Structures Using Pascal,* Aaron M Tenenbaum and Moshe J Augenstein. Englewood Cliffs NJ: Prentice-Hall, 1981; 18.5 by 24.5 cm, 545 pages, hardcover, ISBN 0-13-196501-8, $23.95.

*The 8085 Microprocessor, Fundamentals and Applications (Hands-On),* Howard Boyet. New York: MTI Publications, 1980; 18 by 25.5 cm, 420 pages, softcover, ISBN-none, $17.95.

*First Course in Data Processing with BASIC,* J Daniel Couger and Fred McFadden. Somerset NJ: John Wiley & Sons, 1981; 21.5 by 28 cm, 443 pages, softcover, ISBN 0-471-08046-2, $17.95.

*First Course in Data Processing with BASIC, COBOL, FORTRAN, and RPG,* J Daniel Couger and Fred McFadden. Somerset NJ: John Wiley & Sons, 1981; 21.5 by 28 cm, 532 pages, softcover, ISBN 0-471-05581-6, $20.95.

*Fundamentals of Programming in BASIC,* Robert C Nickerson. Cambridge MA: Winthrop Publishers, 1981; 17.5 by 23.5 cm, 400 pages, softcover, ISBN 8-87626-305-8, $12.95.

*Introduction to Computer Operations, Second Edition,* W M Fuori; A D'Arco; and L Orilia. Englewood Cliffs NJ: Prentice-Hall, 1981; 18.5 by 24.5 cm, 620 pages, hardcover, ISBN 0-13-480392-2, $19.

*Introduction to Computer Data Processing, Third Edition,* Wilson T Price. New York: Holt, Rinehart and Winston, 1981; 19 by 24 cm, 577 pages, hardcover, ISBN 0-03-056728-9, $18.95.

*Invitation to Pascal,* Harry Katzan Jr. Princeton NJ: Petrocelli Books, 1981; 16.5 by 24 cm, 233 pages, hardcover, ISBN 089433-103-5, $17.50.

*MA-2 Microcomputer Applications, Volume I,* Howard Boyet and Ron Katz. New York: MTI Publications, 1979; 15.5 by 23 cm, 461 pages, softcover, ISBN 0-89704-026-0, $16.

*MA-2 Microcomputer Applications, Volume 2,* same as above, 290 pages, ISBN 0-89704-027-9, $9.

*Microprocessor System Debugging,* Noordin Ghani and Edward Farrell. Somerset NJ: John Wiley & Sons, 1980; 18.5 by 28.5 cm, 143 pages, softcover, ISBN 0-471-27860-2, $43.50.

*Microprogrammed Control and Reliable Design of Small Computers,* George D Kraft and Wing N Toy. Englewood Cliffs NJ: Prentice-Hall, 1981; 16 by 24 cm, 428 pages, hardcover, ISBN 0-13-581140-6, $21.95.

*The Pascal Handbook,* Jacques Tiberghien. Berkeley CA: Sybex, 1981; 18 by 23 cm, 500 pages, softcover, ISBN 0-89588-053-9, $14.95.

*Programming with FORTRAN/WATFOR/ WATFIV,* David T Basso and Ronald D Schwartz. Cambridge MA: Winthrop Publishers, 1981; 17.5 by 23.5 cm, 407 pages, softcover, ISBN 0- 87626-638-3, $12.95.

*Systems Analysis and Management: Structure, Strategy and Design,* Donald V Steward. Princeton NJ: Petrocelli Books, 1981; 16.5 by 24 cm, 287 pages, hardcover, ISBN 0-89433-106-X, $25.

*TRS-80 Assembly Language,* Hubert S Howe Jr. Englewood Cliffs NJ: Prentice-Hall, 1981; 18.5 by 24.5 cm, 186 pages, hardcover, ISBN 0-13-931139-4, $15.95.

*Using Microprocessors and Microcomputers: The 6800 Family,* J D Greenfield and W C Wray. Somerset NJ: John Wiley & Sons, 1981; 19.5 by 24.5 cm, 460 pages, hardcover, ISBN 0-471-02727-8, $22.95.■

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Dr Edward R Fisher, associate dean for research and graduate programs at the College of Engineering, assisted Mr Simkovitz with the patent process. A US patent is pending in Wayne State University's name. The two are now searching for a manufacturer that will help develop and market the LVTS. For more information, contact Dr Fisher, (313) 577-3861, or Dan Simkovitz, (313) 577-3902, at Wayne State University, Detroit MI 48202.■

# Startrek 4.0 and Startrek 3.5

Scott Mitchell, 346 S Taylor St, Manchester NH 03103

Startrek 3.5 is the descendant of Lance Micklus's Startrek 3.0. It has been revised five times and is thoroughly debugged. It is the most widely distributed Startrek game. At first I thought it was unfair to compare Startrek 4.0 by Jeff Hamilton with Startrek 3.5, but after playing version 4.0, I found features in it that I liked, and many that BYTE readers might prefer.

Startrek 3.5 is a menu-driven program. After each sequence of events, you are returned to a list that has eleven command numbers and one invisible command. From this list, you pick and choose commands as if it were a menu. Commands include control of phasers, photon torpedoes, impulse and warp drives, long- and short-range sensor scans, and alert status. You can display the ship's current status, call up damage control to see what is or isn't functioning, call for repairs, or have the science computer tell you what objects are in your quadrant. The ship's computer command takes you into a subsystem that scans its data base for data on Klingon warships, starbases, class F stars, planets, unexplored areas, etc. The computer obtains this information each

## At a Glance

| | |
|---|---|
| **Name**<br>Startrek 4.0 | **Name**<br>Startrek 3.5 |
| **Type**<br>Game | **Type**<br>Game |
| **Author**<br>Jeff Hamilton | **Author**<br>Lance Micklus |
| **Manufacturer**<br>The Programmers Guild<br>POB 66<br>Peterborough NH 03458 | **Manufacturer**<br>Adventure International<br>POB 3435<br>Longwood FL 32750 |
| **Price**<br>$14.95 tape, $19.95 disk | **Price**<br>$14.95 tape, $19.95 disk |
| **Format**<br>Cassette or 5-inch floppy disk | **Format**<br>Cassette or 5-inch floppy disk |
| **Language**<br>BASIC | **Language**<br>BASIC |
| **Computer**<br>TRS-80 Model I | **Computer**<br>TRS-80 Model I |
| **Documentation**<br>Two pages, 11.5 by 18 cm (4½ by 7 inches) | **Documentation**<br>Thirteen-page pamphlet, 6 by 15.5 cm (2½ by 6 inches) |
| **Audience**<br>All space-war game fans | **Audience**<br>All space-war game fans |
| **Challenge**<br>Very good | **Challenge**<br>Excellent |

time you request a sensor scan. The invisible command saves the game on disk or cassette.

Startrek 4.0 is not a menu-driven game; instead it runs in real time. To compare the two, let's say you were battling a Klingon warship and you fired your photon torpedoes and missed. The Klingon fired back and knocked out your science computer. At this point, 3.5 returns to the menu and waits for you to enter your next move. On the other hand, in version 4.0, you must think and act quickly because situations occur as in real-time events. For example, a Klingon can wander into your quadrant, spot and fire at you, and leave you dangling in space while you slipped out for a snack. Ship repairs also go on in real time. In general, Jeff Hamilton's Startrek 4.0 has the same commands as Startrek 3.5, but they are displayed in a small window on your control console as you enter them.

Startrek 3.5 has extensive and reasonably quick graphics. Sounds have been added to the game, but they are kept simple so as not to become tiring after many hours of play. Startrek 4.0 doesn't have sound and uses rather simple graphics. The screen accurately demonstrates what is happening, and it shakes wildly when you are hit.

The objective of 4.0 is to destroy all the Klingons within thirty-two stardates, while stopping at a starbase only twice. The objective of 3.5 is to destroy twenty Klingons by a certain stardate, but the game does not end there. You must also explore and collect as much data as you can about an entire region, and you must locate and orbit all class M planets. As you're doing that, you must cope with pulsars, black holes, and, of course, the crafty Klingons. When you have destroyed twenty Klingons and feel you have collected enough data, you dock at a starbase, where Starfleet Command rates your performance on a scale of 1 to 100%.

Startrek 3.5 has a three-dimensional universe (8 by 8 by 3) with 192 quadrants; a quadrant has 64 (8 by 8) sectors. Startrek 4.0 has a two-dimensional universe (8 by 8) with 64 quadrants. Again, each quadrant has 64 (8 by 8) sectors.

In Startrek 4.0, the computer can be used to help you figure out the exact coordinates to fire photon torpedoes or to navigate the ship. This helps your accuracy when you first start playing the game. Klingon warships using a cloaking device that makes them seem invisible are an extra problem in version 4.0, because they are immune to the photon torpedoes when in this state. In 4.0, but not in 3.5, if a star is in your path, you must navigate around it. In version 3.5, you must be true to your Starfleet orders, and never destroy a planet, star, or starbase, or the game ends immediately. The Klingons can maneuver out of the way of photon torpedoes and phaser fire.

### Conclusions

While Startrek 3.5 is my personal favorite, Startrek 4.0 has an interesting angle to it. To some, the real-time aspect of 4.0 may make all the difference, but, all in all, both games are smooth-running and well debugged.■

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Many others. Sample data with each program

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## Software Review

# The BDS C Compiler

Christopher Kern, 201 I St SW, Apt 839
Washington DC 20024

The ubiquitous Pascal compiler has joined the ubiquitous BASIC interpreter as a staple of the microcomputer programming environment, bringing with it the concepts of hierarchical program design, orderly program development, and legibility that generally fall together under the heading "structured programming."

But for those who are not ideologically committed to the proposition that Pascal is the most congenial programming language—and who have access to an 8080-based computer and the CP/M operating system—I would like to suggest an alternative: a language created at Bell Laboratories, named, with characteristic concision, C. C provides the same structured programming approach as Pascal, but it has a cleaner and crisper syntax, one that is both closer to the ultimate machine language of the computer and, paradoxically, somewhat easier to become familiar with than Pascal.

My recommendation is largely a product of my experience with one of the best and least expensive programming language packages I have come across: the C compiler developed by BD Software (by Leor Zolman of Cambridge, Massachusetts). I have been using the BDS C compiler for over a year, and I think many hobbyists who aren't already using a modern, high-level language could easily switch to C from their BASIC interpreter. C, like BASIC, can be learned quickly, but it has resources that BASIC, even in its ingeniously extended forms, can't match. And while the BDS C compiler does not provide as convenient a programming environment as BASIC—no compiled language really can—it comes about as close as possible to eliminating the worst annoyance of many compilers running on microcomputer systems: the long wait between idea and execution as the compiler cranks out an assembly-language file that must itself be compiled (run through an assembler) before the object program can be tested.

The operation of the compiler is relatively straightforward and quite fast. The command "CC1 filename.C" reads in the source program (which has been prepared using the host system's editing facilities and saved as a file on disk), parses it, and leaves the resultant intermediate file in memory. As CC1 goes out of business, it calls in another program, CC2, as an overlay (ie: it takes the place of the previous program). CC2 is the code generator: it saves the C machine-code program on disk in a special relocatable format. The relocatable machine-code program is turned into executable, absolute machine code by the linker, CLINK, which also merges the user's program with previously compiled program files (such as the standard C function library) if necessary. The entire source file is read into memory before compilation begins, but because it is possible to link separately compiled modules together, the available memory space of the computer does not limit source-program size. If the source code is too long to fit into the available memory at

### At a Glance

**Name**
BDS C compiler

**Type**
8080 compiler

**Distributor**
Lifeboat Associates
1651 Third Ave
New York NY 10028

**Price**
Complete package, $145; documentation only, $25

**Format**
Available for all CP/M systems

**Computer**
Any 8080-based computer running Digital Research's CP/M operating system (programs compiled by the BDS C compiler can be tailored to run on any 8080-family computer)

**Documentation**
70 pages; 22 by 28 cm (8½ by 11 inches)

**Audience**
Application programmers and system programmers who require a C compiler running in an 8080 environment

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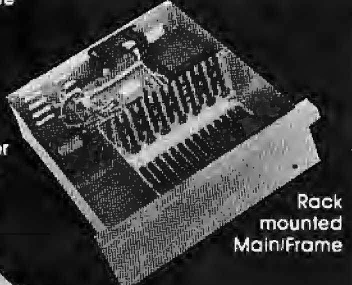

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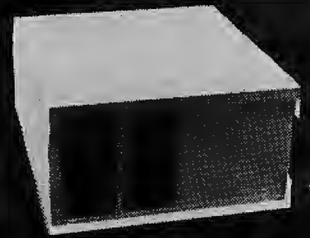

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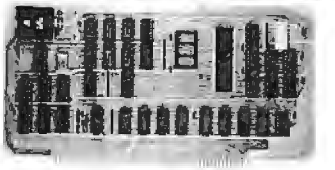

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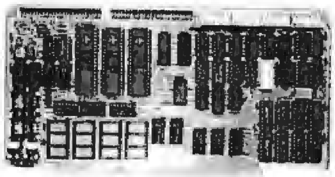

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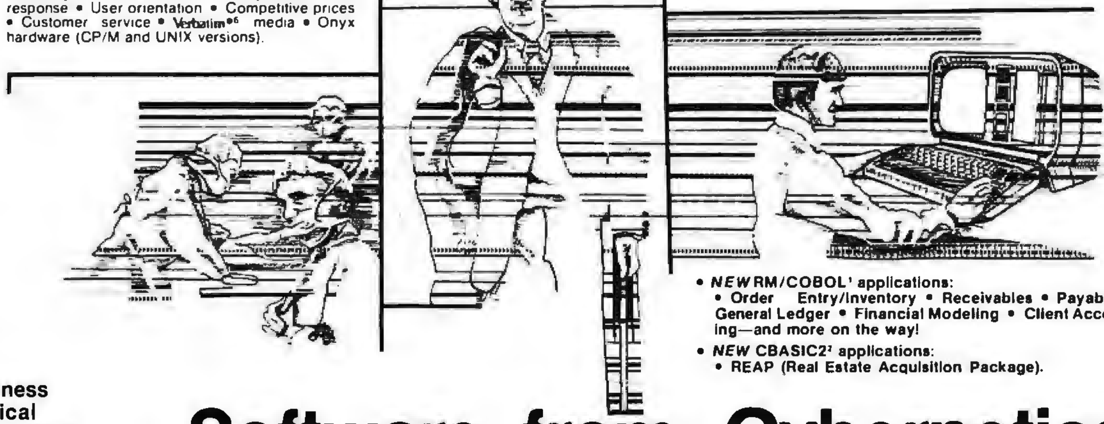

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one time, it can simply be divided up and compiled in pieces. The use of a separate linker also makes it possible to create libraries of compiled functions (such as the C standard library, which supplies a number of basic input/output and utility functions in every system that supports the C language) that can be used in the future as, essentially, part of the language itself.

The manual states that the parser (CC1) operates at about twenty lines of source code per second and that the code generator (CC2) runs at about seventy lines of source per second. In practice—at least on floppy-disk-based systems—the main limitation on compilation speed is the speed of disk input and output. On very long programs, there may be a wait of perhaps a minute while CC1 crunches away. Obviously this can be shortened considerably by compiling only the part of the program that is being worked on and linking it with other, previously compiled, routines. Even with relatively long programs that are compiled as a unit, however, I did not find the delay in compilation to be objectionably long.

For most users, the speed at which a compiled program runs, not the length of time required to compile it, is what really matters. I am reluctant to express this in terms of a benchmark, since the proposed benchmarks I have seen (1) require assumptions about the type of program that will be compiled that cannot hold from one user to the next; (2) can be properly compared only between systems that have both the same processor throughput and the

## A Comparison of C and Pascal

*C programs and Pascal programs look quite a bit alike. They should—the two languages have a lot in common, including sets of similar primitive operations that make direct Pascal-to-C or C-to-Pascal translation feasible. Yet enough differences exist to give the two languages a distinctly different "feel."*

*The most visible difference is block structure; C programs do not have the true block structure found in Pascal programs. A C program is a collection of separate functions; thus one function cannot be nested within another and called as a separate entity. C functions may contain blocks of code that are either executed completely or not at all, but they are not named as functions themselves, and they must be included in-line as part of the normal program flow within the function.*

*C uses only functions, where Pascal distinguishes between functions and procedures. In practice, the only real difference is that any C function can return a value to its calling routine. This is but one example of C's relaxed programming philosophy. Other examples include the ability to assign freely between integers and characters, and between pointers and unsigned integers, the latter providing virtually unlimited opportunity to perform address arithmetic within the host system's available memory space. There are times when this flexibility is very convenient, but there is a price: the compiler won't prevent a foolish move if the programmer insists on it. Whereas Pascal takes a very rigid, protective, and rather mathematical attitude toward program construction, C allows the programmer a certain amount of freedom. This makes sense: Pascal was designed as a teaching language, and C is a production programming language that allows the programmer to do things that he may want to do, at the expense of some conceptual niceties.*

*Both C and Pascal allow parameters to be passed to subroutines* by value *and* by reference. *This means that the called subroutine can receive either its own local copy of a parameter (which it can alter at will without changing the value of the variable as far as the calling routine is concerned), or a reference to the calling routine's variable (which can be subsequently altered by the subroutine that has been called).*

*Each language also provides pointers—variables that point to memory locations, such as the beginnings of arrays. In Pascal, pointers tend to be used sparingly, while in C they are much more common. Here again, C is unwilling to protect the programmer from himself. Pointers are risky. If they are misused, they can point somewhere entirely unexpected and clobber an innocent piece of unrelated code with predictably disastrous results. They can, however, make for extremely efficient programs, and C encourages their use.*

*C has been described as a relatively low-level language. It generally operates on the same primitive data objects as the computer itself, and it does not provide certain composite operations. For example, a string in C is a series of characters beginning at a given memory location, not a discrete entity that can be passed or assigned as a unit. Explicit functions are used to provide more sophisticated facilities for manipulating data objects, as well as for input and output. The more common primitive operations are provided in the C standard function library. Others must be written by the programmer.*

*One of C's most distinctive features is its unusual—and unusually concise—set of operators. C has multiple assignment operators that lead to expressions of the form x += 1 or y >>= 4. These mean, respectively, "let x equal x plus one" and "let y equal y logically shifted right 4 bits." Another unique C concision is the ? : (if... then) operator. It is used in expressions of the form y = x>0 ? 1 : 0. This means "if x is greater than 0 let y=1; otherwise, let y=0."*

*BASIC exists in thousands of dialects. The same diffusion seems to be taking place—to a lesser extent, fortunately—with Pascal. Thus far, not many compilers operate on variations of C, so true portability between computers still exists. I know of three microcomputer C compilers: the BDS compiler (which implements a very complete subset of the language); one for a considerably more restricted (and slightly archaic) subset of C that was published, in C source code, in the May 1980 issue of* Dr Dobb's Journal of Computer Calisthenics and Orthodontia *(this compiler is available from Walt Bilofsky, 14478 Glorietta Dr, Sherman Oaks CA 91423, in CP/M and Heath HDOS formats); and Whitesmiths' C Compiler, which provides the full C language for various 8080-family and DEC LSI-11 systems (Whitesmiths Ltd, POB 1132, Ansonia Sta, New York NY 10023). An excellent C-like interpreter is available from tiny-c associates, POB 269, Holmdel NJ 07733 (see my review of tiny-c: "A User's Look at tiny-c," December 1979 BYTE, page 196). A tiny-c compiler is also available.*

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same disk-access speed, and (3) are of dubious value when used to compare different programming languages because it is unlikely that the benchmark programs will be of equivalent efficiency in all languages.

Having said all that, I will venture the opinion (acknowledging that it may be even more misleading than a benchmark program) that programs compiled on the BDS compiler run very fast indeed. Not as fast as those coded in assembler, obviously, but much faster than any BASIC interpreter, considerably faster than any pseudo-code Pascal system (a technique that amounts to semi-compilation, with object code being generated for a "pseudo-machine" that is emulated by the host computer), and *about as fast* as those created by any microcomputer compiler I have seen. I have used BDS C to compile a rudimentary LISP interpreter, and while it's no match for a machine-coded LISP, the project demonstrated to my satisfaction that the BDS compiler is suitable for system-programming purposes.

BDS C is a true subset of the standard C language. Very little is left out. The most serious omissions are the lack of static variables and initializers. Several library functions are supplied to remedy the latter, although initialization remains somewhat more awkward than in standard C. Also absent are floating-point real numbers and long (32-bit) integers. A series of subroutines to perform floating-point conversions and arithmetic is supplied with the package, but this is not as convenient a way to provide real numbers as building them into the language the compiler accepts directly.

A considerable amount of work has been done to relieve the programmer of some of the more tedious aspects of the CP/M operating system. Library functions permit the use of the standard CP/M carriage-return/line-feed sequence to terminate a line or, at the user's option, the single newline character that is standard in other C programming environments. Buffered file routines are supplied as part of the standard library, which permits the programmer to write data to disk a character at a time instead of in blocks of 128 characters, as required by CP/M. Dynamic storage allocation and deallocation are also provided, so the user can create and dismantle complex data structures at run-time, and therefore reuse the memory area allocated to them (even though CP/M itself contains no allocation mechanism).

It's a shame the BDS compiler doesn't go one step further and provide redirected input and output; this would have permitted the user to write a program using a single I/O stream and then specify at run-time whether the program was to communicate with the console, a modem, a disk file, etc. Some high-level language compilers provide a debugging option that allows the user to trace program execution and print out variable values. Alas, BDS C is not one of them. Short of that, the best debugging tool I





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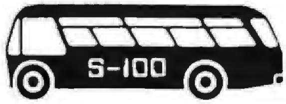


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have found comes right out of the C standard library. It is the function "printf", which allows various data objects to be printed in appropriate formats and number bases while the program is being run.

The compiler accepts a number of optional directives that allow the user to:

- Place the generated code in any memory location (including read-only memory, as long as some programmable memory will be available somewhere in the target system)
- Optimize the object code for speed (which increases the amount of code generated) or for size (which slows the object program down a bit), and to control the way the compiler allocates space
- Save an intermediate file on disk between the two compiler phases
- Display the source text on the user's console during compilation

The linker also supports a number of useful options, including several that permit the programmer to create overlay segments that use the same data elements. This feature is not commonly available in microcomputer compilers for high-level languages.

The assembly-language source code for the run-time package is also supplied (the run-time routines contain the interface to the CP/M operating system). This permits the user to create a customized run-time package that allows BDS C programs to run under other 8080 operating systems. Those who sell application programs will, no doubt, be happy to learn that there are no royalty requirements for programs that include the run-time package in either its original or customized form.

In addition to the compiler and the linker, the BDS C package contains a librarian program, CLIB (used to manipulate compiled function libraries), the C standard library along with some useful extensions for the microcomputer (and specifically the CP/M) environment, and a collection of sample programs that is of more than passing interest.

The precise sample programs that are delivered with any package may vary, but the copy of BDS C Version 1.4 that I received from Lifeboat Associates in New York contained a fairly sophisticated telecommunications program for connecting a microcomputer system through a modem to another microcomputer (or a time-sharing system), several impressive games (some requiring a cursor-addressable video terminal), and several utility programs, including two that permit the compiler to be used from terminals that generate uppercase characters only. The package also includes a lucidly written manual for the compiler and a copy of the outstanding C language manual, *The C Programming Language*, by Brian W Kernighan and Dennis M Ritchie.■

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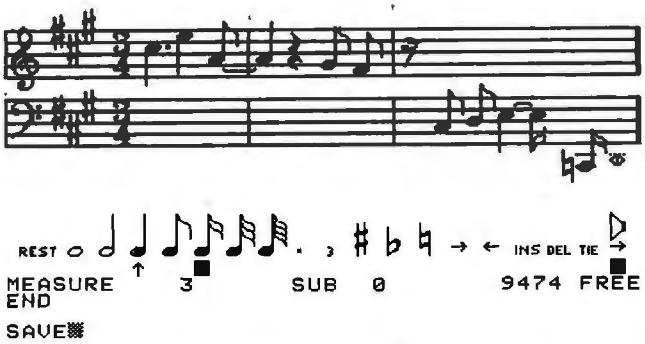

## A L F's 9-voice Music Card MC1 is only $195.

### Here's what our customers have said:

(Excerpts from unsolicited letters. Copies of original letters available on request.)

### About the A L F system:

It's a rare enough occurrence when hardware/software lives up to one's expectations. For something to exceed one's wildest hopes — as the ALF synthesizer certainly does — is a real treat. My congratulations to all concerned.

—Dhahran, Saudi Arabia

I myself have told several people that next to a disk, I consider the [ALF] synthesizer to be the most important peripheral they could purchase for their system. Very excellent job! Keep up the good work.

—Oak Ridge, Tennessee

I recently purchased 2 of your Apple music boards. Out of the peripherals I have for my Apple, I enjoy them the most. It has to be the most enjoyable thing that has ever been invented. I hope you continue to develop products as clever and enjoyable as this one. The Entry program has to be one of the most sophisticated programs I have ever seen. It proves that a hardware manufacturer DOES have the ability to also produce quality software. It is almost worth the price of the boards just for the Entry program.

—Burbank, California

### About ease of use:

I have had my Music Card MC1 for a little more than a week now and I have almost completed entering "The Maple Leaf Rag". I found it to be a lot simpler than I thought and so I am very, very pleased. My family isn't because I sit up to all ends of the night playing with the blasted thing!

—Cypress, Texas

ALF has opened up my head and ears and enabled me to do things musically which I would like to be able to do on [conventional] instruments. As much as I love the instruments I try to play, I just don't have the talent and technique to play what is in my head. By golly, the ALF board doesn't know about my limitations, though. I can play hell out of that thing, playing notes and tempos which previously have existed only in my head. Many thanks from a frustrated musician and satisfied ALF "player".

—Demopolis, Alabama

### About documentation:

I don't know much about hardware, but I have been a programmer for 15 years and I have never seen a better piece of software documentation than your user manual. It is a joy to study!

—Lancaster, California

### About the competition:

Recently, I purchased an [ALF] 9-voice board and a couple of music albums . . . . all I can say is that I wish I had listened and played with it before I purchased the Mtn. Hardware board. It sounds about the same and is vastly superior in software, ease of use, and price. The Entry program is a joy to use and it's easier than Mtn. Hardware's, but then, I guess you guys know that already. (Oh yes, you wouldn't happen to know of anyone that wants to buy a Mtn. Hardware system? $450 or best offer?)

—Kirkland, Washington

I would like to tell you that after having used the system ONLY ONE DAY, that I am absolutely delighted with it. In addition, I purchased the three boards although I ALREADY own Mountain Hardware's music system. Now that I have seen and own your system, I am putting my "old" one up for sale. I think that your software makes it far easier to enter music, and that the software routines allow for far greater flexibility. Again, I extend my compliments to you. As I said, I have owned another music system, and consider myself therefore, qualified to make a judgement between the use of the two. Yours is the clear choice!

—Levittown, New York

See your local Apple® dealer or write:

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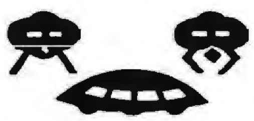

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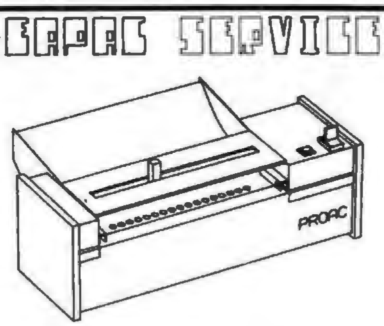


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Besides the Mauro Plotter interface optional drivers are available for CalComp and Houston Instrument Drum plotters, Houston Instrument HIPLOT DMP 3 4 6 & 7 plotters, and diasy wheel or spindle printers such as DIABLO 1620 & 1640 OUME SPRINT 5 and NEC 5510 & 5520.

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# Book Reviews

## Musical Applications of Microprocessors

by Hal Chamberlin
Hayden Book Company, Inc
Rochelle Park, NJ
1980, 661 pages, hardcover $24.95

Reviewed by
Dick Moberg
404 S Quince St
Philadelphia PA 19147

This book is the culmination of many years of experimentation by one of the leaders in the field of computer music for small systems. Its depth of coverage and usefulness are unsurpassed by any other single publication.

A review cannot start without first looking at the book's author. Hal Chamberlin has been involved with microcomputers since their origin. His newsletter, *The Computer Hobbyist,* pioneered construction articles on tape, disk, and graphic interfaces long before there were any books or major publications on the subject. Combining his music and computer talents eventually led him to form a company, Micro Technology Unlimited, and to receive an award for his contributions at the 1979 Personal Computer Arts Festival. He is an avid writer for personal-computer magazines. His clear and often humorous style is prevalent throughout his book.

Before we look at the contents, let's discuss the book's intended audience. Being a long-time computer hobbyist with several years of childhood music lessons, I would target this book for the computer tinkerer or the musician with some syn-

thesizer knowledge. The non-musician will find the introductory parts on waveforms and music theory sufficient for understanding the rest of the book. The musician with no background in computing or electronics should have available some of the excellent paperback volumes now available on op (operational) amps, TTL (transistor-transistor logic) circuits, and microcomputers. But, even for the computer-musician novice, this is a book that is readily understandable.

*Musical Applications of Microprocessors* is divided into three sections: "Background," "Computer-Controlled Analog Synthesis," and "Digital Synthesis and Sound Modification."

Section I covers background material in music synthesis and microprocessors. The first chapter, "Music Synthesis Principles," starts with a discussion on the goals of music making, comparing conventional instruments with electronic-synthesis techniques. It emphasizes that with electronic synthesis, a musician is limited only by his imagination as to the accuracy, complexity, and variety of sounds that can be achieved with this medium. Next, the author discusses the relationship of the physical parameters of waveforms — frequency, amplitude, and harmonics — to the musical concepts of pitch, loudness, and timbre. The chapter ends with a history of electronic sound synthesis from the teleharmonium to the microprocessor.

Chapter 2 presents the terminology and techniques of sound modification. It starts with a section on tape-recording techniques (rearranging tape splices, speed transposition, etc) and then compares these to their electronic counterparts. Other electronic techniques such as filtering, spectrum shifting, reverberation, and chorus synthesis are discussed. The chapter concludes with a discussion on analyzing natural sounds for subsequent modification.

The next chapter, on voltage-control methods, explains the conventional techniques of using voltage to control frequency, amplitude, and harmonics. Each of these techniques is later explained in regard to its implementation with analog and digital circuits or by using software programming. The modular nature of conventional synthesizers is also discussed.

Chapter 4 addresses waveform synthesis by the computer by digital-to-analog conversion and looks at the advantages and limitations of using this method. Music-programming systems and languages, including MUSIC V and Hal's NOTRAN (NOte TRANslation language), are briefly described.

The background section concludes with a chapter on microprocessors. There is an interesting comparison between the 8080, LSI-11, and 6502 microprocessors showing where each (and similar processors) should be used in the grand scheme of a music-synthesis system. The author claims that the 8-bit 8080/Z80 family are the optimal microprocessors for synthesizer control, the 16-bit LSI-11 for direct microprocessor synthesis of music, and the 8-bit 6502 for replacing dedicated logic. Although the choice of processor will vary from one designer to the next, this section gives the design criteria and the desired microprocessor parameters for each area of application.

The remaining two sections of the book offer technical how-to information regarding microcomputers in music synthesis. There's a discussion on the use of a microcomputer as a controller of standard or custom analog sound-synthesizing equipment, and how a computer can simulate the analog module's functions in software to provide direct music synthesis.

The first chapter of the computer-controller section explains circuit details of the three voltage-controlled synthesizer modules—voltage-controlled oscillator, voltage-controlled amplifier, and voltage-controlled filter. Component values are provided along with construction tips for building those modules.

The next chapter, on data-conversion techniques, starts with a tutorial on the terminology regarding the use of D/A (digital-to-analog) and A/D (analog-to-digital) converters. All circuits for the various conversion techniques are given, along with component values and available devices. One impressive circuit shows how to make a 128-channel microcomputer-controlled D/A converter for less than $50.

The remaining four chapters in this section deal with the "systems" aspects of a computer-controlled synthesizer. A chapter on signal routing shows how the computer and various switching devices can replace the ever-confusing patch cords on conventional analog synthesizers. Two chapters on input devices follow: one entirely on keyboard-input methods and one on other devices such as ribbon controllers, joysticks, and digitizers. The last chapter describes the role of computer-graphics displays as aids in computer music composition.

The last section of the book, on direct computer synthesis of music, gives details on digital sound generation and filtering techniques, and includes the techniques that the author has pioneered through much of his previous writings. The section opens with a discussion of quality data-conversion techniques. Three chapters follow on digital sound-generation methods, including separate chapters on filtering and percussive sound generation. The chapter on digital tone-generation techniques includes the author's table-look-up method for generating precomputed waveforms and algorithms, and includes uses of Fourier techniques for "synthesis from scratch." The digital-filtering chapter gives techniques for reverberation and chorus effects.

Direct computer synthesis of music is usually not a real-time technique. But, as the author points out, these techniques are very useful for those designing real-time systems for live performances.

A fascinating chapter follows on the analysis of natural sounds for modification and resynthesis. Methods of three-dimensional spectral plotting for harmonic visualization are covered. Also mentioned are some advanced techniques for sound analysis, such as linear prediction, autocorrelation, and homomorphic analysis.

The last two chapters deal with digital hardware and music-synthesis software. The digital synthesis of music can be accomplished by using either hardware or specific software techniques, or a combination of the two. These chapters discuss the trade-offs of each method. Among other topics the hardware chapter presents circuits for digital multiplexed oscillators, Fourier-series tone generators, and hybrid voice modules. Some of the available music-synthesis boards for small computer systems are also analyzed.

The last chapter describes

## Book Review

the hierarchy of music-software systems with examples from each level. Fixed-point-arithmetic routines for the 6502 processor are given, along with Fourier-series routines for waveform-table filling and much more. The chapter ends with a discussion of the high-level NOTRAN music-composition language.

In summary, this book is a milestone in microcomputer history. Its publication marks the progression — from novelty to serious instruments of expression — of musical applications of small computer systems. With little modification, the book could serve as a reference source on generalized data collection, signal processing, and process control using microcomputers.■

## BYTE's Bits

### Errata Sheets for Osborne Books

If you have been having trouble running some of the CBASIC programs in Osborne/McGraw-Hill business books, a simple request will bring quick relief in the form of errata sheets. The sheets should have been sent with every ordered copy of *Payroll with Cost Accounting, Accounts Payable and Accounts Receivable*, and *General Ledger*. If errata sheets weren't included in your book, contact Sean Dugan, Customer Relations, Osborne/McGraw-Hill, 630 Bancroft Way, Department B10, Berkeley CA 94710, (415) 548-2805.■

# Clubs and Newsletters

## Atari Users Group

The Bay Area Atari Users Group meets on the first Monday and on the third Tuesday of each month at 7 PM. The Monday-night meeting takes place at Foothill College, and the Tuesday-night meeting is at Interim Electronics, 447 S Bascom Ave, San Jose, California. The group publishes a newsletter. The dues for the group are $12 per year. The club currently has eight disks of public-domain software for sale at $5 per disk. The monthly meetings feature speakers discussing microcomputer uses and the Atari. Write to the Bay Area Atari Users Group, c/o Foothill College, 12345 El Monte Rd, Los Altos Hills CA 94022.

## Just for LAUGHS

The Louisville Apple User Group—Hardware and Software (LAUGHS) has separate meetings for the business, software, and special-interest subgroups. A monthly newsletter is published. The subscription rate is $15 per year. For information, contact LAUGHS, c/o Pat Connelly, 3127 Kayelawn Dr, Louisville KY 40220.

## Behavioral Sciences AIM-65 Users Group

Workers in the behavioral and biological sciences who are currently using or are interested in using the Rockwell AIM-65 are invited to participate in this group. Areas of study include hardware and software for experimental control, data acquisition, statistical analyses, and other applications. If you are interested, please write, outlining areas of interest and current or planned projects, to Dr J W Moore Jr, POB 539, Middle Tennessee State University, Murfreesboro TN 37132.

## OSI Group in Northern California

The Ohio Scientific Users Group of Northern California has been formed. For details, write to Rod Freeland, c/o Public Interest Computer Services, POB 1061, Berkeley CA 94701; or call (415) 654-9880 after 1 PM.

## 68XX Users Group

This is a group for those hobbyists who have a strong interest in Motorola 68XX microprocessors. The group meets on the second Tuesday of each month in Santa Clara at American Microsystems Inc. Contact the 68XX Users Group at POB 18081, San Jose CA 95158.

## Boston Group Promotes Artificial Intelligence

The Boston Subchapter of Robotics International of SME has been formed under the auspices of the Society of Manufacturing Engineers. The group has been developed to provide a forum for the exchange of information between engineers, scientists, industrial producers, and users of robotics technology.

For more information on the Boston chapter and the national group, contact Robotics International of SME, One SME Dr, POB 930, Dearborn MI 48128. ■

## June 1981

*June 6-9*
**Atlanta Small Computer Show**, Atlanta Hilton, Atlanta GA. Producers of small computers, peripheral equipment, supplies, and services will be exhibiting at this show. Business owners, corporate and government executives, data processing managers, doctors, lawyers, and other professionals, are expected to attend. Obtain additional information from The Atlanta Small Computer Show, 4060 Janice Dr, Suite C-1, East Point GA 30344, (404) 767-9798.

*June 7-19*
**Computer Camps**, Northeast Louisiana University (NLU), Monroe LA. NLU is offering two one-week sessions for students in grades nine thru twelve. Beginners and advanced programmers are welcome. The cost is $125 per session for room, board, fees, and text materials. Contact Dr Paul Ohme, Department of Mathematics, NLU, Monroe LA 71209, (318) 342-2186.

*June 9-11*
**Understanding and Using Computer Graphics**, Chicago IL. This seminar will cover the latest technology on graphic systems. It will be headed by Carl Machover. Contact Bob Sanzo, Frost & Sullivan Inc, 106 Fulton St, New York NY 10038, (212) 233-1080.

*June 14-18*
**The Second National Conference of the National Computer Graphics Association**, Baltimore Convention Center, Baltimore MD. Computer graphics demonstrations and workshops will be held along with exhibits and seminars. Contact the National Computer Graphics Association Inc, 2033 M Street NW, Suite 330, Washington DC 20036, (202) 466-5895.

*June 16-18*
**NEPCON East '81**, New York Coliseum, New York NY. This exposition is aimed at engineers, prototype developers, production specialists and testing personnel. Technical programs will be presented. Contact Industrial & Scientific Conference Management Inc, 222 W Adams St, Chicago IL 60606, (312) 263-4866.

*June 17-19*
**National Educational Computing Conference**, North Texas State University, Denton TX. This conference will provide a forum for discussion between individuals, and institutions with interests in educational computing. Computer literacy, computer education for teachers, and computers in education are some of the topics to be covered. Contact Dr Jim Poirot, NECC-81, General Chairman, Computer Sciences Department, North Texas State University, Denton TX 76203.

*June 21-26*
**Computer Workshops for Educators**, Northeast Louisiana University (NLU), Monroe LA. This program will cover a wide variety of topics. Room, board, and tuition is $135. Contact Dr Paul Ohme, Department of Mathematics, NLU, Monroe LA 71209, (318) 342-2186.

*June 22-23 and June 24-27*
**Digital Electronics for Automation and Instrumentation** and **Microcomputer Design Interfacing, Programming, and Application Using the Z80, 8080, and 8085**, Virginia Polytechnic Institute and State University, Blacksburg VA. These two workshops allow participants to design and test concepts with the actual hardware. For more information, contact Dr Linda Leffel, CEC, Virginia Tech, Blacksburg VA 24061, (703) 961-5241.

*June 23-25*
**Comdex/Spring '81**, Madison Square Garden and New York Statler Hotel, New York NY. Contact the Interface Group, 160 Speen St, Framingham MA 01701, (800) 225-4620; in Massachusetts (617) 879-4502.

*June 29-July 1*
**The Nineteenth Annual Meeting of the Association for Computational Linguistics**, Stanford University, Stanford CA. Syntax, parsing, and sentence generation, computational semantics, discourse analysis and speech acts, speech analysis and synthesis, machine translation and machine-aided translation, and mathematical foundations of computational linguistics are some of the topics that will be discussed. Contact Don Walker, Artificial Intelligence Center, SRI International, Menlo Park CA 94025, (415) 326-6200, ext 3071.

## July 1981

*July 9-10 and July 20-21*
**Software Engineering**, Denver CO and Seattle WA. Designed for systems analysts, designers, programmers, and managers, this seminar examines the latest developments in software engineer-

ing. For more information, contact Battelle, Seminar and Studies Program, 4000 NE 41st St, POB C-5395, Seattle WA 98105, (206) 525-3130.

*July 29-31*
**The 1981 Microcomputer Show**, Wembley Conference Centre, London, England. Seminars on microcomputer applications in business, production, and in education will be presented. Topics for conference sessions include hardware availability, software packages and development, automatic test equipment, robotics, and process control. Exhibits from major European and American manufacturers will be featured. Contact TMAC, 680 Beach St, Suite 428, San Francisco CA 94109, (800) 227-3477; in California (415) 474-3000.

## August 1981

*August 24-27*
**Software Design, Reliability, and Testing**, Sheraton Motor Inn, Lexington MA. This four-day seminar is for engineers, programmers, and technical managers. It examines concepts and techniques for developing and testing reliable, cost-effective software. It also addresses management concerns and recommended policies. Tuition is $600, which includes course notes, luncheon, refreshments, and an evening reception. Contact the Institute for Advanced Professional Studies, One Gateway Ctr, Newton MA 02158, (617) 964-1412.

*August 24-28*
**The Seventh International Joint Conference on Artificial Intelligence**, University of British Columbia, Vancouver, British Columbia, Canada. This conference examines computer applications of medical diagnosis, computer-aided design, robotics, programmable automation, speech understanding, vision, and other related topics. Tutorial programs and artificial-intelligence exhibits will be presented. For more information, contact Louis G Robinson, American Association for Artificial Intelligence, Stanford University, POB 3036, Stanford CA 94305, (415) 495-8825.

*August 25-28*
**Vector and Parallel Processors in Computational Science**, Chester, England. This conference will concentrate on hardware, software, algorithms, applications, and case studies concerning vector and parallel processors. For information, contact Mrs S A Lowndes, Science Research Council, Daresbury Laboratory, Daresbury, Warrington, WA4 4AD, England.

*August 26-29*
**The Fifth Annual National Small Computer Show**, New York Coliseum, New York NY. There will be daily lectures, and a five-hour seminar will be presented daily for executives who need an introduction to the understanding, acquisition, and use of computers in business. The registration fee for the show is $10 per day. The seminar for executives is $200, which includes all materials and show registration. For information, contact the National Small Computer Show, 110 Charlotte Pl, Englewood Cliffs NJ 07632, (201) 569-8542.

*August 28-30*
**Personal Computer Arts Festival '81 (PCAF '81)**, Philadelphia Civic Center, Philadelphia PA. This show will include technical sessions, demonstrations, and exhibits, as well as the annual computer-music concert and computer graphics film and video show. PCAF '81 is being held in conjunction with the Personal Computing '81 show. For complete details, contact the address below.

The PCAF '81 Committee invites persons interested in microcomputer-music and digital-sound synthesis, computer composition tools, signal processing, computer-generated visual art, and other computer-based creations, to talk, demonstrate, display, or perform at PCAF '81. To participate, send a half-page description of a topic or performance (include tapes, prints, or slides, if possible) before July 1 to PCAF '81, POB 1954, Philadelphia PA 19105.■

## Book Reviews

### TEX and METAFONT: New Directions in Typesetting

by Donald E Knuth
Digital Press,
Bedford, MA 1979
$12.00

Reviewed by
Richard Fritzson
25 Callodine Ave
Buffalo, NY 14226

*TEX and METAFONT* is primarily documentation for two programs that Donald E Knuth has written. TEX is a text-formatting program for preparing documents and METAFONT is a program for designing new fonts for digital typesetting devices (such as high-density raster-scan printers). The two manuals are preceded by a forty-page talk that Dr Knuth presented to the American Mathematical Society on the subject of mathematical typography.

Normally, program manuals are not very interesting, even to people who are using the program, and, unfortunately, most people are not yet using TEX or METAFONT. However, if you are interested in how a well-designed program can produce high-quality camera-ready text, if you are interested in mathematical methods for designing new type fonts, or if you are just interested in how a world-renowned computer scientist goes about designing, writing, and documenting his programs, read this book.

The introductory lecture, "Mathematical Typography," describes two aspects of the same subject: how to make it easy to compose mathematical papers of very high visual quality (ie: easy to read, beautiful to look at), and how to use mathematics in the design of good-looking type fonts. It contains very brief introductions to both TEX and METAFONT, but, more interestingly, Dr Knuth describes some of the history of typesetting and typefont design and some of the history of his investigations into mathematical typesetting and font design, including some of the decisions he made while designing the two programs. His prose is comfortable and enjoyable. If you find it necessary to skip the more technical mathematics, you're skipping only about one page of Dr Knuth's lecture.

Judged by its manual, TEX is unlike any other text-formatting program. The care and thought that went into its design set a standard for programs of this kind, and programs in general, that few can meet. It uses a novel algorithm for splitting text into equal-length lines which considers the appearance of the entire paragraph in which the line appears, not just the line itself. It has extensive facilities for handling mathematical formulas in a manner that is easy for the typist but yields professional-looking output. (Naturally it supports proportionally spaced type fonts, multiple-column page formats, footnote references, and other features which are essential for full typesetting capability.) The manual is easy to read, and while it certainly makes you wish you had a copy of TEX to run on your own computer, you don't need it to enjoy reading the manual. (Dr Knuth says that he intends to publish the programs in a book, putting them in the public domain.)

As far as I know, METAFONT, the typeface-design program, is unique. It allows you to write programs, in a special METAFONT language, that specify the shapes of a family of characters — that is, it allows you to design your own type fonts. Currently though, only high-density raster-scan printers can print the new fonts, and these devices are still extremely expensive. Consequently, the microcomputer applications for a font-design program are limited. However, like the TEX manual, the METAFONT manual is both interesting and informative. It reads as though the author were standing at times in front of you lecturing and, at other times, behind you looking over your shoulder, helping. Even if you are just interested in the design of type fonts by Dr Knuth's analytic method, you will find this book useful. (The manual includes many exercises. While they are interesting to read, if you're not actually trying to learn to use TEX or METAFONT you may well want to skip them; I did.)

I used to think that only a hard-core, lost soul computer hacker could enjoy reading a manual for a program he might never use. This book has made me reconsider. ■

## BYTE's Bugs

### Correction

The name of the manufacturer of the wire-wrap prototyping board mentioned in "What's Inside Radio Shack's Color Computer?" (March 1981, BYTE, page 90) should have been Vector Electronic Company. We apologize for any confusion this may have caused. ■

### Notice of Omission

Due to a processing error the Washington Computer Service ad which appeared on page 27 of the May Byte had no Reader Service Number.

For more information regarding their "no problem trial offer" circle 475 on the inquiry card in this issue.

## BYTE's Bits

### First Annual Undergraduate Paper Competition in Cryptology

*Cryptologia*, a magazine devoted to cryptology, has announced a contest for undergraduate students who have an interest in the study of encoding and decoding. A $300 award will be given to the student whose paper on any aspect of cryptology is judged the most valuable. Topics can include technical, historical, and literary subjects concerning cryptology.

Papers must be no more than twenty typewritten pages in length, double-spaced and referenced. Four copies must be submitted. Only original works that have never been published should be submitted. Authors must be enrolled in an undergraduate curriculum at the time of composition. All copies become the property of *Cryptologia* and the magazine assumes publication rights on all entries.

The papers will be judged by the editors of the magazine, and the winner will be announced on April 1, 1982, with publication of the winning paper in the July 1982 issue of *Cryptologia*. For information, contact *Cryptologia*, Albion College, Albion MI 49224.■

# An Easy-to-Use A/D Converter

Robert Daggit
1648 Hillview Rd
New Brighton MN 55112

With the addition of an analog-to-digital converter and some simple sensors, a microcomputer can monitor analog voltages, read light levels, sense temperatures, or read the analog output from laboratory instruments. The six-channel A/D (analog-to-digital) converter that I will describe reads positive voltages from 0 to 3 V, with either 8 or 10 bits of accuracy. It interfaces to the computer through an 8-bit bidirectional peripheral port whose I/O (input/output) lines are individually programmable and latched when used as outputs.

Once started, the converter operates asynchronously with respect to the computer and requires a minimum of code in the user's program. Conversion times are voltage-dependent, with an approximate range of 1 to 2 ms (milliseconds). A sample program segment and subroutine written in 6502 assembly language are included to illustrate the use of the converter.

Major components of the A/D converter unit, shown as a schematic diagram in figure 1, are a Fairchild Semiconductor μA9708 analog-to-digital-converter integrated circuit, a clock, a 12-bit counter, and a 16-bit output multiplexer. The μA9708 features an analog input multiplexer, controlled by address lines A0 thru A2, that selects one of eight input sources. Address 0 selects the internal zero voltage, and address 7 selects the internal reference voltage. Addresses 1 thru 6 select user inputs I1 thru I6, as shown in figure 1. Although the manufacturer rates the μA9708 at 8 bits of accuracy, it performs well at 10 bits of accuracy. A series of voltage readings taken at 0.1 V intervals from 0 to 3 V compared favorably with readings taken with a Fluke Model 8000A Digital Multimeter. Voltage differences ranged from 2 to 11 mV (millivolts). The greatest relative error, defined as the absolute value of the voltage difference divided by the multimeter reading, was less than 2%.

In order to read one of the analog channels, the channel address is placed on the address lines, and the ramp-start input (pin 3) is set low. The ramp-stop output (pin 7) goes high at this time. With the address lines stable for a signal-acquisition time of about 1 ms, the ramp capacitor, C1, charges to the voltage

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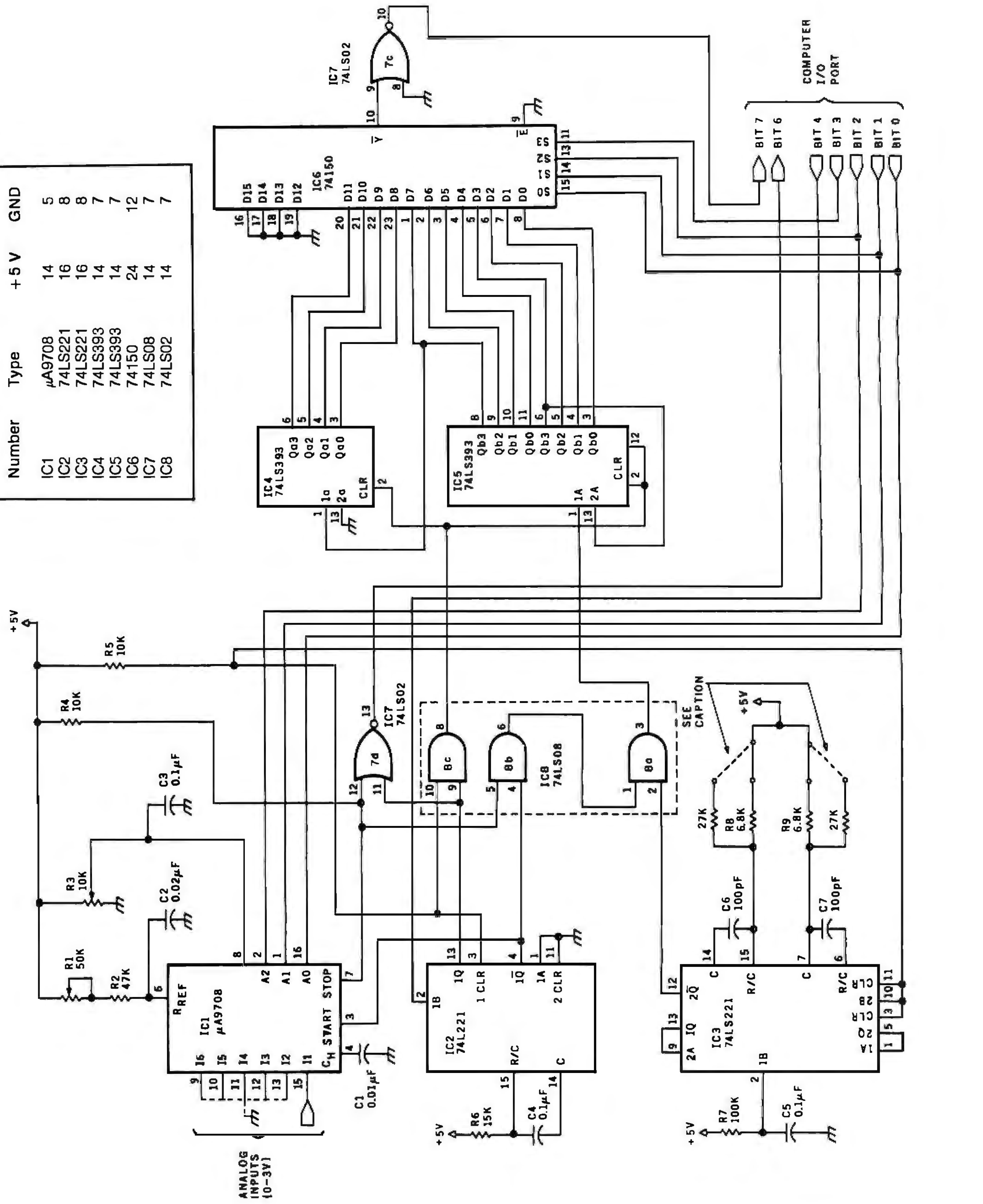
Circle 263 on inquiry card.



| Number | Type | +5 V | GND |
| --- | --- | --- | --- |
| IC1 | μA9708 | 14 | 5 |
| IC2 | 74LS221 | 16 | 8 |
| IC3 | 74LS221 | 16 | 8 |
| IC4 | 74LS393 | 14 | 7 |
| IC5 | 74LS393 | 14 | 7 |
| IC6 | 74150 | 24 | 12 |
| IC7 | 74LS02 | 14 | 7 |
| IC8 | 74LS08 | 14 | 7 |

**Figure 1:** *Schematic diagram of the A/D converter. Inputs I1 thru I6 of IC1 are the user's analog-input channels. The input voltage is converted to a binary number in the counter (IC4 and IC5), where it is retained until needed. The binary output is read in bit-serial fashion by the output multiplexer, IC6. Interface to the computer is through an 8-bit I/O port.*

*Easy selection of 8 or 10 bits of accuracy is accomplished by installing the clock timing components (C6, C7, R8, and R9) on a DIP header (see figure 2).*

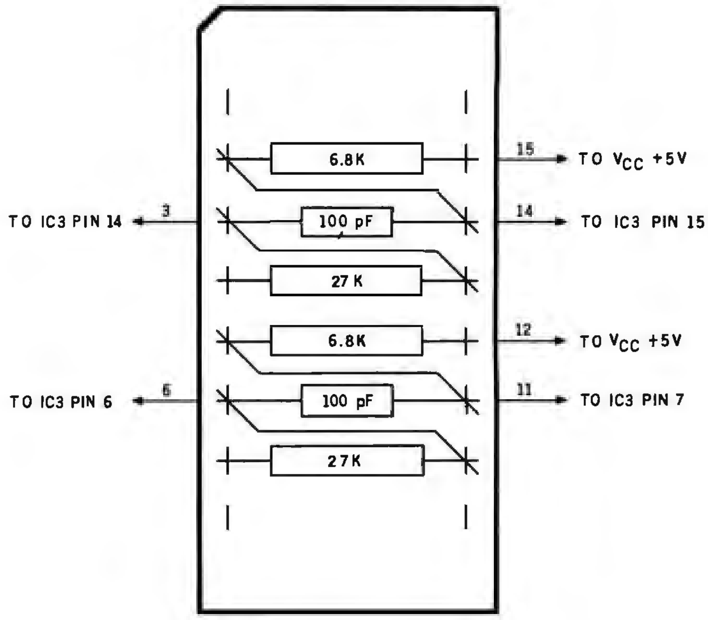



**Figure 2:** *Wiring of the DIP header (top view). This optional feature may be installed for easy selection of 8 or 10 bits of accuracy. The clock timing components are mounted on the header in such a way that when it is reversed in its socket, the time constants of IC3 (a 74LS221 monostable multivibrator) are appropriately changed.*

**Listing 1:** *A program segment, written for the 6502 microprocessor, that illustrates use of the A/D converter. Hexadecimal 10 is added to the channel address, and this value is then written to the interfacing I/O port to start the conversion. Data from the counter is read when needed.*

| Address | Object Code | Label | Mnemonics | Comments |
|---|---|---|---|---|
| 0250 | A9 10 | | LDA H#10 | ;CHANNEL 0 ADDRESS |
| 0252 | 8D 01 A8 | | STA DRA | ;INITIATE A/D CONVERSION |
| 0255 | 20 30 03 | | JSR RDADC | ;READ CHANNEL 0 COUNT |
| 0258 | 85 D0 | | STA D0 | |
| 025A | 86 D1 | | STX D1 | |
| 025C | A9 17 | | LDA H#17 | ;CHANNEL 7 ADDRESS |
| 025E | 8D 01 A8 | | STA DRA | ;INITIATE A/D CONVERSION |
| 0261 | 20 30 03 | | JSR RDADC | ;READ CHANNEL 7 COUNT |
| 0264 | 85 C0 | | STA C0 | |
| 0266 | 86 C1 | | STX C1 | |
| 0268 | A9 11 | | LDA H#11 | ;CHANNEL 1 ADDRESS |
| 026A | 8D 01 A8 | | STA DRA | ;INITIATE A/D CONVERSION |
| 026D | A9 02 | | LDA H#02 | |
| 026F | 20 7C 05 | | JSR SUBM | ;COUNT(REF) – COUNT(0) |
| 0272 | A5 C0 | | LDA C0 | |
| 0274 | A6 C1 | | LDX C1 | |
| 0276 | 85 A0 | | STA A0 | ;SAVE CORRECTED REF COUNT |
| 0278 | 86 A1 | | STX A1 | |
| 027A | 20 30 03 | | JSR RDADC | ;READ CHANNEL 1 COUNT |
| 027D | 85 C0 | | STA C0 | |
| 027F | 86 C1 | | STX C1 | |
| 0281 | A9 02 | | LDA H#02 | |
| 0283 | 20 89 05 | | JSR CMPM | ;IS COUNT(1) < COUNT(0)? |
| 0286 | 10 08 | | BPL SKIP | |
| 0288 | A5 D0 | | LDA D0 | ;SET COUNT(1) |
| 028A | 85 C0 | | STA C0 | ; TO |
| 028C | A5 D1 | | LDA D1 | ; COUNT(0). |
| 028E | 85 C1 | | STA C1 | ; |
| 0290 | A9 02 | SKIP: | LDA H#02 | |
| 0292 | 20 7C 05 | | JSR SUBM | ;COUNT(1) – COUNT(0) |

at the selected input. The ramp-start input is then set high. This disconnects the input voltage from the ramp capacitor, which now discharges linearly at a controlled rate through resistors R1 and R2. When the ramp capacitor is discharged, the ramp-stop output goes low. Since the capacitor's discharge time is directly proportional to the input voltage, a counter running during the interval from the conditions ramp-start-high to ramp-stop-low will, at the end, contain a count that is proportional to input voltage.

In this circuit, a low-to-high transition of peripheral-port bit 4 triggers IC2, a 74LS221 monostable multivibrator. Its Q output goes high to clear the counter, while the $\overline{Q}$ output holds the ramp-start line low, allowing the μA9708 (IC1) to acquire the voltage from the selected channel. Upon timing out, IC2's outputs change states, raising the ramp-start line to a high logic level and turning on the counter. When the ramp-stop line goes low, the counting stops, and peripheral-port bit 6 goes high to signal the computer that the conversion is complete. The counter value is the useful output of the converter, and is retained until it has been read and the next conversion cycle has begun.

The clock, IC3, is a multivibrator whose frequency is set to about 1 MHz by the 100 pF capacitors, C6 and C7, and 6.8 k-ohm resistors, R8 and R9, for a 10-bit count. An 8-bit count is selected by replacing R8 and R9 with 27 k-ohm resistors. If the frequency-determining components are installed symmetrically on a header, as shown in figure 2, the 8- or 10-bit counts can be selected by simply unplugging the header and reversing it.

A ripple counter and a 16-bit output multiplexer, controlled by address lines A0 thru A3, complete the circuit.

Before the circuit is used, all unused analog inputs should be grounded and the reference voltage and ramp slope should be set. The 10 k-ohm potentiometer, R3, is first adjusted until the reference voltage at pin 8 of IC1 is exactly 3 V, as indicated by an accurate voltmeter. Then the converter connected to the computer is run in a loop, repeatedly addressing and reading the reference voltage at address 7. The 50 k-ohm potentiometer, R1, is adjusted until the count is just under hexadecimal FF for an 8-bit count, or hexadecimal 3FF for a 10-bit count.

In normal use, the program must first configure the peripheral-port bits 0 thru 4 as outputs and bits 5 thru 7 as inputs, and it must clear bit 4. Voltage readings are taken by writing the value of the channel address plus hexadecimal 10 to the peripheral port and then waiting until bit 6 goes high. The channel address should not be changed during this time. Reading of the counter data automatically clears peripheral port bit 4, enabling its low-to-high transition when the next address is written to the port. The counter is read a bit at a time by writing the address of the desired bit into the peripheral port, reading the port, and then left-shifting bit 7 (the counter data bit) into a register pair

**Listing 2:** *RDADC, a 6502 subroutine to read data from the counter in the converter. The 16-bit counter value is returned in the accumulator and X register. Status bits reflect the condition of the high-order byte.*

```
;                         ***** READ A/D CONVERTER *****
;          THIS SUBROUTINE READS THE COUNTER OF THE A/D CONVERTER.
;          IT RETURNS THE HIGH-ORDER BYTE IN THE ACCUMULATOR
;          AND THE LOW-ORDER BYTE IN THE X REGISTER.
;
;          SCRATCH LOCATIONS USED: F0,F1
;
0330  A9  40        RDADC:  LDA    H#40    ;LOAD MASK TO TEST BIT 6
0332  2C  01  A8      LP1:  BIT    DRA     ;IS A/D CONVERSION COMPLETED?
0335  50  FB                BVC    LP1     ;IF NOT, LOOP UNTIL DONE
0337  A2  0F                LDX    H#0F    ;LOAD INDEX REGISTER/COUNTER
0339  8E  01  A8      LP2:  STX    DRA     ;BIT ADDRESS
033C  AD  01  A8            LDA    DRA     ;READ BIT
033F  2A                    ROL    A       ;ROTATE ACCUMULATOR
0340  26  F1                ROL    F1      ;ROTATE MEMORY LOCATION F1
0342  26  F0                ROL    F0      ;ROTATE MEMORY LOCATION F0
0344  CA                    DEX
0345  10  F2                BPL    LP2     ;BRANCH IF POSITIVE
0347  A6  F1                LDX    F1      ;LOAD LOW-ORDER BYTE
0349  A5  F0                LDA    F0      ;LOAD HIGH-ORDER BYTE
034B  60                    RTS
```

| Reference Designation | Part |
|---|---|
| IC1 | µA9708, A/D converter |
| IC2,IC3 | 74LS221, monostable multivibrator |
| IC4,IC5 | 74LS393, dual 4-bit binary counter |
| IC6 | 74150, 1 of 16 data selectors |
| IC7 | 74LS02, quad 2-input NOR gate |
| IC8 | 74LS08, quad 2-input AND gate |
| C1 | 0.01 µF, polyester |
| C2 | 0.02 µF, ceramic |
| C3,C4,C5 | 0.1 µF, ceramic |
| C6,C7 | 100 pF, ceramic |
| R1 | 50 k-ohm, 10-turn potentiometer |
| R2 | 47 k-ohm, ¼ W, 5% tolerance |
| R3 | 10 k-ohm, 10-turn potentiometer |
| R4,R5 | 10 k-ohm, ¼ W, 10% |
| R6 | 15 k-ohm, ¼ W, 5% |
| R7 | 100 k-ohm, ¼ W, 10% |
| R8,R9 | 6.8 k-ohm or 27 k-ohm, ⅛ W, 5% |

**Table 1:** *Parts list for circuit of figure 1. Capacitor C1 should be a low-leakage type. No precision tolerances are required.*

or 2 bytes of memory that will contain the 16-bit count. The sequence is repeated for each bit, starting with the most-significant bit at hexadecimal address 0F and ending with the least-significant bit at address 00.

The most efficient operation will result when the analog-to-digital conversion is initiated at a point in the program that occurs a number of instructions before the voltage reading is required. The computer is then free to execute the intervening instructions before having to wait for completion of the conversion. The hand-assembled program segment, shown in listing 1, illustrates the use of the converter and the RDADC subroutine (see listing 2). Note the instructions inserted between the initiation of the conversion at hexadecimal address 026A and the reading of the output at address 027A.

A nonzero count is always obtained, even when reading 0 V. This count must be subtracted from the reference voltage and channel counts. Thus, the computation for a linearized and scaled voltage reading becomes:

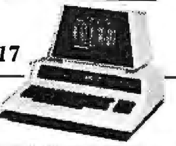
$$V(i) = \frac{\text{Count(Channel } i) - \text{Count (0)}}{\text{Count (7)} - \text{Count (0)}} \times V_{REF}$$

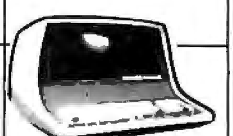
where $V_{REF}$ is the reference voltage.

Long-term drift effects are minimized by reading the zero and reference voltages each time a channel is sampled. When reading very small input voltages, the possibility exists that a channel count may be smaller than the zero count. The apparent instability resulting from this condition is avoided by simply setting the channel count equal to the zero count.

The uses for such a converter are many and diverse. For example, if you are an energy-conscious homeowner, you may wish to monitor temperatures throughout your home. Or, if you are an amateur horticulturist, you may wish to monitor light intensity and temperatures of air and soil to optimize growing conditions for plants or cuttings. Whatever the application, I hope that this converter, with its 8 bits of accuracy for table subscripts or 10 bits of accuracy for better resolution, will serve you well. ■

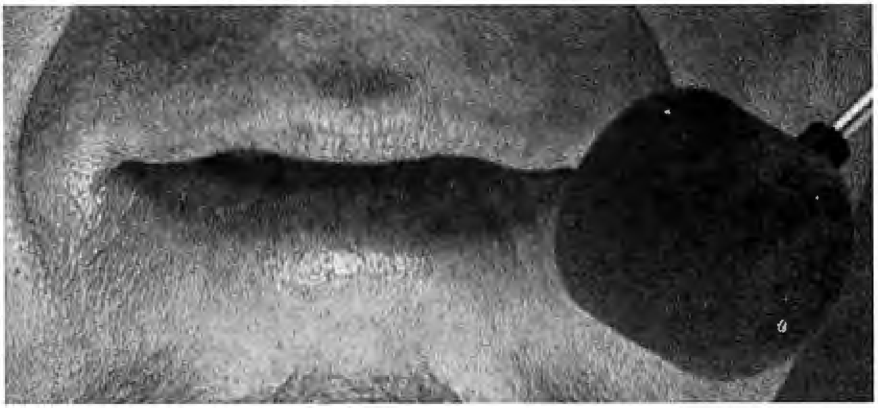












# Technical Forum

# A Votrax Vocabulary

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1394 Rankin St, Troy MI 48084

This vocabulary of 139 entries can be stored in as little as 770 bytes. The ASCII codes shown are for the TRS-80 voice synthesizer. Using Votrax symbology, however, this vocabulary is applicable to many other synthesizers, including the new SC01 phoneme speech chip.

[*In February, Kathryn Fons and Tim Gargagliano coauthored an article entitled "Articulate Automata" (February 1981 BYTE, page 164), in which they presented an overview of the physiology of speech and a look at how Votrax voice synthesizers are programmed. Since that article contained only general guidelines for programming voice synthesizers, they decided to provide us with more specific information in the form of this list of common computer terms and how they would be programmed....*SM]

```
A . . . . . . . . . . .A1   AY   Y    Votrax
                       @    *    &    ASCII

B . . . . . . . . . . .B    E1   AY   Y    Votrax
                       B    E    *    &    ASCII

C . . . . . . . . . . .S    E1   AY   Y    Votrax
                       S    E    *    &    ASCII

D . . . . . . . . . . .D    E1   AY   Y    Votrax
                       D    E    *    &    ASCII

E . . . . . . . . . . .E1   Y    Votrax
                       E    &    ASCII

F . . . . . . . . . . .EH1  EH2  F    Votrax
                       3    4    F    ASCII

G . . . . . . . . . . .J    E1   AY   Y    Votrax
                       J    E    *    &    ASCII

H . . . . . . . . . . .A1   AY   Y    T    CH   Votrax
                       @    *    &    T    C    ASCII

I . . . . . . . . . . .AH1  EH3  I3   Y    Votrax
                       ;    5    #    &    ASCII

J . . . . . . . . . . .D    J    EH3  A1   AY   Y    Votrax
                       D    J    5    @    *    &    ASCII

K . . . . . . . . . . .K    EH3  A1   AY   Y    Votrax
                       K    5    @    *    &    ASCII

L . . . . . . . . . . .EH1  EH3  UH3  L    Votrax
                       3    5    8    L    ASCII

M . . . . . . . . . . .EH1  EH2  M    Votrax
                       3    4    M    ASCII

N . . . . . . . . . . .EH1  EH3  N    Votrax
                       3    5    N    ASCII
```

 

```
O . . . . . . . . . . . .O1  U1   Votrax
                          O    U    ASCII

P . . . . . . . . . . . .P   E1   AY   Y    Votrax
                          P    E    *    &    ASCII

Q . . . . . . . . . . . .K   Y1   IU   U1   U1   Votrax
                          K    Y    (    U    U    ASCII

R . . . . . . . . . . . .AH1 UH2  ER   Votrax
                          ;    7    /    ASCII

S . . . . . . . . . . . .EH1 EH3  S    Votrax
                          3    5    S    ASCII

T . . . . . . . . . . . .T   E1   AY   Y    Votrax
                          T    E    *    &    ASCII

U . . . . . . . . . . . .Y1  IU   U1   U1   Votrax
                          Y    (    U    U    ASCII

V . . . . . . . . . . . .V   E1   AY   Y    Votrax
                          V    E    *    &    ASCII

W . . . . . . . . . . . .D   UH1  B    UH3  L    Y1   IU   U1   Votrax
                          D    6    B    8    L    Y    (    U    ASCII

X . . . . . . . . . . . .EH1 EH2  K    PA0  S    Votrax
                          3    4    K    0    S    ASCII

Y . . . . . . . . . . . .W   AH1  EH3  I3   Y    Votrax
                          W    ;    5    #    &    ASCII

Z . . . . . . . . . . . .Z   E1   AY   Y    Votrax
                          Z    E    *    &    ASCII

ACCESS . . . . . . . . .AE1 EH3  K    PA0  S    EH1  EH3  S    Votrax
                          9    5    K    0    S    3    5    S    ASCII

ADDRESS . . . . . . . . .AE1 EH3  D    R    EH1  EH3  S    Votrax
                          9    5    D    R    3    5    S    ASCII

AND . . . . . . . . . . .AE1 EH3  N    D    Votrax
                          9    5    N    D    ASCII

AUTOMATIC . . . . . . . .AW1 T    UH2  M    AE1  EH3  T    I1   K    Votrax
                          1    T    7    M    9    5    T    I    K    ASCII

BILLION . . . . . . . . .B   I1   I3   L    Y    UH3  N    Votrax
                          B    I    #    L    &    8    N    ASCII

BLOCK . . . . . . . . . .B   L    AH1  UH3  K    Votrax
                          B    L    ;    8    K    ASCII
```

*Vocabulary continued on page 386*

*Vocabulary continued:*

```
BREAK . . . . . . . .B   R   A1  AY  K   Votrax
                     B   R   @   *   K   ASCII

BUS . . . . . . . . .B   UH1 UH3 S   Votrax
                     B   6   8   S   ASCII

CABLE . . . . . . . .K   A1  Y   B   UH3 L   Votrax
                     K   @   &   B   8   L   ASCII

CHARACTER . . .K   EH1 R   EH1 K   T   ER  Votrax
               K   3   R   3   K   T   /   ASCII

CLEAR . . . . . . . .K   L   AY  I3  R   Votrax
                     K   L   *   #   R   ASCII

CLOSE . . . . . . . .K   L   O1  U1  Z   Votrax
                     K   L   O   U   Z   ASCII

CONTINUE . . . .K   UH1 N   T   I1  I3  N   Y1  IU  U1  Votrax
                K   6   N   T   I   #   N   Y   (   U   ASCII

COSINE . . . . . .K   O1  U1  S   AH1 EH3 Y   N   Votrax
                  K   O   U   S   ;   5   &   N   ASCII

DATA . . . . . . . . .D   AE1 EH3 T   UH2 UH3 Votrax
                      D   9   5   T   7   8   ASCII

DESK . . . . . . . . .D   EH1 EH3 S   K   Votrax
                      D   3   5   S   K   ASCII

DEVICE . . . . . . .D   EH1 EH3 V   UH3 AH2 Y   S   Votrax
                    D   3   5   V   8   A   &   S   ASCII

DISK . . . . . . . . .D   I1  I3  S   K   Votrax
                      D   I   #   S   K   ASCII

DISPLAY . . . . .D   I1  S   P   L   A1  I3  Y   Votrax
                 D   I   S   P   L   @   #   &   ASCII

DRIVE . . . . . . . .D   R   AH1 EH3 Y   V   Votrax
                     D   R   ;   5   &   V   ASCII

EDIT . . . . . . . . .EH1 D   I1  T   Votrax
                      3   D   I   T   ASCII

ELSE . . . . . . . . .EH1 EH3 L   S   Votrax
                      3   5   L   S   ASCII

ENABLE . . . . . . .EH1 N   A1  Y   B   UH3 L   Votrax
                    3   N   @   &   B   8   L   ASCII
```

| Word | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| END . . . . . . . . . . | EH1 | EH3 | N | D | | | | | | | | | Votrax |
| | 3 | 5 | N | D | | | | | | | | | ASCII |
| ENTER . . . . . . . . | EH1 | EH3 | N | T | ER | | | | | | | | Votrax |
| | 3 | 5 | N | T | / | | | | | | | | ASCII |
| ERASE . . . . . . . . | AY | I1 | R | A1 | AY | Y | S | | | | | | Votrax |
| | * | I | R | @ | * | & | S | | | | | | ASCII |
| ERROR . . . . . . . . | EH1 | ER | O1 | R | | | | | | | | | Votrax |
| | 3 | / | O | R | | | | | | | | | ASCII |
| ESCAPE . . . . . . . | EH1 | EH3 | S | K | A1 | Y | P | | | | | | Votrax |
| | 3 | 5 | S | K | @ | & | P | | | | | | ASCII |
| EXECUTE . . . . . | EH1 | K | PA0 | S | EH1 | K | Y1 | IU | U1 | T | | | Votrax |
| | 3 | K | 0 | S | 3 | K | Y | ( | U | T | | | ASCII |
| EXPONENT . . . . | EH1 | EH3 | K | PA0 | S | P | O1 | U1 | N | EH1 | N | T | Votrax |
| | 3 | 5 | K | 0 | S | P | O | U | N | 3 | N | T | ASCII |
| FEED . . . . . . . . . . | F | E1 | Y | D | | | | | | | | | Votrax |
| | F | E | & | D | | | | | | | | | ASCII |
| FIELD . . . . . . . . . | F | E1 | Y | L | D | | | | | | | | Votrax |
| | F | E | & | L | D | | | | | | | | ASCII |
| FIX . . . . . . . . . . . | F | I1 | I3 | K | PA0 | S | | | | | | | Votrax |
| | F | I | # | K | 0 | S | | | | | | | ASCII |
| FLOPPY . . . . . . . . | F | L | AH1 | UH3 | P | Y | | | | | | | Votrax |
| | F | L | ; | 8 | P | & | | | | | | | ASCII |
| FOR . . . . . . . . . . . | F | O2 | O2 | R | | | | | | | | | Votrax |
| | F | [ | [ | R | | | | | | | | | ASCII |
| FORMAT . . . . . . . | F | O2 | O2 | R | M | AE1 | EH3 | T | | | | | Votrax |
| | F | [ | [ | R | M | 9 | 5 | T | | | | | ASCII |
| FORWARD . . . . . | F | O2 | O2 | R | W | ER | D | | | | | | Votrax |
| | F | [ | [ | R | W | / | D | | | | | | ASCII |
| FRAME . . . . . . . . | F | R | A1 | AY | Y | M | | | | | | | Votrax |
| | F | R | @ | * | & | M | | | | | | | ASCII |
| FREE . . . . . . . . . . | F | R | E1 | Y | | | | | | | | | Votrax |
| | F | R | E | & | | | | | | | | | ASCII |
| GET . . . . . . . . . . . | G | EH1 | EH3 | T | | | | | | | | | Votrax |
| | G | 3 | 5 | T | | | | | | | | | ASCII |
| GLITCH . . . . . . . . | G | L | I1 | I3 | T | CH | | | | | | | Votrax |
| | G | L | I | # | T | C | | | | | | | ASCII |

*Vocabulary continued on page 388*

*Vocabulary continued:*

```
GOSUB . . . . . . . .G    O1   U1   S    UH1  UH3  B    Votrax
                     G    O    U    S    6    8    B    ASCII

GOTO . . . . . . . . .G   O1   U1   T    IU   U1   Votrax
                     G    O    U    T    (    U    ASCII

HUNDRED . . . . .H    UH1  UH3  N    D    R    EH3  D    Votrax
                 H    6    8    N    D    R    5    D    ASCII

IF . . . . . . . . . .I1  I3   F    Votrax
                     I    #    F    ASCII

INKEY . . . . . . . .I1   I3   N    K    AY   Y    Votrax
                     I    #    N    K    *    &    ASCII

INPUT . . . . . . . .I1   I3   N    P    OO   T    Votrax
                     I    #    N    P    $    T    ASCII

INSTRING . . . .I1   I3   N    S    T    R    I1   I3   NG   Votrax
                I    #    N    S    T    R    I    #    +    ASCII

INSTRUCTION .I1   I3   N    S    T    R    UH1  K    SH   UH1  N  Votrax
             I    #    N    S    T    R    6    K    >    6    N  ASCII

KEYBOARD . . . .K    AY   Y    B    O1   O2   R    D    Votrax
                K    *    &    B    O    [    R    D    ASCII

KILL . . . . . . . . .K   I1   I3   L    Votrax
                     K    I    #    L    ASCII

LEFT . . . . . . . . .L   EH1  EH3  F    T    Votrax
                     L    3    5    F    T    ASCII

LEN . . . . . . . . . .L  EH1  EH3  N    Votrax
                     L    3    5    N    ASCII

LENGTH . . . . . . .L    EH1  EH3  N    TH   Votrax
                    L    3    5    N    =    ASCII

LEVEL . . . . . . . .L    EH1  EH3  V    UH3  L    Votrax
                     L    3    5    V    8    L    ASCII

LINE . . . . . . . . .L   AH1  Y    N    Votrax
                     L    ;    &    N    ASCII

LIST . . . . . . . . .L   I1   I3   S    T    Votrax
                     L    I    #    S    T    ASCII

LOAD . . . . . . . . .L   O1   U1   D    Votrax
                     L    O    U    D    ASCII

LOCK . . . . . . . . .L   AH1  UH3  K    Votrax
                     L    ;    8    K    ASCII
```

```
LOG . . . . . . . . . . .L    AW2  AW2  G    Votrax
                         L    2    2    G    ASCII

MANUAL . . . . . . . . .M    AE1  EH3  N    Y1   U1   UH3  L    Votrax
                         M    9    5    N    Y    U    8    L    ASCII

MEMORY . . . . . . . . .M    EH1  EH3  M    O2   O2   R    Y    Votrax
                         M    3    5    M    [    [    R    &    ASCII

MERGE . . . . . . . . . .M    ER   D    J    Votrax
                         M    /    D    J    ASCII

MID . . . . . . . . . . .M    I1   I3   D    Votrax
                         M    I    #    D    ASCII

MODEL . . . . . . . . . .M    AH1  UH3  D    UH3  L    Votrax
                         M    ;    8    D    8    L    ASCII

MICRO . . . . . . . . . .M    UH3  AH2  AY   K    R    O1   U1   Votrax
                         M    8    A    *    K    R    O    U    ASCII

MILLION . . . . . . . . .M    I1   I3   L    Y    UH3  N    Votrax
                         M    I    #    L    &    8    N    ASCII

NAME . . . . . . . . . . .N    A1   AY   Y    M    Votrax
                         N    @    *    &    M    ASCII

NEXT . . . . . . . . . . .N    EH1  EH3  K    PA0  S    T    Votrax
                         N    3    5    K    0    S    T    ASCII

NEW . . . . . . . . . . .N    IU   U1   U1   Votrax
                         N    (    U    U    ASCII

NOT . . . . . . . . . . .N    AH1  UH3  T    Votrax
                         N    ;    8    T    ASCII

ON . . . . . . . . . . . .AH1 UH3  N    Votrax
                         ;    8    N    ASCII

OPEN . . . . . . . . . . .O1   P    I1   N    Votrax
                         O    P    I    N    ASCII

OR . . . . . . . . . . . .O1   O2   R    Votrax
                         O    [    R    ASCII

OUT . . . . . . . . . . .UH3  AH2  U1   T    Votrax
                         8    A    U    T    ASCII

PEEK . . . . . . . . . . .P    E1   Y    K    Votrax
                         P    E    &    K    ASCII

PHASE . . . . . . . . . .F    A1   AY   Y    Z    Votrax
                         F    @    *    &    Z    ASCII
```

*Vocabulary continued on page 390*

*Vocabulary continued:*

```
POINT . . . . . . . .P    O1   I3   AY   N    T    Votrax
                     P    O    #    *    N    T    ASCII

POKE . . . . . . . . .P   O1   U1   K    Votrax
                     P    O    U    K    ASCII

POSITION . . . .P         UH1  UH3  Z    I1   SH   UH3  N    Votrax
                     P    6    8    Z    I    >    8    N    ASCII

POWER . . . . . . . .P    AH1  UH3  W    ER   Votrax
                     P    $    8    W    /    ASCII

PRINT . . . . . . . .P    R    I1   I3   N    T    Votrax
                     P    R    I    #    N    T    ASCII

PUT . . . . . . . . . .P  OO1  OO1  T    Votrax
                     P    %    %    T    ASCII

RANDOM . . . . . . .R     AE1  EH3  N    D    UH1  M    Votrax
                     R    9    5    N    D    6    M    ASCII

READ . . . . . . . . .R   E1   Y    D    Votrax
                     R    E    &    D    ASCII

REMARK . . . . . . .R     E1   M    AH1  R    K    Votrax
                     R    E    M    $    R    K    ASCII

REPEAT . . . . . . .R     E1   P    E1   AY   T    Votrax
                     R    E    P    E    *    T    ASCII

RESET . . . . . . . .R    E1   S    EH1  EH3  T    Votrax
                     R    E    S    3    5    T    ASCII

RESTORE . . . . . .R      E1   S    T    O2   O2   R    Votrax
                     R    E    S    T    [    [    R    ASCII

RESUME . . . . . . .R     E1   Z    IU   U1   U1   M    Votrax
                     R    E    Z    (    U    U    M    ASCII

RETURN . . . . . . .R     E1   T    ER   R    N    Votrax
                     R    E    T    /    R    N    ASCII

REWIND . . . . . . .R     E1   W    AH1  AY   Y    N    D    Votrax
                     R    E    W    $    *    &    N    D    ASCII

RIGHT . . . . . . . .R    UH3  AH2  Y    T    Votrax
                     R    8    A    &    T    ASCII

SAVE . . . . . . . . .S   A1   AY   Y    V    Votrax
                     S    @    *    &    V    ASCII

SELECT . . . . . . .S     EH2  L    EH1  K    PA0  T    Votrax
                     S    4    L    3    K    0    T    ASCII
```

```
SET . . . . . . . . . .S    EH1  EH3  T    Votrax
                       S    3    5    T    ASCII

SHIFT . . . . . . . . .SH   I1   I3   F    T    Votrax
                       >    I    #    F    T    ASCII

SINE . . . . . . . . . .S   AH1  EH3  Y    N    Votrax
                        S   ;    5    &    N    ASCII

STEP . . . . . . . . . .S   T    EH1  EH3  P    Votrax
                        S   T    3    5    P    ASCII

STOP . . . . . . . . . .S   T    AH1  UH3  P    Votrax
                        S   T    ;    8    P    ASCII

STRING . . . . . . . .S     T    R    I1   I3   NG   Votrax
                      S     T    R    I    #    +    ASCII

SUPPLY . . . . . . . .S     UH1  P    L    AH1  EH3  Y    Votrax
                      S     6    P    L    ;    5    &    ASCII

SYSTEM . . . . . . . .S     I1   S    T    EH1  M    Votrax
                      S     I    S    T    3    M    ASCII

TAB . . . . . . . . . . .T  AE1  EH3  B    Votrax
                         T  9    5    B    ASCII

TANGENT . . . . . .T        AE1  EH3  N    D    J    EH1  N    T    Votrax
                   T        9    5    N    D    J    3    N    T    ASCII

THEN . . . . . . . . . .THV EH1  EH3  N    Votrax
                        <   3    5    N    ASCII

TIME . . . . . . . . . .T   AH1  EH3  Y    M    Votrax
                        T   ;    5    &    M    ASCII

TRACE . . . . . . . . .T    R    A1   AY   Y    S    Votrax
                       T    R    @    *    &    S    ASCII

THOUSAND . . . .TH          AH1  UH3  U1   Z    EH3  N    D    Votrax
                =           ;    8    U    Z    5    N    D    ASCII

USER . . . . . . . . . .Y1  IU   U1   U1   Z    ER   Votrax
                        Y   (    U    U    Z    /    ASCII

USING . . . . . . . . .Y1   IU   U1   U1   Z    I1   I3   NG   Votrax
                       Y    (    U    U    Z    I    #    +    ASCII

VALUE . . . . . . . . .V    AE1  EH3  L    Y1   IU   U1   Votrax
                       V    9    5    L    Y    (    U    ASCII

ZAPPED . . . . . . . .Z     AE1  EH3  P    PA0  T    Votrax
                      Z     9    5    P    0    T    ASCII
```

# The Impossible Dream:

## Computing $e$ to 116,000 Places with a Personal Computer

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The 1960s were a decade of unrest, turbulence, and accomplishment. Man walked on the moon, *Star Trek* was launched, and the first million digits of $\pi$ were determined by a computer. Today, as we face the early 1980s, Robert Truax, a backyard hobbyist, is constructing a private spacecraft, *Star Trek* has been revived as a movie, and personal computers are a reality. As a people, passion drives us to explore the unknown reaches of our universe. It is pleasing to note that this exploration is no longer the exclusive domain of governments and large institutions.

The purpose of this article is to share my experiences in computing the mathematical constant $e$ to 116,000 digits of precision on an Apple II computer. Although this computation has little intrinsic value or use, the experience was stimulating and educational. The problems I was forced to overcome gave me insights that greatly contributed to new floating-point routines. These routines were, in some cases, two to three times as fast as those currently implemented in some of our languages at Apple. Because I wanted to develop my own solutions to the problem, I did not research existing techniques for computing $e$ to great precision. Therefore, my approaches are quite possibly not state-of-the-art.

I first calculated $e$ to 47 K bytes of precision in January 1978. The program ran for 4.5 days, and the binary result was saved on cassette tape. Because I had no way of detecting lost-bit errors on the Apple (16 K-byte dynamic memory circuits were new items back then), a second result, matching the first, was required. Only then would I have enough confidence in the binary result to print it in decimal.

Before I could rerun the 4.5 day program successfully, other projects at Apple, principally the floppy-disk controller, forced me to deposit the project in the bottom drawer. This article, already begun, was postponed along with it. Two years later, in March 1980, I pulled the $e$ project out of the drawer and reran it, obtaining the same results. As usual (for some of us), writing the magazine article consumed more time than that spent meeting the technical challenges.

*Just before this issue went to press, Steve Wozniak told me that he had redesigned the theoretical "e-machine" that uses dedicated hardware for calculating e. The machine, which costs under $10,000, would use disk storage on a hard disk to replace large amounts of programmable memory. Steve estimates that a calculation of e to 100,000,000 places (ten times as many places as the current calculation of e) could be made in three months of calculation time....*GW

### Little Things Add Up

To compute the value of $e$, a method or formula must be found or derived. The *CRC Standard Mathematical Tables* handbook (see references) provides the well-known formula:

$$e = 1 + 1/1! + 1/2! + 1/3! + \ldots$$

We know that $e$ is approximately 2.71828. For the sake of simplicity, we will deal with the fractional part only (.71828, etc) and abbreviate it *efrac*.

$$efrac = 1/2! + 1/3! + 1/4! + \ldots$$

Because each term is less than one-half the prior term, this series converges with the property that the sum of all terms beyond a specified $n$th term is less than that $n$th term. Thus, if the series is truncated after $n$ terms, the maximum error in the computation is less than $(1/n!)$. This property relates the number of terms used, $n$, to the precision obtained in the computation. Because this series contains a factorial in the denominator of the terms, it is said to converge rapidly. This means that great precision can be obtained with relatively few terms. For example, the *CRC Standard Mathematical Tables* handbook lists 100! as $9.3326 \times 10^{157}$, signifying that 100 terms will yield almost 158 digits of precision. The rate of convergence is sufficient that, for the problem at hand, neither algebraic manipulation of the series for faster convergence nor selection of a different formula is necessary.

## Divide and Conquer

The following algorithm accomplishes the evaluation of the series for *e*. Of course, all critical routines should be implemented in highly optimized machine (assembly) language for speed. An extra hour spent optimizing the innermost loops could save days of computation time. Even self-modifying code should be used to save a critical microsecond! Binary arithmetic should be used to obtain maximal precision and the fastest possible computation time. Later, the result can be converted to decimal as it is printed.

The algorithm is as follows (also see figure 1):

1. Divide available memory equally into two arrays, TERM and E. The TERM array will contain successive terms ($1/i!$) and is initialized to 0.5 ($^1/_2!$). The E array will contain the running total of the terms and is also initialized to 0.5. Both arrays can be thought of as long bit streams of the fractional parts of the numbers they represent.
2. Set the variable DIVISOR to an initial value of 3.
3. Divide TERM by DIVISOR, forming 1/(DIVISOR!). Multiprecision division techniques will be discussed later.
4. Add TERM to E, keeping the assumed decimal points aligned. This sum will always be purely fractional (ie: it will never equal or exceed 1).
5. Increment the DIVISOR variable.
6. Repeat steps 3, 4, and 5 until TERM is reduced to all zeros or until a predetermined maximum divisor is reached.

This basic computation algorithm utilizes only 50% of available memory for the result. By rearranging the series for *e*, we can arrive at an approach that utilizes 100% of the memory.

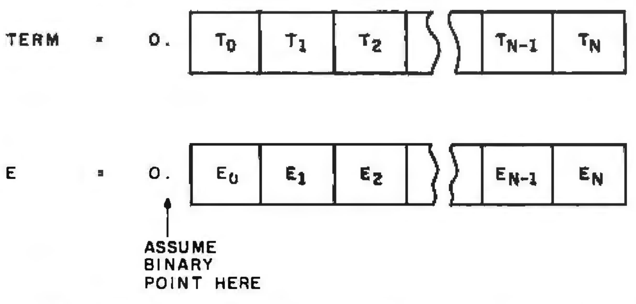


**Figure 1:** *Memory usage in the first algorithm to calculate e. Equal amounts of memory are devoted to a sequence of bytes representing the value of the current term being calculated (TERM) and the sum of all terms calculated thus far (E). Both numbers are seen as binary fractions (ie: the leftmost bit represents ½, the next bit represents ¼, etc).*

We begin by reversing the order of terms in *efrac*:

$$
\begin{aligned}
efrac &= 1/2! + 1/3! + \ldots + 1/(n-1)! + 1/n! \ (n \text{ terms}) \\
&= 1/n! + 1/(n-1)! + \ldots + 1/3! + 1/2!
\end{aligned}
$$

We then develop the following identity:

$$
\frac{1}{i!} + \frac{1}{(i-1)!} = \frac{1}{i(i-1)!} + \frac{1}{(i-1)!}
$$

$$
= \frac{\frac{1}{i} + 1}{(i-1)!}
$$

By repeatedly applying this identity to the formula, we get:

$$
efrac = \cfrac{\cfrac{\cfrac{\cfrac{\frac{1}{n} + 1}{(n-1)} + 1}{\vdots} + 1}{3} + 1}{2}
$$

On inspection, the second series is equivalent to the first for *n* terms. A notable property of the new series is that the computation begins with the *n*th (greatest) divisor and ends with 2 (the smallest). The algorithm for computing *e* with this series is as follows:

1. Allocate all available memory to the E array (which stores the value of *efrac*, the fractional part of *e*). Initialize it to zero.
2. Set the initial value of DIVISOR to *n*, the precalculated maximum term (where *n*! is greater than the precision of the result to be computed).
3. Add 1 to E and divide by the current DIVISOR. The addition may simply imply setting the carry before dividing.
4. Decrement the DIVISOR.
5. Repeat steps 3 and 4 until the divisor equals 1.

| Divisor | E (after step 3) |
|---|---|
| 5 | 1/5 |
| 4 | 1/4 + 1/(4 × 5) |
| 3 | 1/3 + 1/(3 × 4) + 1/(3 × 4 × 5) |
| 2 | 1/2 + 1/(2 × 3) + 1/(2 × 3 × 4) + 1/(2 × 3 × 4 × 5) |
| | (1/2! + 1/3! + 1/4! + 1/5!) |

**Table 1:** *Example of the calculation of e by the first algorithm.*

An example of this algorithm for $n=5$ is given in table 1.

## How Large Is It?

An associate of mine once discovered that integrated circuit layouts could be conveniently specified in nanoacres! In the computation of $e$, it is more meaningful to specify the precision of the result in decimal digits rather than in the number of bytes allocated. The following formula performs the conversion:

$$\log_{10}(x) = \log_{256}(x) \times \log_{10}(256)$$
$$(\text{number of digits}) = (\text{number of bytes}) \times (2.40824)$$

For example, assume that 14 K bytes of memory are allocated to the fraction of $e$. The number of digits of accuracy this represents is given by the following:

$$\text{number of digits} = 14 \times 1024 \times 2.40824 = 34524.5 \text{ digits}$$

The process of calculating the number of terms needed to compute $e$ to this precision is less straightforward. What must be determined is the minimum value of $n$, where $n!$ is greater than the precision corresponding to available memory. For the above example, this is the minimum $n$ such that $n!$ is greater than $10^{34524}$. The *CRC Standard Mathematical Tables* handbook lists Stirling's Formula, an equation useful for calculating the magnitude of $n!$ for reasonably large $n$:

$$\lim_{n\to\infty} \frac{n! \exp(n)}{n^{(n+0.5)}} = \sqrt{2\pi}$$

Taking the natural logarithms of both sides, we get:

$$\lim_{n\to\infty} \ln(n!) = \frac{\ln(2\pi)}{2} + [\ln(n)]\,[n+0.5] - n$$

Dividing by $\ln(10)$ to obtain the result in common (base-10) logarithms, we see the following:

$$\lim_{n\to\infty} \log_{10}(n!) = \frac{\log_{10}(2\pi)}{2} + [\log_{10}10(n)][n+0.5] - \frac{n}{\ln(10)}$$

The integer portion of this result gives us one less than the number of digits in $(n!)$.

The HP-41C calculator program in listing 1 calculates $\log_{10}(n!)$ (the number of digits in $n!$), given $n$.

By trial and error, it is easy to zero in on the minimum $n$ for which $\log_{10}(n!)$ is greater than 34,524, the number of digits of precision corresponding to 14 K bytes of memory. Table 2 shows a set of values for $n$ in the order in which they were calculated to find the desired value.

The value 9716 is found to be the minimum suitable value of $n$. Because it is difficult to relate the precision of $n!$ to that of $1/n!$, a slightly higher value (perhaps 9720) should be used for $n$. This will also compensate for minor formula or calculation errors.

## A Multiprecision Division Algorithm

The problem at hand calls for the division of a very large dividend (possibly several kilobytes) by a moderate divisor (2 bytes). The general approach is to shift the divisor relative to the dividend, from the most significant bits toward the least, performing the familiar subtract/replace and shift technique that we call long division.

A few general optimizations should be considered. First, the following algorithm assumes that the divisor is less than 32,768 ($2^{15}$). If the divisor were to exceed 32,768, it would have to be compared to a value that could exceed 16 bits (2 bytes). Because indexed operations on the 6502 microprocessor are slower than absolute, direct, zero-page, or register operations, a few "fast" memory locations are allocated to hold the temporary (ie: relating to the current byte) dividend/quotient, and remainder. These locations are designated A0 (dividend/quotient), and A1 and A2 (2-byte remainder), and they should be allocated to the most accessible memory locations (or registers). The high-order byte of

**Listing 1:** *The FACTLOG program for the Hewlett-Packard HP-41C calculator. This program calculates the approximate number of digits in the number (n!).*

```
LBL ALPHA FACTLOG ALPHA ENTER LOG LASTX .5 + *
x<>y 10 LN / -
PI ENTER + LOG 2 / + RTN
```

the fraction array E is assumed to be E(0), and the low-order byte is E($n$). Remember that the 2-byte divisor, NH and NL, represents a whole number, and that the dividend represents a binary fraction with the binary point directly to the left of the MSB (most significant bit) of E(0).

In the algorithm that follows, the A0 byte represents the current byte, E($i$), of the dividend at step 2. By step 6, however, all the digits of the dividend have been shifted out to the left (to the A1, A2 combination), and the digits of the new quotient have been shifted into A0 from the right. A0 is actually doing the work of two 8-bit registers.

Of course, all computation should be done in binary for maximum precision and speed. While targeted for 8-bit machines, these techniques are applicable to machines of longer word lengths.

The "add 1 and divide by $n$" algorithm (see figure 2) is as follows:

| n | $\log_{10}(n!)$ (number of digits in $n!$) |
|---|---|
| 10000 | 35659.5 |
| 9000 | 31681.9 |
| 9700 | 34461.4 |
| 9800 | 34860.3 |
| 9730 | 34581.0 |
| 9720 | 34541.2 |
| 9710 | 34501.3 |
| 9715 | 34521.2 |
| 9716 | 34525.2 |

**Table 2:** *Trial-and-error determination of the number of terms, n, needed to obtain 34,524 digits of precision in the calculation of e. In the algorithm used to calculate e, the smallest contribution to the final value is made by the term (1/n!). The number of digits in (n!) is determined by estimating the value of n! and taking the logarithm to the base 10. The desired value of n is the first integer value greater than 34,524.*

1. Initialize the remainder (locations A2 and A1) to 1, effectively adding 1.0 to the fractional dividend prior to dividing. (A2 is the most significant byte of the remainder.) This accommodates the algorithm developed for calculating $e$. An unmodified divide operation would call for initializing the remainder to zero. Initialize the index, $i$, to zero.
2. Move the next dividend byte, E($i$), to location A0 to divide it by $n$. Shift A0 left 1 bit, moving the MSB into the carry bit.
3. Rotate the 16-bit remainder (A2 and A1) to the left by 1 bit, and rotate the carry bit from A0 into the LSB (least significant bit) of A1. This corresponds to the "shift" portion of the subtract-and-shift algorithm for division. No overflow can occur from this shift because the residual remainder must be less than twice the divisor, which in turn is less than 32,768 ($2^{15}$).
4. Compare the remainder, A2 and A1, to the divisor locations NH and NL. If the remainder is greater, then replace it with the difference of the two and set the quotient bit to 1. Otherwise, clear the quotient bit.
5. Rotate the quotient bit into the LSB of A0, and rotate the MSB of A0 into the carry bit.
6. Perform steps 3, 4, and 5, a total of eight times. Then replace E($i$) with the byte in A0 (which is now the quotient of the byte-wide division just finished). Increment the index, $i$, and continue at step 2 until the last byte, E($n$), has been processed.

## Special Optimizations

I drive a small car and have found that it is helpful to accelerate or decelerate slightly in advance of certain stretches of the road (especially hills and downgrades) to obtain an adequate performance. Similarly, it is

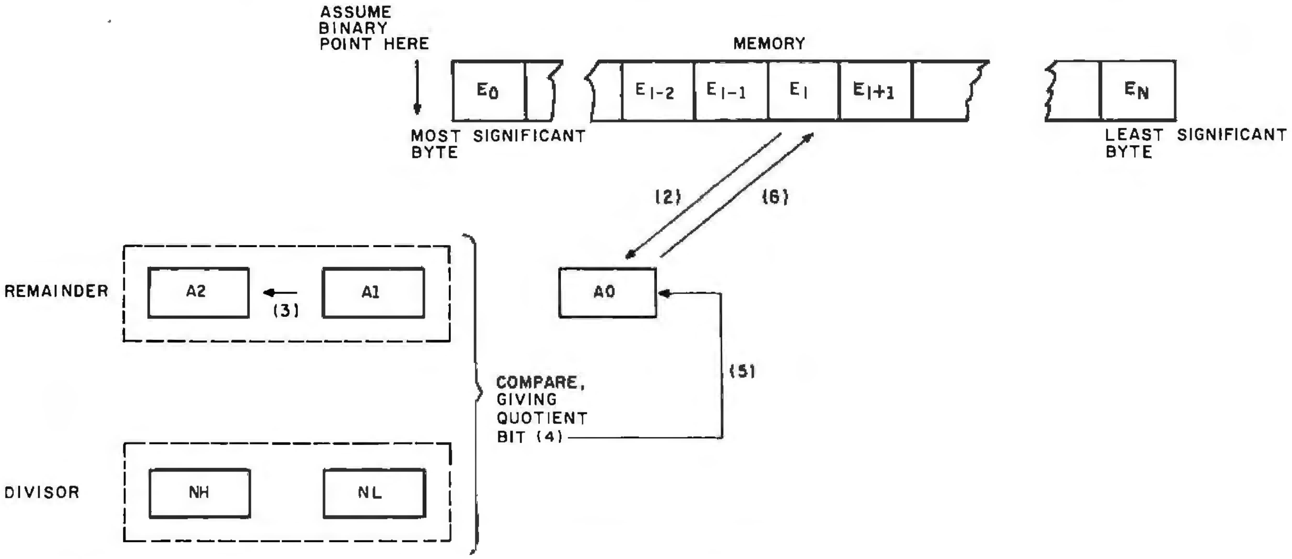


**Figure 2:** *Memory usage in the multiple-byte "add 1 and divide by n" division algorithm. The second algorithm (given in the text) reduces memory usage by 50% by using one long string of bytes in the computation process. The E array is divided 1 byte at a time by the 2-byte divisor. The A0 byte is used to store both the dividend and the quotient at different points in the algorithm. The numbers in parentheses refer to numbered steps in the algorithm.*

sometimes necessary to compensate for the inherent deficiencies of microprocessors (eg: their size) by carefully implementing specific optimizations. For example, the comparison performed in step 4 (discussed above) would normally be done by subtracting the low, and then high bytes, and possibly preserving the difference for replacement of the remainder. Within certain processors, it may be faster to first compare the high bytes, since they frequently dictate the comparison result (255 out of 256 times for arbitrary contents). Also, the critical steps 3, 4, and 5 can be coded eight times in-line to avoid the overhead time of a loop. And because the divisor changes infrequently, it can be coded as fast immediate-mode data. After each full divide, the code, which resides in programmable memory, can be modified for the next divisor.

The 6502 assembly-language program in listing 2 calculates *e* in 14 K bytes of memory. In order to keep the listing brief for this article, the program is not fully optimized. The major operation (add 1, divide) is not coded in-line eight times but is instead implemented as a loop. Because the Y register is used as a loop counter, it is not available as an index to the *e* array, and time-consuming increment instructions must be performed on the instructions at EREF1 and EREF2. Also, it is slightly faster not to move the current dividend byte of *e* into a separate fast location (A0 in the algorithm).

The *e* array begins at hexadecimal location 800 (which is the most significant byte of the array). This secondary text-screen page of the Apple II allows you to view roughly the first 1 K bytes of *e* as they are calculated. Although the character representation is not readily useful, it is at least comforting to observe that the program is working on the correct section of memory. Do not execute this program until you read further and have a good idea of how long it runs before completion. Also, remember that although the result is in binary and somewhat meaningless, it will later be converted to decimal and printed.

### Tomorrow Is a Long Time

The execution time of this program is proportional to the number of divisions performed (9719 for the above example), the number of bytes being divided (14 K bytes in this case), and the average divide time per byte.

The average divide time per byte is calculated as follows. In listing 2, the numbers in parentheses are the cycle times of all significant instructions of the divide routine. Careful analysis shows that when the high-order dividend (remainder) byte is less than the high-order divisor byte, 23 cycles are used. When the former is greater than or equal to the latter, 39 cycles are used, with approximately 13.5 additional cycles (on the average) if the two are equal. Statistically, the remainder will be less than the divisor half of the time and greater than or equal to the divisor half of the time. Analysis reveals that the 2 bytes will be equal approximately one out of every $2H$ comparisons, where $H$ is the high-order divisor byte contents. In the example, $H$ varies from 37 down to 0, so the average frequency of equality is 1 in 37. Using this "fudge factor," the average cycle time per 1-bit partial division is computed as follows:

$$\text{cycles per bit} = {}^{23}/_{2} + {}^{39}/_{2} + {}^{13.5}/_{37}$$
$$= 31.3649 \text{ cycles}$$

Every byte divided includes eight of the above iterations plus an overhead of 21 cycles, giving the following average:

$$\text{cycles per byte} = (\text{cycles per bit} \times 8 \text{ bits per byte}) + 21$$
$$= 31.3649 \times 8 + 21$$
$$= 271.919 \text{ cycles}$$

The average time per cycle on the Apple II is a function of the crystal frequency (14.31818 MHz) and the fre-

*Text continued on page 399*

**Listing 2:** *A 6502 machine-language program for calculating e to 34,524 decimal digits. The result is in binary and must be converted to decimal by the programs shown in listings 3 and 4.*

```
SOURCE FILE: ECALC1
0000:                      LSTON
0000:                 ***********************************
0000:                 *                                 *
0000:                 *    CALCULATION OF E -- 14K      *
0000:                 *                                 *
0000:                 *      WOZ        20-APR-80       *
0000:                 *                                 *
0000:                 *        EXAMPLE PROGRAM          *
0000:                 *                                 *
0000:                 ***********************************
0000:                 *                                 *
0000:                 *  LOCATIONS $800-3FFF ARE USED *
0000:                 *  FOR THE (BINARY) FRACTION OF *
0000:                 *  E. LOCATION $800 IS THE MOST *
0000:                 *  SIGNIFICANT BYTE, $3FFF IS   *
0000:                 *  THE LEAST SIGNIFICANT.  THIS *
0000:                 *  CORRESPONDS TO APPROXIMATELY *
0000:                 *  34524 DIGITS.                *
0000:                 *                                 *
0000:                 ***********************************
0000:                 *                                 *
0000:                 *  THE FIRST DIVISOR IS 9720    *
0000:                 *  AND THE LAST IS 2.  9720     *
0000:                 *  FACTORIAL IS GREATER THAN    *
0000:                 *  10 ^ 34524.                  *
0000:                 *                                 *
0000:                 ***********************************
0000:                 *                                 *
0000:                 *  THE MAJOR OPERATION IS AN    *
0000:                 *  INCREMENT (+1) OF E FOLLOWED *
0000:                 *  BY A MULTI-PRECISION DIVIDE  *
0000:                 *  BY THE CURRENT DIVISOR.      *
0000:                 *  EACH SUCCESSIVELY LESS SIG-  *
0000:                 *  NIFICANT BYTE OF E, TOGETHER *
0000:                 *  WITH THE RESIDUAL REMAINDER  *
0000:                 *  A1 AND A2, IS DIVIDED BY THE *
0000:                 *  CURRENT 2-BYTE DIVISOR.  THE *
0000:                 *  8-BIT QUOTIENT IS LEFT IN E  *
0000:                 *  AND THE RESIDUAL REMAINDER   *
0000:                 *  IN A1 AND A2 (ACC HOLDS A2). *
0000:                 *                                 *
0000:                 ***********************************
0000:                 A1      EQU  0        (CURRENT BYTE OF E IS A0, ACC IS A2)
0001:                 PCOUNT  EQU  1        COUNTS RAM PAGES OF E ARRAY.
```

*Listing 2 continued on page 398*

*Listing 2 continued:*

```
0800:              E        EQU  $800       E, BINARY FRACTION, TO $3FFF.
0038:              NUMPAG   EQU  $38        14K IS 56 RAM PAGES.
25F8:              N        EQU  9720       (N FACTORIAL IS > 34524 DIGITS)
25F8:              NL       EQU  N&$FF      LO BYTE OF N.
0025:              NH       EQU  N/256      HI BYTE OF N.

----- NEXT OBJECT FILE NAME IS ECALC1.OBJ0
0240:                       ORG  $240
0240:A9 38         NXTDVSR  LDA  #NUMPAG    INIT RAM PAGE COUNTER
0242:85 01                  STA  PCOUNT       FOR 56 PAGES.
0244:A9 01                  LDA  #1
0246:85 00                  STA  A1         INIT RESIDUAL REMAINDER TO 1. (FOR +1)
0248:A9 08                  LDA  #E/256
024A:8D 5C 02               STA  EREF1+2    MODIFY CODE SO THAT REFS
024D:8D 78 02               STA  EREF2+2      TO E POINT TO FIRST BYTE.
0250:A9 00                  LDA  #0         (ACC IS ALSO A2 OF RESIDUAL REMAINDER)
0252:8D 5B 02               STA  EREF1+1
0255:8D 77 02               STA  EREF2+1
0258:A0 08         NXTBYTE  LDY  #8         (2) COUNTER--8 BITS PER BYTE.
025A:0E 00 08      EREF1    ASL  E          (6) MSB OF DIVIDEND BYTE TO CARRY.
025D:26 00         NXTBIT   ROL  A1         (5) SHIFT 3-BYTE DIVIDEND.
025F:2A                     ROL  A          (2)  (ACC IS A2)
0260:C9 25         NHREF1   CMP  #NH        (2) IF HI BYTE LESS THAN DIVISOR
0262:90 12                  BCC  EREF2      (3/2)   THEN QUOTIENT BIT IS 0.
0264:D0 06                  BNE  REPLACE    (3/2) (TAKEN IF GREATER)
0266:A6 00                  LDX  A1         (3) COMPARE LOW BYTES IF HI BYTES EQUAL.
0268:E0 F8         NLREF1   CPX  #NL        (2)
026A:90 0A                  BCC  EREF2      (3/2) IF LESS, QUOTIENT BIT IS 0.
026C:AA            REPLACE  TAX             (2)
026D:A5 00                  LDA  A1         (3) REPLACE RESIDUAL REMAINDER A1 AND A2
026F:E9 F8         NLREF2   SBC  #NL        (2)   WITH RESIDUAL REMAINDER
0271:85 00                  STA  A1         (3)   MINUS CURRENT DIVISOR.
0273:8A                     TXA             (2) (HI BYTE OF RESIDUAL REMAINDER)
0274:E9 25         NHREF2   SBC  #NH        (2) (GUARANTEED TO SET CARRY)
0276:2E 00 08      EREF2    ROL  E          (6) QUOTIENT BIT INTO A0 LSB, MSB TO CARRY.
0279:88                     DEY             (2) NEXT OF 8 BITS.
027A:D0 E1                  BNE  NXTBIT     (3/2) LOOP--NOTE: CARRY = QUOTIENT BIT.
027C:EE 5B 02               INC  EREF1+1    (5)
027F:EE 77 02               INC  EREF2+1    (5) MODIFY CODE REFS TO E ARRAY.
0282:D0 D4                  BNE  NXTBYTE    (3)  (NO BYTE OVERFLOW)
0284:EE 5C 02               INC  EREF1+2
0287:EE 78 02               INC  EREF2+2    (MODIFY HI BYTE)
028A:C6 01                  DEC  PCOUNT
028C:D0 CA                  BNE  NXTBYTE    LOOP UNTIL DONE 56 RAM PAGES.
028E:AD 69 02               LDA  NLREF1+1
0291:D0 06                  BNE  NXTDVR2
0293:CE 61 02               DEC  NHREF1+1   DECR IMMEDIATE REFS TO
0296:CE 75 02               DEC  NHREF2+1     CURRENT DIVISOR.
0299:CE 69 02      NXTDVR2  DEC  NLREF1+1
029C:CE 70 02               DEC  NLREF2+1
029F:AD 69 02               LDA  NLREF1+1
02A2:4A                     LSR  A
02A3:0D 61 02               ORA  NHREF1+1   LOOP IF DIVISOR > 1.
02A6:D0 98                  BNE  NXTDVSR
02A8:60                     RTS             (DONE)

*** SUCCESSFUL ASSEMBLY: NO ERRORS
```

*Text continued from page 397:*
quency-dividing circuitry that generates the microprocessor clock. Due to color-graphics considerations, a slight adjustment (to eliminate display jitter) is made, which introduces a constant multiplying the crystal period, and gives us the following time per machine cycle:

$$\begin{aligned}\text{time per cycle} &= 912/((65)(14.31818\ \text{MHz}))\\ &= 0.9799269\ \mu\text{s}\end{aligned}$$

The division time per byte (in $\mu$s) and time per program execution can now be calculated:

$$\begin{aligned}\text{time per byte} &= \text{cycles per byte} \times \text{time per cycle}\\ &= 271.919 \text{ cycles} \times .9799269\ \mu\text{s per cycle}\\ &= 266.46\ \mu\text{s}\\ \text{time per program} &= \text{time per byte} \times \text{number of bytes} \times \text{number of divisions}\\ &= 266.46\ \mu\text{s} \times (14)(1024) \times 9719\\ &= 37{,}126 \text{ seconds}\\ &= 10.3 \text{ hours}\end{aligned}$$

Note that as you compute $e$ to greater precision, both the number of divisors and the length of each division increase. Also, at some point, a 2-byte division no longer suffices and a 3-byte division must be used. This causes the execution time to vary with roughly the second power of the precision sought. For example, three times the precision takes ten times as long to calculate!

## Running the Example Program

If you wish to try the example program before branching out on your own, a few suggestions should be heeded. First, it is a shame to run a program for 10 hours and then find out it contained a minor bug. By changing N (the maximum divisor) to 1000 and NUMPAG to 4 (for 1 K bytes of precision), a quick trial/practice version can be assembled. The practice run allows the user to get the obvious mistakes out of the way with minimum consequence and verify that the assembly is correct. The following commands will clear the memory locations used, run the program, and finish in about 4.5 minutes (273 seconds). Hexadecimal location 0800 should contain B7, and location 0BFF should contain 24 upon completion. As mentioned previously, you can watch the calculation proceed by displaying the secondary text screen on the Apple II. During the trial run, it should be constantly changing.

The following two lines (to be entered when the Apple II is in monitor mode) allow you to run the test program:

```
*800:0 N801<800.BFEM
*C055 240G C054
```

The first line clears the area of memory that will be used, and the second line switches the video display to text page 2 (which will contain the value of $e$ being computed), runs the program of listing 2, then returns to text page 1 when the program is complete.

The real (10-hour) example program should be run twice, and the results compared to verify that the program does not contain a minor bug and that the constants were properly determined. As discussed below, it is not necessary to initialize memory before running the program if the constant $n$ has been properly selected. Therefore, it is recommended that the program be run first with initialized memory and later with random (uninitialized) memory. These results, when compared, should be identical. Once you have confidence in the binary result, save it on tape or floppy disk for printing in decimal.

## Go Forth and Multiply

The computed binary fraction must next be converted to decimal and printed. The general method of converting a binary fraction to a decimal fraction is to repeatedly multiply it by decimal 10 (in binary). The carry from each multiplication (integer portion of product) is the next decimal digit. Because the most significant digits are generated first, the result can be printed as it is generated.

A higher-level language such as BASIC should be used to format the output, but unless you are planning a short vacation, highly optimized machine language should be used for the base conversion. The 6502 programs in listing 3 accomplish the conversion. Subroutine INIT is called once to generate a 256-entry, multiply-by-100 lookup table. Subroutine MULT scans the $e$ array, from the least toward the most significant bytes, multiplying each byte by 100 via a fast table lookup. It also handles carries. The resultant carry is a 2-digit number between 0 and 99 that is returned to BASIC for printing. Note that multiplying by 100, instead of 10, generates 2 digits per pass.

## Seeing Is Believing

The BASIC formatting program in listing 4 should produce an attractive printout. No single program will suffice, due to the fact that printers and people are so varied. The considerations include page headers (title, date, page number), lines per page, spacing between lines, digits per line, digit groupings (eg: groups separated by a space or two), and margins. For example, the poor horizontal registration of a Centronics 779 printer is painfully obvious with single-spaced printouts but almost undetectable with double-spaced ones. A little trial and error will insure that your printout is a perfect "10."

The program in listing 4 was used with an NEC (Nippon Electric Company) Spinwriter. It prints 60 digits per line (twelve groups of 5 digits, separated by single blanks) and 60 lines per page. The page heading is simply the letter $e$ and the page number, carefully aligned with the left and right margins. The text "e=2." precedes the first digit of the printout. The program ends after printing 34,500 digits, despite the fact that an additional 24 digits are re-

*Text continued on page 402*

**Listing 3:** *A BASIC driver program to print e from binary to decimal form. The program uses the machine-language program EPRNT, shown in listing 4.*

```
SOURCE FILE: EPRNT
0000:                   **********************************
0000:                   *                                *
0000:                   *    'E' PRINTOUT ROUTINES       *
0000:                   *                                *
0000:                   *          14K VERSION           *
0000:                   *                                *
0000:                   *     WOZ        20-APR-80       *
0000:                   *                                *
0000:                   **********************************
0000:                   *                                *
0000:                   *  THESE SUBROUTINES PERFORM     *
0000:                   *  THE CRITICAL OPERATIONS       *
0000:                   *  FOR CONVERTING THE 14K        *
0000:                   *  BINARY VERSION OF 'E'         *
0000:                   *  TO DECIMAL FOR PRINTING.      *
0000:                   *  THEY ARE INTENDED TO BE       *
0000:                   *  CALLED FROM A BASIC PROGRAM   *
0000:                   *  WHICH DOES THE ACTUAL         *
0000:                   *  PRINTING.                     *
0000:                   *                                *
0000:                   **********************************
0000:                   *                                *
0000:                   *  THE BINARY REPRESENTATION     *
0000:                   *  OF THE FRACTIONAL PART OF     *
0000:                   *  E (OR ANY OTHER NUMBER        *
0000:                   *  TO BE CONVERTED TO DECIMAL)   *
0000:                   *  IS STORED IN LOCATIONS $800   *
0000:                   *  (MOST SIGNIFICANT) TO $3FFF   *
0000:                   *  (LEAST).  THE SUBROUTINES     *
0000:                   *  INIT AND MULT RESIDE IN THE   *
0000:                   *  $4000 PAGE OF MEMORY AND      *
0000:                   *  USE TABLES PRODLO AND         *
0000:                   *  PRODHI IN THE $4100 AND       *
0000:                   *  $4200 PAGES RESPECTIVELY.     *
0000:                   *  LOMEM MUST BE SET TO $4300    *
0000:                   *  (17152 DECIMAL) OR GREATER    *
0000:                   *  FROM BASIC.                   *
0000:                   *                                *
0000:                   **********************************
0000:                   *                                *
0000:                   *  SUBROUTINE INIT MUST BE       *
0000:                   *  CALLED ONCE TO GENERATE       *
0000:                   *  'MULTIPLY BY 100' TABLES      *
0000:                   *  PRODLO AND PRODHI.  INIT      *
0000:                   *  MUST BE CALLED BEFORE MULT.   *
0000:                   *                                *
0000:                   *  SUBROUTINE MULT PERFORMS      *
0000:                   *  A 'MULTIPLY BY 100' ON THE    *
0000:                   *  NUMBER 'E'.  IT RETURNS       *
0000:                   *  THE NEXT TWO DIGITS OF THE    *
0000:                   *  DECIMAL EQUIVALENT AS A       *
```

```
0000:              *  NUMBER BETWEEN 0 AND 99 IN  *
0000:              *  LOCATION 1 (WHERE BASIC     *
0000:              *  CAN PEEK IT FOR PRINTING).  *
0000:              *                              *
0000:              ********************************

0000:              XSAV    EQU  0         X-REG SAVE LOCATION.
0001:              RESULT  EQU  1         RESULT BYTE FROM MULTIPLY.
0002:              PCOUNT  EQU  2         COUNTS NUMBER OF RAM PAGES OF E.
4100:              PRODLO  EQU  $4100     LOW BYTE TABLE (100 * IDX).
4200:              PRODHI  EQU  $4200     HI BYTE TABLE (100 * IDX).
0800:              E       EQU  $800      E, BINARY FRACTION, TO $3FFF.
0038:              NUMPAG  EQU  56        56 PAGES IN 14K
003F:              LASTPAG EQU  $3F       LAST (LEAST SIGNIFICANT) PAGE OF E.
0000:              *
0000:              *****************************************************
0000:              *
----- NEXT OBJECT FILE NAME IS EPRNT.OBJ0
4000:                      ORG  $4000
4000:86 00         INIT    STX  XSAV      PRESERVE X-REG FOR INT BASIC.
4002:A9 00                 LDA  #0        STARTING PRODUCT LO BYTE.
4004:AA                    TAX            STARTING PRODUCT HI BYTE.
4005:A8                    TAY            STARTING INDEX TO PRODUCT TABLES.
4006:99 00 41      PRODGEN STA  PRODLO,Y  STORE LOW BYTE OF 100 * Y.
4009:48                    PHA            PRESERVE A-REG
400A:8A                    TXA            HI BYTE OF CURRENT PRODUCT.
400B:99 00 42              STA  PRODHI,Y  STORE HI BYTE OF 100 * Y.
400E:68                    PLA            RESTORE A-REG (PRODUCT LOW BYTE).
400F:18                    CLC
4010:69 64                 ADC  #100      ADD 100 FOR NEXT PRODUCT.
4012:90 01                 BCC  NXTPROD
4014:E8                    INX
4015:C8            NXTPROD INY            NEXT OF 256 PRODUCTS.
4016:D0 EE                 BNE  PRODGEN
4018:A6 00                 LDX  XSAV      RESTORE X-REG FOR INT BASIC.
401A:60                    RTS            (RETURN
401B:              *
401B:              *****************************************************
401B:              *
401B:A9 38         MULT    LDA  #NUMPAG
401D:85 02                 STA  PCOUNT    56 PAGES IN 14K.
401F:A9 3F                 LDA  #LASTPAG
4021:8D 32 40              STA  MULT1+2   INIT E REFS FOR LEAST
4024:8D 38 40              STA  MULT2+2     SIGNIGICANT RAM PAGE.
4027:A0 00                 LDY  #0        INIT INDEX TO E (WILL DECR TO $FF FIRST TIME)
4029:A2 00                 LDX  #0        TRICK TO CLEAR RESIDUAL CARRY.
402B:18                    CLC
402C:BD 00 42      MULBYT  LDA  PRODHI,X  (4) HI PROD BYTE IS RESIDUAL CARRY.
402F:88                    DEY            (2) NEXT MORE SIGNIFICANT BYTE OF E.
4030:BE 00 08      MULT1   LDX  E,Y       (4) (GET IT)
4033:7D 00 41              ADC  PRODLO,X  (4) TIMES 100, PLUS RESIDUAL CARRY.
4036:99 00 08      MULT2   STA  E,Y       (5) RESTORE PRODUCT BYTE.
4039:98                    TYA            (2) LAST BYTE THIS PAGE?
403A:D0 F0                 BNE  MULBYT    (3/2)  NO, CONTINUE.
403C:CE 32 40              DEC  MULT1+2   (6)
```

*Listing 3 continued on page 402*

*Listing 3 continued:*

```
403F:CE 38 40          DEC  MULT2+2    (6) NEXT MORE SIGNIFICANT PAGE.
4042:C6 02             DEC  PCOUNT     (5) DONE 56 PAGES?
4044:D0 E6             BNE  MULBYT     (3)   NO, CONTINUE.
4046:7D 00 42          ADC  PRODHI,X   RETRIEVE FINAL CARRY.
4049:85 01             STA  RESULT     SAVE AS TWO-DIGIT RETURNED VALUE.
404B:A6 00             LDX  XSAV       RESTORE X-REG FOR INT BASIC.
404D:60                RTS             (RETURN)

*** SUCCESSFUL ASSEMBLY: NO ERRORS
```

**Listing 4:** *EPRNT, a machine-language program that converts a binary number for printing as a decimal number.*

```
FORMATTER PROGRAM - APPLE INTEGER BASIC

FILE E1 IS 'E' FROM $800 TO $3FFF

FILE EPRNT.OBJO IS INIT AND MULT SUBRS

CAUTION: MUST SET LOMEM TO 17152!

  10 D$="": PRINT D$;"NOMON C,I,O": PRINT D$;"BLOAD E1,A$800": PRINT D$;
     "BLOAD EPRNT.OBJO,A$4000": PRINT D$;"PR#2"
  20 INIT=16384:MULT=16411: CALL INIT:ODDEVEN=0
  30 FOR PAGE=1 TO 10: PRINT : PRINT "      E";: FOR I=1 TO 63: PRINT " "
     ;: NEXT I: PRINT "PAGE ";PAGE/10;PAGE MOD 10: PRINT
  40 FOR LINE=1 TO 60: IF PAGE>1 OR LINE>1 THEN 50: PRINT "  E=2.";: GOTO
     60
  50 PRINT "      ";
  60 FOR GROUP=1 TO 12
  70 FOR DIG=1 TO 5: GOSUB 200: NEXT DIG
  80 PRINT " ";: NEXT GROUP
  90 PRINT : IF PAGE=10 AND LINE=35 THEN 110: NEXT LINE: REM QUIT AFTER 34500
      DIGITS
 100 PRINT : PRINT : PRINT : NEXT PAGE
 110 PRINT D$;"PR#0": END : REM  TURN PRINTER OFF
 190 REM
 192 REM  SUBROTINE 200 PRINTS NEXT DIG
 194 REM
 200 IF ODDEVEN=1 THEN 220: CALL MULT
 210 PRINT PEEK (1)/10;: GOTO 230
 220 PRINT PEEK (1) MOD 10;
 230 ODDEVEN=1-ODDEVEN: RETURN
```

*Text continued from page 399:*
quired in order to be correct. The final page and line number were precalculated to detect this stopping point. Lines 200 thru 230 make up a digit-printing subroutine that calls the assembly-language multiply-by-100 routine (MULT) every other digit.

## Analysis of the Algorithm

The specified algorithm has the property that the contents of $e$ at a given stage of computation will yet be divided by ($i!$), where $i$ is the current divisor. The first implication of this property is that the allocated memory need not be initialized, since it will all be reduced to insignificance when divided by $n!$ (because $n$, the starting divisor, was specifically chosen such that $n!$ is greater than the significance corresponding to that much memory).

An interesting aspect of this implication is that the result is perfect to the last calculated bit, despite the fact that terms beyond the $n$th have been omitted. Additional terms (before the $n$th) would simply cause the allocated

memory to have different contents (ie: be initialized arbitrarily) when the $n$th term is reached. Since division proceeds from high toward low significant bits, arbitrary data beyond a specified least significant byte can never affect the contents of that byte or any more significant byte. There can be no accumulated truncation errors such as those encountered with summation-of-terms approaches.

The second implication is that, at a given stage of calculation, only the most significant bytes of $e$ (ie: those that will not subsequently be divided to insignificance) need to be divided! The first divisions can be very short, only a few bytes or so, while the last ones must encompass all of $e$. For a given divisor, $i$, the number of (least significant) bytes of $e$ which need *not* be divided is $\log_{256}(i!)$, which may be calculated by the HP-41C program in listing 5. Note that it calls the previously written program FACTLOG, which calculates the number of digits of ($i!$). The algorithm used is:

$$\text{number of bytes of } i! = \text{number of digits of } i!/\log_{10}(256)$$

It is unfeasible to precalculate the number of bytes to leave undivided (or the number to divide) for each divisor and to save it in a table because the table would consume a great deal of memory. As an alternative, the divisors can be broken into blocks of, say, 1 K bytes each, and for each block a fixed number of bytes (of $e$) can be divided. The number of bytes to divide for a given block is calculated as the total number of bytes in the $e$ array minus the number of insignificant bytes (calculated as above) corresponding to the minimum divisor of the block, plus a "guard" byte or two to cover slight calculation errors.

In a later program that calculated $e$ to 116,000 digits, I used 47 K bytes (188 pages of 256 bytes each) of memory, and the maximum divisor was 28,800. The divisors were grouped into fifteen blocks of 2 K-byte divisors each, and the number of memory pages not to be divided were precalculated for each block (see table 3). This version of the program used a lookup table to determine how many pages to divide (188 minus the number *not* to divide) for each divisor. This technique proved extremely beneficial because it reduced the computation time from four days to two.

The 47 K-byte version used virtually all the memory in a 48 K-byte Apple. The $e$ array occupied hexadecimal locations 400 thru BFFF. A starting divisor of 28,800

**Listing 5:** *The FACTBYT program for the Hewlett-Packard HP-41C calculator. This program calculates the precision to which the multibyte division has to be carried out for a given divisor. See table 3 for details.*

```
LBL ALPHA FACTBYT ALPHA XEQ ALPHA FACTLOG ALPHA
256 LOG / RTN
```

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| Range of Divisors in Same Group | Number of Insignificant Bytes | Number of Pages That Can Be Left Uncalculated |
|---|---|---|
| 2 to 2047 | 0 | 0 |
| 2048 to 4905 | 2448 | 9.6 |
| 4096 to 6143 | 5406 | 21.1 |
| 6144 to 8191 | 8558 | 33.4 |
| 8192 to 10239 | 11836 | 46.2 |
| 10240 to 12287 | 15206 | 59.4 |
| 12288 to 14335 | 18652 | 72.9 |
| 14336 to 16383 | 22158 | 86.6 |
| 16384 to 18431 | 25718 | 100.5 |
| 18432 to 20479 | 29325 | 114.5 |
| 20480 to 22527 | 32972 | 128.8 |
| 22528 to 24575 | 36656 | 143.2 |
| 24576 to 26623 | 40374 | 157.7 |
| 26624 to 28671 | 44123 | 172.4 |
| 28672 to 30719 | 47900 | 187.1 |

**Table 3:** *Table of truncated multibyte divisions that can be made during the second algorithm. Due to the nature of the second algorithm, most divisors need not carry the division out the entire length of the multibyte dividend. By grouping divisors and not calculating the bytes that are unimportant to that particular group, calculation time can be significantly decreased.*

resulted in 115,925 digits of precision. Because the result occupied screen memory, it had to be written to cassette tape by the calculation program before returning to the Apple II monitor. Because there was no memory available for a BASIC program, the output formatting program was coded in assembly language and resided in parts of pages 0 and 1. Pages 2 and 3 were used for the multiply-by-100 tables.

## On the Horizon

As with any limitless search, there remains the challenge to compute *e* to even greater precision. Unfortunately, the computation time of the specified algorithm is exponentially related to the precision sought. Divide operations on high-speed computers (approximately 12 μs per 32 bits) are two orders of magnitude faster than the 6502 routines. The ultimate approach is to construct a custom "divide machine." Current technologies and low programmable memory prices make it feasible to construct such a machine with a thousand-fold performance improvement over the 6502 microprocessor. With such a machine, *e* could be computed to 100,000,000 digits within a couple of years (one year constructing and testing, one year computing). Such a machine would require power supply backup and error-correcting memory. The memory should be purchased at the latest possible date due to decreasing prices.

Once a few simple concepts are understood, the computation that I have described is as easy as *pi* (see listing 6). Why do people spend time computing these numbers to such absurd precision? Because they're there, I suppose. Who knows what great discoveries will be made by personal computer owners in the coming years? Rest assured that a guaranteed place in the mathematics Hall of Fame awaits the discoverer of the next greatest prime number. ■

**Listing 6:** *A partial printout of the value of e. The first line agrees with the fifty-place value for e that is given in the* CRC Standard Mathematical Tables.

```
   E                                                                   PAGE 01

E=2.71828 18284 59045 23536 02874 71352 66249 77572 47093 69995 95749 66967
    62772 40766 30353 54759 45713 82178 52516 64274 27466 39193 20030 59921
    81741 35966 29043 57290 03342 95260 59563 07381 32328 62794 34907 63233
    82988 07531 95251 01901 15738 34187 93070 21540 89149 93488 41675 09244
    76146 06680 82264 80016 84774 11853 74234 54424 37107 53907 77449 92069
    55170 27618 38606 26133 13845 83000 75204 49338 26560 29760 67371 13200
    70932 87091 27443 74704 72306 96977 20931 01416 92836 81902 55151 08657
    46377 21112 52389 78442 50569 53696 77078 54499 69967 94686 44549 05987
    93163 68892 30098 79312 77361 78215 42499 92295 76351 48220 82698 95193
    66803 31825 28869 39849 64651 05820 93923 98294 88793 32036 25094 43117
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# What's New?

## SYSTEMS

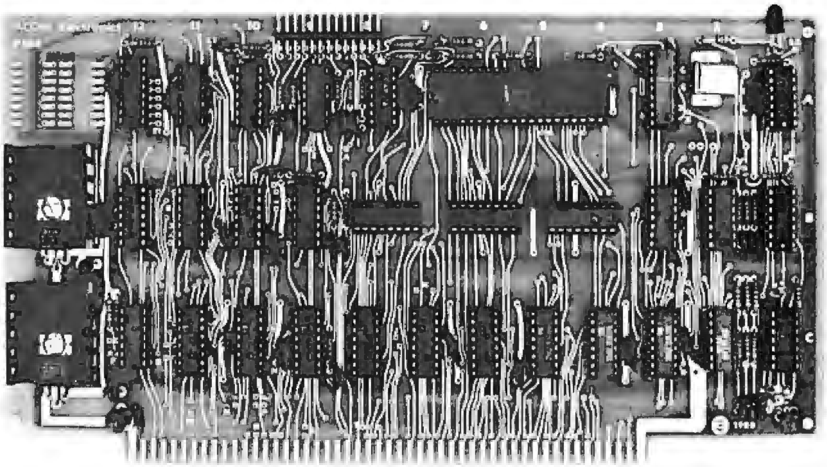
### CCS Microcomputer Systems

A new line of S-100 Z80-based microcomputer systems from California Computer Systems provides real-time hardware-vectored interrupt and interrupt-nesting capabilties. Multiprocessing with interleaved data-transfer rates of up to 2 megabytes per second can be achieved using direct memory access. The main board has two programmable real-time clocks, two 8-bit parallel interface channels, and two programmable RS-232C serial I/O (input/output) channels, one of which may be used for synchronous communication. The chassis contains a nineteen-slot motherboard and a power supply.

The CCS OASIS multitasking operating system features reentrant and relocatable program capabilities, and employs an ISAM (indexed-sequential access method) file structure. Task-to-task communication, file protection, timekeeping, spooling, overlay, and device-independent I/O are accomplished through software. The operating system is supported with debug, editing, relocatable-linkage, and file-sort utilities. CP/M and MP/M can be used with the system. A BASIC interpreter and compiler, FORTRAN, COBOL, and Pascal compilers are also available.

Optional boards include printer and terminal interfaces, 16 K-, 32 K-, and 64 K-byte memory boards, floppy-disk subsystems and expansions, and Winchester-type disk subsystems and expansions. Prices for the CCS systems range up to $9100. Contact California Computer Systems, Marketing Department, 250 Caribbean Dr, Sunnyvale CA 94086, (408) 734-5811.

Circle 524 on inquiry card.



### Acom's 8088 Board

The P188 is an S-100 bus 8088 microprocessor board that will run as a stand-alone processor or as a slave. Jumpers allow configuring the card to run in different operating modes, as well as with static or dynamic memory. The 8088 microprocessor has 16-bit internal architecture, addresses 1 megabyte of memory, and features 8- and 16-bit signed and unsigned arithmetic in binary or decimal, including multiply and divide.

The P188 costs $345 assembled and tested, and $275 in kit form. For more information, contact Acom Electronics, 4151 Middlefield Rd, Palo Alto CA 94303, (415) 494-7499.

Circle 525 on inquiry card.

### Single-Board 6800 Computer

The ACS 12-PRO requires a power supply and terminal to operate. The 6800-based system provides two programmable 16-bit timers, an RS-232C serial port, two 8-bit parallel ports with handshake control, and up to 4 K bytes of programmable memory and 6 K bytes of PROM (programmable read-only memory).

The ACS 12-PRO is supplied with Datricon's 4 K D-FORTH operating system. With 1 K bytes of programmable memory, D-FORTH, and a manual, the ACS 12-PRO sells for $495. For additional details, contact Datricon Corporation, 7911 NE 33rd Dr, Suite 200, Portland OR 97211, (503) 284-8277.

Circle 526 on inquiry card.

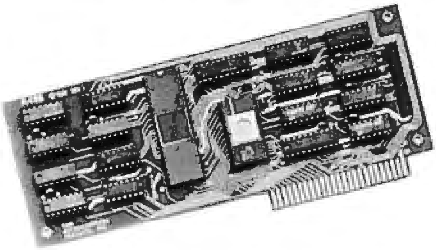
**Where Do New Products Items Come From?**

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.

# What's New?

## PERIPHERALS

### Apple IEEE-488 Interface



The A488 interface card permits the Apple II and the Apple II Plus to operate as IEEE-488 bus controllers. The A488 uses an MC68488 LSI 488-controller integrated circuit that decreases the number of circuits required. The board has 2 K bytes of firmware in EPROM (erasable programmable read-only memory). For special-purpose firmware development, the EPROM can be replaced by programmable memory. The A488 allows bus and system control with character-string instrument commands for set-up, measure, clear, local, trigger, serial-poll, and respond functions. Any equipment on the bus can be designated by a name of up to sixteen characters. Up to fifteen pieces of equipment can be connected to the A488 across a distance of up to 20 meters (66 feet) from the Apple. The card's driver firmware is linked to string routines within Applesoft; floating-point processing of numeric data is easily done. Error checking is included, and software timing loops are not needed.

The A488 is priced at $475 from SSM Microcomputer Products Inc, 2190 Paragon Dr, San Jose CA 95131, (408) 946-7400.

Circle 527 on inquiry card.

### Turn IBM Typewriters Into RS-232Cs

California Micro Computer's 5060 and 5061 modules enable the IBM Model 50, 60, and 75 electronic typewriters to perform as RS-232C-compatible computer I/O (input/output) devices. The modules can be installed and removed easily without requiring modifications to the typewriter. The model 5061 is a print-only version, while the 5060 allows the typewriter to perform full terminal functions. Both units offer ASCII coding with full buffering. The 5061 costs $497 and the 5060 is $860.

For further information, contact California Micro Computer, 9323 Warbler Ave, Fountain Valley CA 92708, (714) 968-0890.

Circle 528 on inquiry card.

### Printer for Under $1000

The Model 445 Paper Tiger printer features a seven-wire ballistic-type print head and tractor-feed motor drives. The 445 can print at speeds up to 198 cps (characters per second). Functions include bold text and the ability to print 80 columns at 10 pitch and 132 columns at 16.7 pitch. Other features include the 96-character upper- and lowercase ASCII (American Standard Code for Information Interchange) character set, six or eight lines-per-inch vertical spacing, multiline buffering, and RS-232C- and Centronics-compatible parallel interfaces. Transmission rates from 110 to 1200 bps (bits per second) are selectable. Variable form length, perforation skipping, and the ability to handle six-part forms and roll paper are other features.

Integral Data Systems' DotPlot graphics capability is offered as an option. DotPlot enables printing the full range of graphics characters. The Paper Tiger Model 445 costs $795 and the DotPlot package is $99. Contact Integral Data Systems Inc, Milford NH 03055, (603) 673-9100.

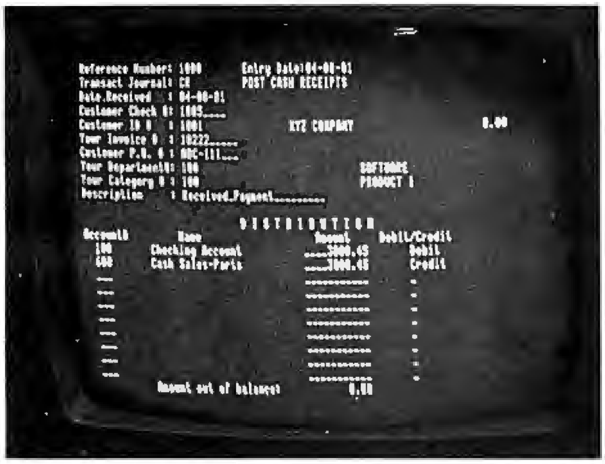
Circle 529 on inquiry card.

### Extend the TRS-80 Color Computer Bus

The Color Connection is a device that extends the TRS-80 Color Computer system bus as a System-50 bus (SS-50). Using the Color Connection, floppy-disk drives and video terminals can be added, and the Color Computer's 16 K-byte internal memory can be expanded. The Color Connection sells for $99.95 from Percom Data Company, 211 N Kirby, Garland TX 75042, (800) 527-1592; in Texas, (214) 272-3421. Circle 530 on inquiry card.

# Computerize your bookkeeping without terrifying your bookkeeper.

Introducing The Boss:™ the most advanced, yet most understandable, financial accounting system. Designed to automate your bookkeeping without confusion or mistakes.


Typical screen format - actual photograph.

If "fear of the unknown" is standing between you and computerization, you should find out about The Boss.

The Boss system is immediately comprehensible to bookkeepers because it utilizes virtually the same format they're used to.

So even someone with no previous computer experience can easily learn and operate The Boss system.

**Features seldom found in packaged software.**

The Boss system is fully interactive, fully departmentalized and exceptionally fast. It can generate an astounding number of complex reports at the touch of a button.

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State__________

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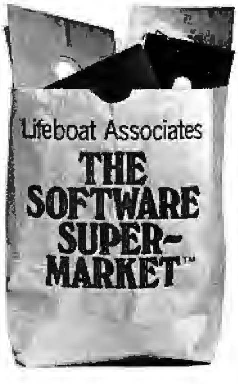


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Boss is a trademark of Balcones Computer Corp.
CP/M is a trademark of Digital Research, Inc.

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Software with full support

# What's New?

## PERIPHERALS

### Low-Cost Color-Graphics Terminal

RCA's VP-3301 is a microprocessor-controlled terminal with color graphics, reverse video, programmable and resident character sets, selectable data rates and formats, a flexible-membrane keyboard, and audio feedback. The VP-3301 can be connected to modems for communication with most timesharing and data-base computer networks. The software-selectable character-display format can produce either 40 characters by 24 lines or 20 characters by 12 lines. Characters and background can be displayed in one of eight colors or gray scales. The communications interface is RS-232C or 20 mA current-loop. Configuration control includes line/local, uppercase only, full- and half-duplex, data-word formatting, plus two control-code options. The video output can be directly connected to monitors or, with an RF (radio frequency) modulator, to a television set. The suggested price for the VP-3301 is $369 from RCA Microcomputer Products, New Holland Ave, Lancaster PA 17604, (717) 397-7661.

Circle 531 on inquiry card.

### 8-Inch Floppy-Disk Drives

Matchless Systems, 18444 S Broadway, Gardena CA 90248, (213) 327-1010, has announced the MS-800 8-inch floppy-disk drive. The drive is compatible with the TRS-80 Models I and II, the Apple II, and S-100 systems. The MS-800 has a capacity of 256 K bytes of storage. The data transfer rate is 256 k bps (bits per second) and the track-to-track access time is 10 ms. The prices range from $995 to $1595, which includes all hardware (such as the controller), software, and documentation. Circle 532 on inquiry card.

### S-100 I/O Board

The MFIO is an I/O (input/output) board designed for S-100 bus systems. It features four serial RS-232C ports with independent data rates of 50 to 19.2 k bps. It also includes 24 bits of parallel I/O configurable for four ports, five timer/counters, sixteen levels of vectored-interrupt control, and an optional battery-powered real-time clock/calendar. The MFIO costs $595. For more information, contact Digicomp Research, Terrace Hill, Ithaca NY 14850, (607) 273-5900.

Circle 533 on inquiry card.

### Series 47-TR Plotter

The Series 47-TR Strip Chart/Plotter is a curve tracer with alphanumeric capabilities. Its plotting area is 25 cm (10 inches) wide. The plotter features an RS-232C- or IEEE-488-compatible port and bidirectional paper drive. It requires two 8-bit words formatted to provide analog pen position. Pen speed is 75 cm per second with a position accuracy of $\pm 0.15\%$, full scale. Paper can be incremented up to 2 cm per second at 0.0127 cm per step. The 47-TR is priced at $945. For details, contact Pedersen Instruments, 2772 Camino Diablo, Walnut Creek CA 94596, (415) 937-3630.

Circle 534 on inquiry card.

### Graphics Terminal for the North Star

The Sigma 1042S high-resolution, memory-mapped graphics terminal is designed for the North Star microcomputer. The display provides a 640 by 800 dot matrix backed by a 64 K-byte display memory. The display memory is divided into sixteen 4 K-byte blocks, which are individually selectable for mapping onto a main-memory window of only 4 K bytes. The 1042S terminal can also be used as a word-processing work station. In this application mode, it includes variable spacing, multiple fonts, and scientific-character capabilities. Reverse video, blinking, and intensification are offered as hardware features. The terminal can be used as a system console under CP/M. The 1042S costs $4000.

For more information, contact Sigma Information Systems USA Inc, 556 Trapelo Rd, Belmont MA 02178, (617) 484-2063.

Circle 535 on inquiry card.

### Cash Register Scans Bar Code

The CE-1000 bar-code-scanning cash register can keep track of your entire inventory. It is designed for use with the Commodore CBM microcomputer and includes software, firmware, and hardware. The unit can read UPC (Universal Product Code) bar codes found on most products for point-of-sale operations, making it useful for convenience, liquor, food, record stores, and other small businesses.

The CE-1000 bar-code scanner costs $1350. For more information, contact Creative Equipment, 50 NW 68 Ave, Miami FL 33126, (305) 261-7866.

Circle 536 on inquiry card.

# What's New?

## PUBLICATIONS

### The Sizzle Sheet

The Sizzle Sheet is a marketing-communications guide for those who market computers, communications and information products, systems, and services. Featured are reviews and reports, editorials on the news, business and trade press, plus special issues.

For details, contact The Sizzle Sheet, POB 801, 150 Speen St, Framingham MA 01701, (617) 875-0013.

Circle 537 on inquiry card.

### Symbol Manipulation Using LISP

This is a manual for the LISP programming language. The book introduces the basics of LISP programming and demonstrates how it is used in practice. It also discusses how artificial intelligence systems are built. Case studies and problems in pattern matching, natural-language understanding, and problem solving are included. An appendix offers a sample terminal session, lists basic LISP functions, and explains differences between MACLISP and INTERLISP.

Symbol Manipulation Using LISP costs $13.95, and is published by Addison-Wesley, Reading MA 01867, (617) 944-3700.

Circle 538 on inquiry card.

### Printronix Printers Described in Brochure

A color brochure describing Printronix dot-matrix printers is available from Printronix Inc. The brochure discusses the Printronix hammer-bank printing mechanism and includes examples of graphics, bar codes, labels, and alphanumeric forms. For your free copy, contact Printronix Inc, 17421 Derian Ave, POB 19559, Irvine CA 92713, (714) 549-7700.

Circle 539 on inquiry card.

### Magazine for TI 99/4 Users

99'er Magazine is a bimonthly magazine with news about the TI 99/4 and other TMS9900-based personal-computer systems. It features tutorial articles, software, book and product reviews, opinions and news items, and a question-and-answer technical forum.

Each issue is divided into sections for education, games and simulations, home activities, and business, scientific, or professional applications. Regular features include columns on the Logo language, CAI (computer-aided instruction), speech-synthesis usage, interfacing with peripherals, computer chess, The Source and TEXNET, news from user groups, and lessons in programming techniques. Advertisements from suppliers of software, peripherals, and other related products and services are also included. A bulletin-board page for noncommercial messages is provided for its readers.

The subscription rate is $15 for one year. Contact 99'er Magazine, Emerald Valley Publishing Company, 2715 Terrace View Dr, Eugene OR 97405, (503) 485-8796. Circle 540 on inquiry card.

### GamesMaster Catalog

The GamesMaster Catalog has listings of board, computer, electronic, hand-held, fantasy, and other kinds of games. One section is exclusively devoted to Dungeons and Dragons-type games. Nearly 1000 games are described in full detail, including landscape sets and miniature pieces.

For a copy of the catalog, contact Boynton & Associates Inc, Clifton House, Clifton VA 22024, (703) 830-1000.

Circle 541 on inquiry card.

### Computer Crimes Books

The Computer/Law Journal has published a two-volume set on computer crimes. This first volume contains an introduction by Senator Abraham Ribicoff, author of the Federal Computer Crimes Protection Act. There are articles by well-known scholars like Donn Parker, Susan Nycum, John Taber, Rob Kling, and Jay Becker.

Volume two has a history of the Stanley Mark Rifkin case and a compliation and analysis of all federal and state statues and bills addressing computer crimes, as well as a case digest, bibliography, and book reviews. Both issues are available for $16 each, plus $1 per issue postage. Contact the Center for Computer/Law, 530 W 6th St, 10th floor, Los Angeles CA 90014.

Circle 542 on inquiry card.

### Computer Books from Entelek

This catalog of computer books from Entelek features books on programming languages, microcomputers, robots, calculators, and educational uses of computers. The catalog is free from Entelek, Ward-Whidden House/The Hill, POB 1303, Portsmouth NH 03801.

Circle 543 on inquiry card.

### 1981 Computer-Science and Engineering Books

A catalog of MIT Press books in the computer-science and engineering fields is available. This catalog describes over fifty books. Most of the books are offered at a 20% discount through December 1981. Copies of the catalog can be obtained from The MIT Press, Promotion Department, 28 Carleton St, Cambridge MA 02142, (617) 253-5642.

Circle 544 on inquiry card.

# What's New?

## SOFTWARE

### Merge Your 737 Printer and Scripsit

Until Apparat Inc introduced Flextext, TRS-80 Model I users could not use all of the features of the Centronics 737 printer (Radio Shack Line Printer IV) with Scripsit, Radio Shack's word-processing program. Flextext is a utility for Scripsit and the 737 printer that supports proportional or compressed character sets in normal and extended modes, right-justified formatting using the proportional or compressed character sets, underlining in any of the Scripsit-selectable formats and Flextext-selectable character sets, super- or subscripts, and the intermixing and combining of the 737's features anywhere in a document. Flextext requires at least one disk drive and a TRSDOS-type operating sytem. The program costs $29.95 from Apparat Inc, 4401 S Tamarac, Denver CO 80237.

Circle 545 on inquiry card.

### Chinese Lessons Program

Chinese greetings, times, seasons, numbers, foods, and other commonly used terms are contained in eleven computer-instruction lessons. Color, graphics, and sound are used in each lesson. Memory aids, meanings, and pronunciations are presented with the Chinese characters. The proper stroke sequence for each character is shown and can be repeated at the user's pace.

The Chinese lesson program is available for $29.95 on a double-sided 5-inch floppy disk for the Apple II with 48 K bytes of programmable memory and a single disk drive. For details, contact Computer Translation Inc, Department BPI, POB 7004 University Sta, Provo UT 84602, (801) 224-1169. Circle 546 on inquiry card.

### Utilities for the TRS-80 Color Computer

Mint Software's utilities for the Color Computer require 16 K bytes of memory. There are three cassette-based programming utilities available: Renumber, which provides the capability to load a program, renumber and save it; Squeeze, which will compress BASIC code to utilize minimum memory; and Merge, which allows two separate programs on cassette to be merged and saved. Other aids for cross-referencing line numbers and variables are available. The programs cost $19.95. A 16 K-byte memory expansion is also available for $70. Contact Mint Software, 6422 Peggy St, Baton Rouge LA 70808, (504) 766-2318.

Circle 547 on inquiry card.

### DMADOS for 8080/Z80 Systems

DMADOS is a single-user, CP/M-compatible 8080 and Z80 disk operating system. It maintains up to sixteen user-defined passwords, allows files to be declared write-protected or invisible to the directory, and can function as a batched console processor. Using DMADOS, up to six print files can be sent to a background print task for printing. User-oriented prompting and error messages are provided.

DMADOS offers support for floppy- and hard-disk files of up to 4.2 megabytes. It is supplied with several utilities and a manual. DMADOS is available on 8-inch floppy disks or North Star double/quad-density formats. For more information on this $200 operating system, contact John D Owens Associates Inc, 12 Schubert St, Staten Island NY 10305, (212) 448-6283.

Circle 548 on inquiry card.

### Electronics Designers Program

Wiremaster is for small electronics companies with printed-circuit layout and wrapped-wire prototyping production problems. Connection data is derived from the schematic diagram and fed to Wiremaster in a CP/M text file. Outputs include a network map showing all pins and wires, a wire list sorted by lengths and levels, a parts list, and checklists that detect all wiring errors. The resulting information can then be used for printed-circuit-board layout, error checking, wiring, component stuffing, and system debugging.

Wiremaster comes on a single-density 8-inch CP/M floppy disk with a manual for $150. It runs on Z80 and TRS-80 Model II CP/M systems with 48 K bytes of memory. Contact Afterthought Engineering, 7266 Courtney Dr, San Diego CA 92111, (714) 277-7863.

Circle 549 on inquiry card.

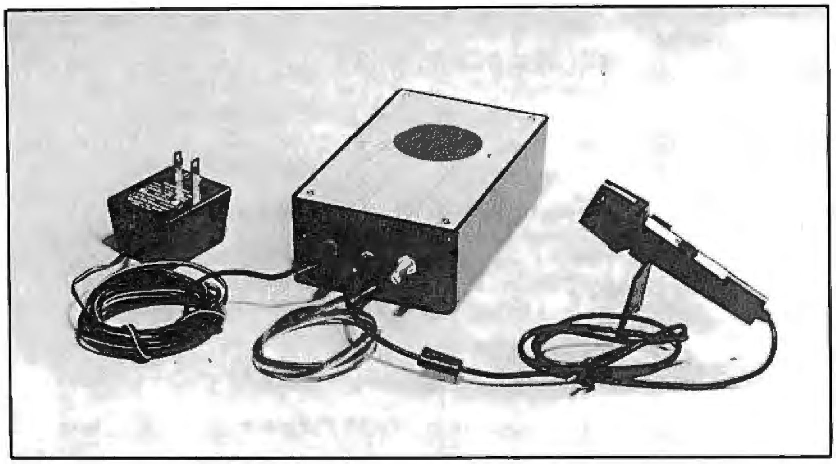
### Dragonquest

In a race against the sun, you search for Smaegor, Monarch of Dragonfolk, who has kidnapped the Princess of the Realm and holds her in an unknown place. You must search the land, seeking the tools needed for the ultimate battle. On the river Delta and in the Temple of Baathteski, clues abound. But where is the Princess? This is the scenario of Dragonquest, an adventure game from The Programmer's Guild, POB 66, Peterborough NH 03458, (603) 924-6065. It runs on TRS-80 Model I microcomputers, and costs $15.95 on cassette or $21.95 on a floppy disk.

Circle 550 on inquiry card.

# What's New?

## MISCELLANEOUS



### Voice Recognition for Z80 Systems

The Cognivox Model VIO-232 voice peripheral is designed for microcomputers using the Z80 microprocessor with a minimum-size programmable memory of 16 K bytes. The VIO-232 can be programmed to recognize words or short phrases from up to 32 entries, and it can answer with up to 32 words or short phrases. The recognition and voice response vocabularies can be different, allowing a dialogue with the computer. Vocabularies larger than 32 words are possible. The Cognivox VIO-232 includes a microphone, power supply, amplifier, speaker, and manual. The price is $149 from Voicetek, POB 388, Goleta CA 93116.

Circle 551 on inquiry card.

### RS-232C-to-Current-Loop Adapter

The ADA400 is a bidirectional RS-232C-to-current-loop adapter, ideal for use with KIM-1 microcomputers. It allows the utilization of an RS-232C-interface terminal instead of a current-loop-interface teletypewriter. The ADA400 does not alter the data-transfer rate. It uses standard power supplies with low current requirements. The adapter can be modified to become an RS-232C-to-TTL (transistor-transistor logic) and TTL-to-RS-232C adapter. The ADA400 retails for $24.50. More information can be obtained from Connecticut microComputer Inc, 34 Del Mar Dr, Brookfield CT 06804, (203) 775-4595.

Circle 552 on inquiry card.

### Record-Retrieval System for PL/I-80

BT-80 is a single-user record-retrieval system based on the B-tree index-organization technique. BT-80 is useful in PL/I-80 applications where single- or multi-keyed access to data records is required. Its facilities can be accessed from PL/I-80 or assembly-language application programs. The system includes utilities that provide access to command-level functions.

BT-80 runs under the CP/M 2.0, MP/M, and CP/NET operating systems. To operate, BT-80 requires the PL/I-80 run-time library and LINK-80 linkage editor. For complete details, contact Digital Research, POB 579, 801 Lighthouse Ave, Pacific Grove CA 93950, (408) 649-3896.

Circle 553 on inquiry card.

### Battery Backup for the PET

Backpack is a battery backup system for the Commodore PET. It is designed for installation within the computer case. Backpack provides 6 to 10 minutes of full-power emergency backup to the computer (video display included) during power failures. The batteries are recharged from the computer's power supply. No special wiring is needed to install the device. Backpack comes assembled for $225.

For more information, contact ETC Corporation, POB G, Apex NC 27502, (919) 362-4200.

Circle 554 on inquiry card.

### Datapro Rates Word-Processing Systems

Thirteen word-processing systems have been named to the 1980 Datapro Honor Roll. Selection of these systems was based on results of a mail survey, which is contained in a thirty-page report, *Word Processing Systems User Ratings*. This report also contains general information about word-processing systems. The report is available for $15 from Datapro Research Corporation, 1805 Underwood Blvd, Delran NJ 08075, (609) 764-0100.

Circle 555 on inquiry card.

### Floppy-Disk Carrier Case

The En Route case carries up to fifty 8- and 5-inch floppy disks during travel. It is small enough to fit under an airplane seat. The case has a polyethylene inner lining to prevent dust buildup. A key lock is included. The En Route case costs $65 from Inmac, 2465 Augustine Dr, POB 4780, Santa Clara CA 95051, (408) 727-1970.

Circle 556 on inquiry card.

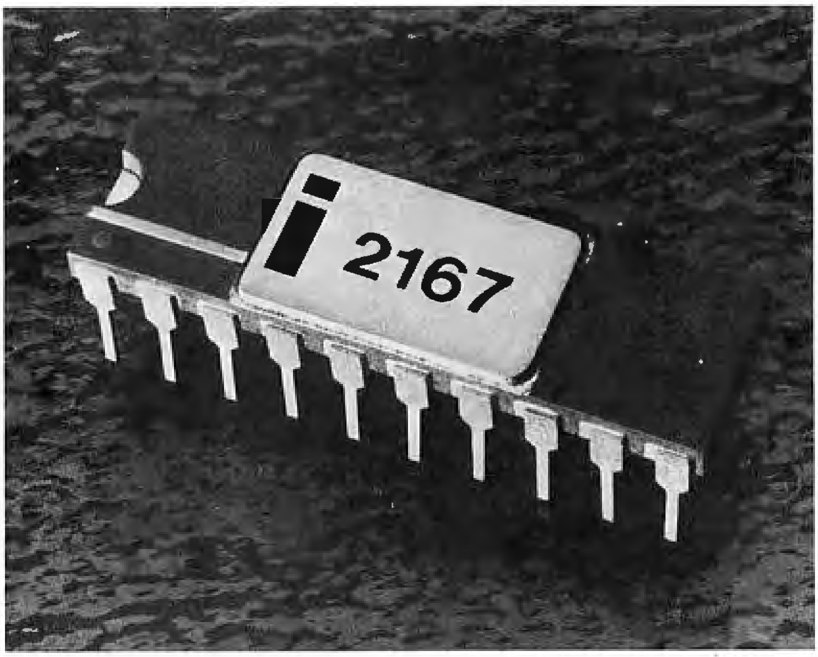
# What's New?

## MISCELLANEOUS

### Universal Development System

The UDS-1000 universal development system is a floppy-disk-based system that uses the Z80 microprocessor. Various cross-assemblers for software development are supplied from a selection including the Texas Instruments TMS1000 and the TMS-1400 series; Rockwell R6500/1, MM75, -76, -77, and -78 series; Motorola 6800; Mostek 3870; Intel 8748, 8048; RCA 1802; NSC COP 420; OKI OLMS42; and other microprocessors. In addition to the cross-assembler, a ROM (read-only memory) emulation board for prototype testing and an EPROM (erasable programmable ROM) programmer are included. The price of the system, including 64 K bytes of programmable memory, a 24-line by 80-character video terminal, an 80 cps (characters per second) printer, ROM emulation, and the EPROM programmer board, is $8750. For information, contact Multitech Electronics Inc, 10322A N Stelling Rd, Cupertino CA 95014, (408) 252-4212.

Circle 557 on inquiry card.




### 16 K by 1-Bit Static Memory

The 2167 is a 16 K by 1-bit programmable static memory device from Intel. The 2167 can replace Intel's 2147 and 2141 static circuits. Compared to these devices, the 2167 has a greater density and lower power consumption. It also has a 55 ns access speed. The HMOS (high-performance metal-oxide semiconductor) device does not require clocking or timing strobes. The 2167's inputs and outputs are TTL-compatible and are unlatched. Address set-up and hold timings are not required.

Prices for the 2167 are $68.55 per unit, in quantities of 100. For further details, contact Intel Corporation, 3585 SW 198th Ave, Aloha OR 97005, (503) 642-6344.

Circle 558 on inquiry card.

### Spelling Error Detection/Correction Package

Proof/it is a set of programs that scans the words in a text file and compares them with those in one or more dictionaries. Words that are not found are flagged as possible errors. Correctly spelled new words can be added automatically to the dictionary. Corrections can be directly substituted for incorrectly spelled words in the text file. A package including manual and software on a floppy disk with over 10,000 words in the dictionary is $125. Software on a 5-megabyte hard-disk pack with over 30,000 words in the dictionary is $100 more. The manual can be purchased separately for $10.

Proof/it runs on Alpha Micro AM-100 computers with 32 K bytes of memory. For information, contact Datalab Inc, 617 E University, Suite 250, Ann Arbor MI 48104, (313) 995-0663.

Circle 559 on inquiry card.

### Daisy-Wheel Printer

The Starwriter letter-quality daisy-wheel printer runs at 25 cps. The Starwriter comes with a Centronics-compatible parallel interface, and uses Diablo ribbons and print wheels. The Starwriter has graphics capabilities and is code-compatible with Qume and Diablo printers. The printer accommodates paper widths of up to 38 cm (15 inches), and can make three copies. The Starwriter is available for $1779 from Computer Textile Inc, 10960 Wilshire Blvd, Suite 1504, Los Angeles CA 90024, (213) 477-2196.

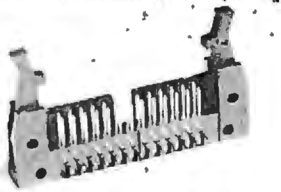
Circle 560 on inquiry card.

# page
DIGITAL INC.

1858 Evergreen Street, Duarte, California 91010 Phone 213-357-5005

# INSULATION DISPLACEMENT SOCKETS

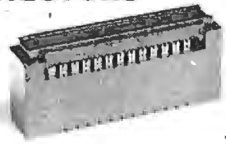
## RIGHT ANGLE HEADERS



| Pins | PC Mounting | | Wire Wrap | |
|---|---|---|---|---|
| 10 | IDH10SR | .80 | IDH10WR | 1.75 |
| 20 | IDH20SR | 1.25 | IDH20WR | 2.75 |
| 26 | IDH26SR | 1.85 | IDH26WR | 3.60 |
| 34 | IDS34SR | 2.15 | IDH34WR | 4.15 |
| 40 | IDH40SR | 2.50 | IDH40WR | 4.90 |
| 50 | IDH50SR | 3.15 | IDH50WR | 6.15 |

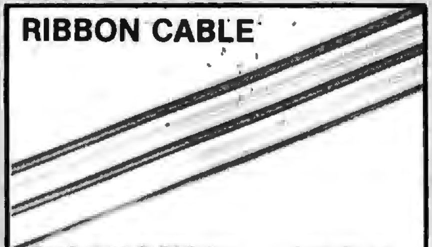
EJECTOR EARS .25 EACH

## CARD EDGE CONNECTORS



| Pins | Part No. | |
|---|---|---|
| 10 | IDE10 | 3.25 |
| 20 | IDE20 | 3.50 |
| 26 | IDE26 | 4.05 |
| 34 | IDE34 | 4.85 |
| 40 | IDE40 | 5.65 |
| 50 | IDE50 | 5.90 |

## RIBBON CABLE

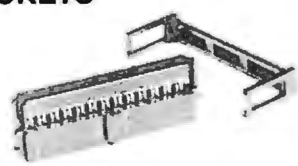


| Conductors: | Solid Color 10 ft. | Solid Color 100 ft. | Color Coded 10 ft. | Color Coded 100 ft. |
|---|---|---|---|---|
| 10 | 2.90 | 17.00 | 4.00 | 30.00 |
| 14 | 3.40 | 23.80 | 5.00 | 42.00 |
| 16 | 3.70 | 27.20 | 5.60 | 48.00 |
| 20 | 4.40 | 34.00 | 7.00 | 60.00 |
| 24 | 5.00 | 40.80 | 8.00 | 72.00 |
| 26 | 5.40 | 44.20 | 8.60 | 78.00 |
| 34 | 6.80 | 57.80 | 11.00 | 102.00 |
| 40 | 7.80 | 68.00 | 13.00 | 120.00 |
| 50 | 9.50 | 85.00 | 16.00 | 150.00 |

## 25 PIN "D" CONNECTORS

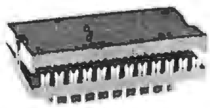
| Style | Part # | |
|---|---|---|
| SOLDER STYLE | | |
| Male | DB25P | 2.25 |
| Female | DB255 | 3.00 |
| Hood | DB25C | 1.10 |
| INSULATION DISPLACEMENT | | |
| Male | IDC25P | 4.95 |
| Female | IDC255 | 5.25 |
| Hood | IDC25C | 1.35 |

## SOCKETS



| Pins | Part No. | | Stain Relief |
|---|---|---|---|
| 10 | IDS10 | 1.25 | .25 |
| 20 | IDS20 | 2.02 | .25 |
| 26 | IDS26 | 2.65 | .25 |
| 34 | IDS34 | 3.50 | .25 |
| 40 | IDS40 | 4.05 | .25 |
| 50 | IDS50 | 5.06 | .25 |

## CABLE PLUGS



| Pins | Part No. | |
|---|---|---|
| 14 | IDP14 | 1.25 |
| 16 | IDP16 | 1.40 |
| 24 | IDP24 | 2.25 |
| 40 | IDP40 | 3.65 |

## WIRE WRAP WIRE

| Length | 100/Bag | 500/Bag | 1K/Bag | Length | 100/Bag | 500/Bag | 1K/Bag |
|---|---|---|---|---|---|---|---|
| 2.5" | $1.25 | $3.58 | $ 6.19 | 6.5" | $1.92 | $6.44 | $11.81 |
| 3.0" | 1.30 | 3.86 | 6.78 | 7.0" | 1.99 | 6.76 | 12.44 |
| 3.5" | 1.37 | 4.15 | 7.37 | 7.5" | 2.08 | 7.07 | 13.09 |
| 4.0" | 1.42 | 4.44 | 7.94 | 8.0" | 2.14 | 7.38 | 13.73 |
| 4.5" | 1.48 | 4.74 | 8.54 | 8.5" | 2.18 | 7.69 | 14.36 |
| 5.0" | 1.54 | 5.04 | 9.13 | 9.0" | 2.24 | 8.11 | 15.01 |
| 5.5" | 1.58 | 5.38 | 9.72 | 9.5" | 2.30 | 8.32 | 15.65 |
| 6.0" | 1.65 | 5.66 | 10.31 | 10.0" | 2.39 | 8.71 | 16.28 |

Kynar precut wire. All lengths are overall, including 1" strip on each end. Colors and lengths cannot be mixed for quantity pricing. Choose from colors Red, Blue, Black, Yellow, White, Green, Orange, and Violet.

## WIRE KITS

| Kit No. 1 | $9.95 | | |
|---|---|---|---|
| 250 | 3" | 100 | 4½" |
| 250 | 3½" | 100 | 5" |
| 100 | 4" | 100 | 6" |

| Kit No. 3 | $32.95 | | |
|---|---|---|---|
| 500 | 2½" | 500 | 4½" |
| 500 | 3" | 500 | 5" |
| 500 | 3½" | 500 | 5½" |
| 500 | 4" | 500 | 6" |

| Kit No. 2 | $24.95 | | |
|---|---|---|---|
| 250 | 2½" | 250 | 5" |
| 500 | 3" | 100 | 5½" |
| 500 | 3½" | 250 | 6" |
| 500 | 4" | 100 | 6½" |
| 250 | 4½" | 100 | 7" |

| Kit No. 4 | $59.95 | | |
|---|---|---|---|
| 1000 | 2½" | 1000 | 4½" |
| 1000 | 3" | 1000 | 5" |
| 1000 | 3½" | 1000 | 5" |
| 1000 | 4" | 1000 | 6" |

## ORDERING INFORMATION:

- Orders under $25 include $2 handling
- All prepaid orders shipped UPS Ppd.
- Visa, MC & COD's charged shipping.
- All prices good through cover date.
- Most orders shipped same day.
- Byte must be mentioned to get sale price.

**Write or call for 1981 catalog**

- IC Sockets
- Vector Board & Pins
- Bishop Drafting Aids
- OK Tools
- RN IDC Crimp Connectors

## "NEW" WIRE WRAP SOCKETS

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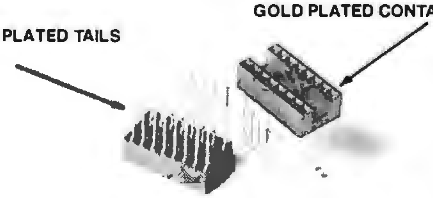



3 Level closed entry.

**RN Side Wipe contact design gives twice the contact area for high reliability.**

| Size | Quantity/Tube | Price ea.* | Price/Tube |
|---|---|---|---|
| 8 | 52 | .41 | 21.32 |
| 14 | 30 | .47 | 14.10 |
| 16 | 26 | .51 | 13.26 |
| 18 | 23 | .70 | 16.10 |
| 20 | 21 | .87 | 18.27 |
| 22 | 19 | .94 | 17.86 |
| 24 | 17 | .96 | 16.32 |
| 28 | 15 | 1.25 | 18.75 |
| 40 | 10 | 1.70 | 17.00 |

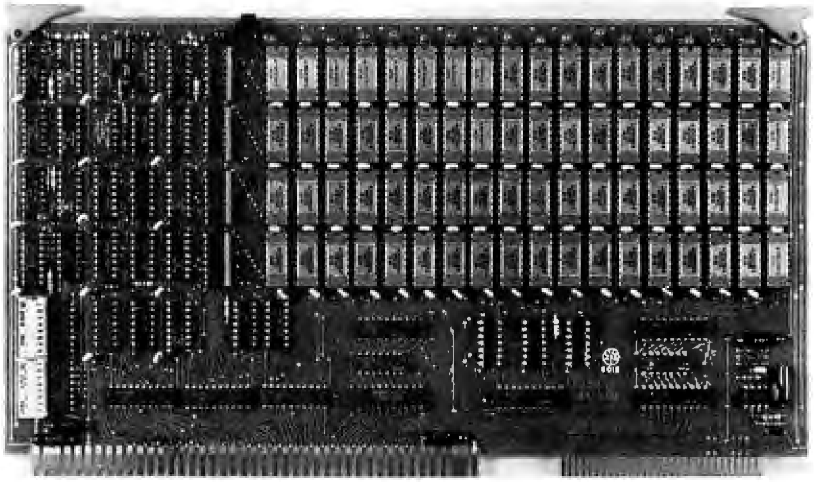
*FOR REFERENCE. MUST BE ORDERED IN TUBE QUANTITIES.

**TOLL FREE ORDERING NUMBER 1-(800)-423-7144**

# What's New?

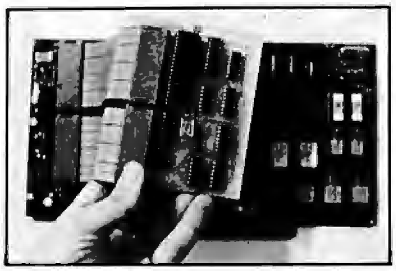
## MISCELLANEOUS

### Memory Board for the SBC 86/12A



The CI-8086 memory board is designed for Intel's Intellec SBC 86/12A microcomputer. Available with 32 K to 512 K bytes on a single board (depending on what memory components are used), the module is compatible with 8- and 16-bit Multibus-based systems. The CI-8086 generates and checks even parity with selectable interrupt on parity error. It features a 250 ns data-access time and a 375 ns cycle time. The memory is addressable in 16 K-byte increments up to a total of 16 megabytes of memory. Power consumption is under 8 W. The price is $1500 for the 128 K-byte board and $4700 for the 512 K-byte module. The CI-8086 is available from Chrislin Industries Inc, 31352 Via Colinas, #102, Westlake Village CA 91361, (213) 991-2254.

Circle 561 on inquiry card.



### Replace an 8080 with an 8085

A 50 to 250% throughput increase can be achieved with the Series II Microprocessor Enhancement Modules. These modules perform 8080A in-circuit emulation using a code-compatible 8085A-2 microprocessor. Installation requires less than five minutes, involving only the replacement of the system 8080A processor and status latch with connectors. The modules are offered for most 8080A products at $350 in OEM (original equipment manufacturer) quantities. An Evaluation Design Pack is available for $500. Contact Paragon Systems Inc, POB 2050, Corvallis OR 97330, (503) 758-1029.

Circle 562 on inquiry card.

### 12-Bit CMOS Converters

The DAC1218 and the DAC1219 are 12-bit CMOS (complementary metal-oxide semiconductor), 4-quadrant, multiplying, D/A (digital-to-analog) converters. The devices offer 12-bit monotonicity, maximum differential linearity error of ±0.5 LSB (least significant bit), and feature a design technique resulting in TTL (transistor-transistor logic) compatibility. Power-supply voltages can range from +5 to +15 V; typical power consumption is 20 mW. The DAC1218 has a maximum linearity error specification of 0.012%, and the DAC1219 is rated at 0.024%.

In OEM quantities of 100, the DAC1218 sells for $10.75 each, and the DAC1219 is priced at $9.75 each. For additional information, contact National Semiconductor Corporation, 2900 Semiconductor Dr, Santa Clara CA 95051, (408) 737-5000.

Circle 563 on inquiry card.

### Expand Atari's Memory

The RAMCRAM memory modules can expand the Atari 400's memory to 32 K bytes and the Atari 800's to 48 K. RAMCRAM plugs into the Atari internal memory-module slot, replacing the Atari's module. Each RAMCRAM module contains 32 K bytes of programmable memory. The suggested retail price is $320.

An 8-slot bus-expansion board for the Atari and Apple microcomputers, with power supply, controller, and software, is available for further memory expansion. This memory-board bus can hold up to eight RAMCRAMs, offering 256 K bytes of programmable memory. Its suggested retail price is $850.

For further details on both of these devices, contact Axlon Inc, 170 N Wolf Rd, Sunnyvale CA 94086, (408) 730-0216.

Circle 564 on inquiry card.

# New Commodore VIC 20 Computer Now Available

## Introducing the first full-featured, expandable color computer priced under $300!

Now, a new computer — the VIC 20 — offers a full range of special features and expansion capabilities which rival the features of existing microcomputers selling for 4 or 5 times as much!

The new VIC (Video Interface Computer) connects to any television set or monitor and provides 5K bytes of memory.

### Check these outstanding features:

- **Color:** 8 character colors, 8 border colors, 16 screen colors
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- **Graphics:** Full PET keystroke graphics
- **Language:** PETBASIC
- **Programmable Function Keys:** 4 programmable function keys (8 separate functions)
- **Plug-In Program & Memory Expansion Cartridges:** (programs plug directly into the back of the computer...each program can be up to 27K)
- **Full Computer Accessories:** disk drive, printer, tape cassette, game controls & more
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### A "User Friendly" Computer

The new VIC computer is designed to be the most *user friendly* computer on the market...friendly in price, friendly in size, friendly to use and expand.

With the VIC, Commodore is providing a computer system which helps almost anyone get involved in computing quickly and easily...with enough built-in expansion features to let the system "grow" with the user as his knowledge and requirements become more sophisticated.

### Expansion Features & Peripherals

The VIC 20 is designed so a first time user can begin using it immediately with plug-in program cartridges, and build his system gradually as his needs (or budget) allow.

VIC system peripherals will include a tape cassette unit, single floppy disk drive, printer — and a broad range of add-on accessories which tailor the system to a variety of applications.

**FREE** with purchase the VIC 20 Personal Computer Manual. This User Manual is very unique as it is the most comprehensive manual ever written for a personal computer. The key ingredient is that no previous knowledge of programming or even typewriting is required. The manual is designed for the first-time owner along with extensive appendices for both the more experienced computerists and the beginners.

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| | Software Cassettes — 6-Pak | 59.70 | |
| | VIC Programming Reference Guide | 15.00 | |
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| | | Tax (6% Calif) | |
| | | Shipping & Handling | 5.00 |
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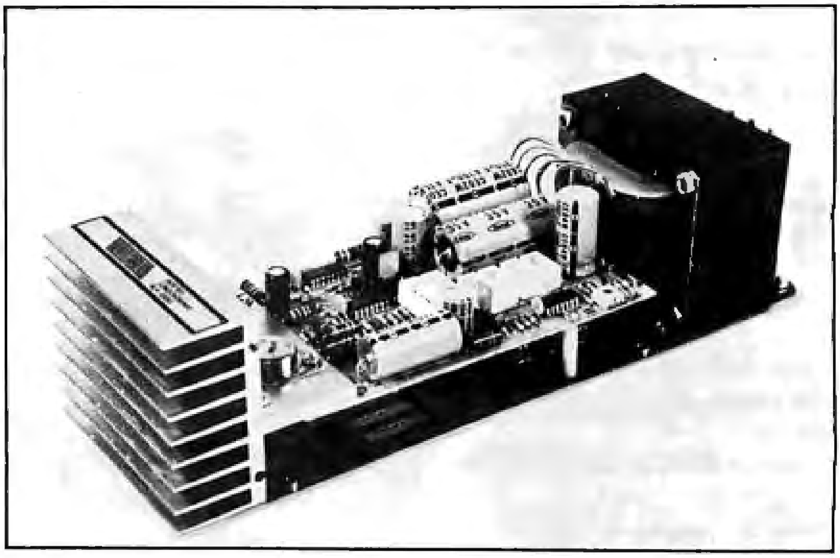
# What's New?

## MISCELLANEOUS

### Eight Amp Power Supply for OEMs

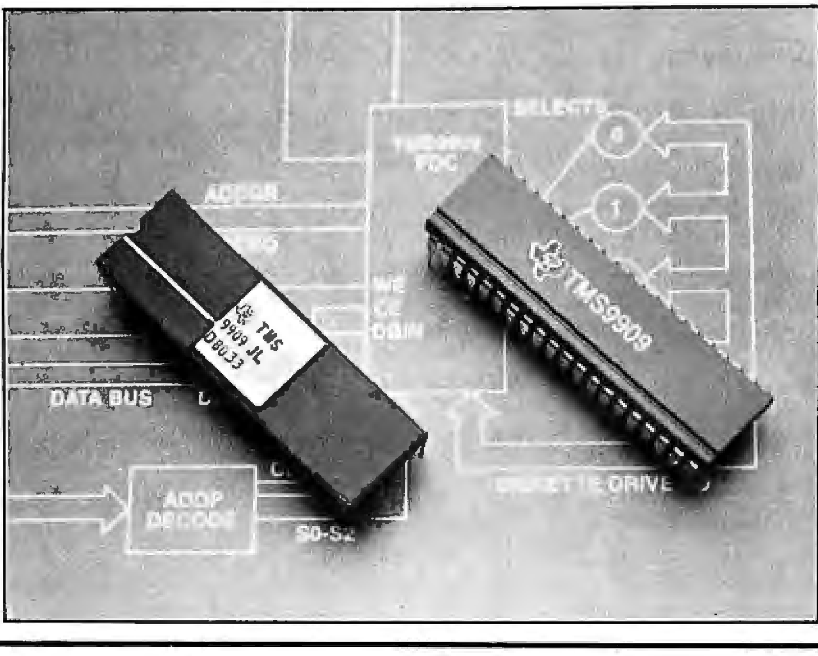
The CEI Model FD503 is an 8 A power supply that provides outputs of +5 VDC at 8 A, +12 VDC at 2.5 A, −5 VDC at 1 A, −12 VDC at 0.5 A, and +24 VDC at 1.5 A continuous, 4 A surge. Floppy-disk drives can plug into the output connectors of the supply. The FD503 regulates positive outputs to 0.1% and negative outputs to 1%. Options include 100, 115, or 230 VAC power use; AC step-down for 115 V Shugart motors; and interconnecting cables. The CEI FD503 is priced at $139 each in lots of 100. Contact CEI Corporation, POB 501, Grenier Industrial Park, Londonderry NH 03053, (603) 623-8888.



Circle 565 on inquiry card.

### Universal Floppy-Disk-Controller Circuit

The TMS9909 floppy-disk-controller integrated circuit can control any floppy-disk drive while interfacing with any 8- or 16-bit microprocessor. It can read from and write onto partial sectors, read from or write onto single or multiple sectors of hard- and soft-sectored disks, as well as simultaneously control 5- and 8-inch drives. The TMS9909 provides CRC (cyclic redundancy check); data transfer rates of 125, 250, and 500 k bytes per second with one crystal; hard and soft formatting for 5- and 8-inch disks; and side selection for double-sided disks. Users can program the device for all major track parameters and various track-stepping, settling, and head-loading times. The TMS9909 supports single- and double-density formats on up to four drives. The TMS9909 has a memory-mapped microprocessor interface that supports an external DMA (direct memory access) interface. This allows designers to build only one interface for all floppy-disk formats.




For further details, contact Texas Instruments, Inquiry Answering Service, POB 25012, M/S 308, Dallas TX 75265, attn: TMS9909.

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| DISK II for APPLE /// | |
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| SAME AS OPTION A PLUS: | |
| DISK II FOR APPLE /// | |
| SILENTYPE Thermal Printer | |

### APPLE HARDWARE

| | |
|---|---|
| Parallel Printer Interface Card | 160 |
| Communications Card | 195 |
| High Speed Serial Interface | 175 |
| Pascal Language System | 425 |
| Centronics Printer Interface | 185 |
| Applesoft Firmware Card | 160 |
| Integer Firmware Card | 160 |
| Disk ][ with Controller DOS 3.3 | 529 |
| Disk ][ only | 475 |
| Graphics Tablet | 625 |

### OTHER HARDWARE

| | |
|---|---|
| Alf Music Synthesizer (3 Voice) | 245 |
| 9 voice | 175 |
| ABT Numeric Keypad | 119 |
| Micromodem ][ | 295 |
| Apple Clock | 245 |
| Rom Plus with Keyboard Filter | 175 |
| Introl/X-10 System | 250 |
| Romwriter | 150 |
| **DoubleVision 80 x 24 Video Interface** | 295 |
| CCS Arithmetic Processor | 399 |
| CCS Parallel Interface | 119 |
| **16K Ram Card** | 195 |
| Microworks DS-65 Digisector | 339 |
| SVA 8 inch Disk Controller | 335 |
| Sup-R-Mod | 30 |
| CCS Synchronous Serial Interface | 159 |
| CCS Asynchronous Serial Interface | 159 |
| Corvus 10 Meg. Hard Disk | 4395 |
| Corvus Constellation | 595 |

### MISCELLANEOUS/SUPPLIES

| | |
|---|---|
| 16K RAM (200-250 NS) | 49 |
| Verbatium Datalife Diskette (Box of 10) | 30 |
| Dysan Diskettes (Box of 5) | 22 |
| Apple Diskettes (Box of 10) | 45 |
| Verbatim Diskette Boxes (Holds 50 Disks) | 18 |
| Silentype Paper (Box of 10 rolls) | 40 |

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**16K.......$1075**
**48K.......$1193**
**Disk][Drive..$529**
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**$425**
**Z-80 Softcard**
**$299**

### MONITORS/DISPLAYS

| | |
|---|---|
| Leedex Video 100 12″ | 140 |
| Sanyo 9″ Monitor | 195 |
| KG-12C Green Phos. Monitor | 275 |
| Sanyo 12″ Green Phosphor. Monitor | 275 |
| NEC 12″ Green Phosphor. Monitor | 275 |
| Sanyo 12″ B/W Monitor | 250 |

### PRINTERS

| | |
|---|---|
| **Apple Silentype with Interface** | 525 |
| **IDS 445 (Paper Tiger) with Graphics** | 795 |
| **IDS 460 with Graphics** | 1199 |
| **IDS 560 with Graphics 10)** | 1695 |
| Centronics 737 | 895 |
| NEC Spinwriter (RO, Serial) | 2650 |

### SOFTWARE

| | |
|---|---|
| The Controller | 525 |
| Apple Post (Mailing List Program) | 40 |
| Easywriter Professional System | 195 |
| Apple Pie 2.0 | 95 |
| DB Master Data Management | 150 |
| The Cashier | 210 |
| Apple Writer | 65 |
| **Visicalc** | 125 |
| **CCA Data Management System** | 90 |
| **Full Screen Mapping for CCA DMS** | 59 |
| Pascal Interactive Terminal Software (PITS) | 29 |
| Basic Interactive Terminal Software (BITS) | 29 |
| Data Capture | 29 |
| Data Factory DMS | 95 |
| Apple Plot | 55 |
| Apple Pilot | 120 |
| Magic Wand Word Processor (Needs Z-80 Softcard) | 345 |
| Dow Jones Portfolio Evaluator | 45 |
| **Fortran** | 140 |

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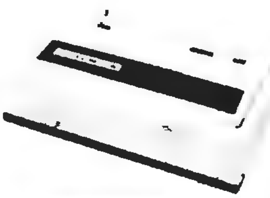

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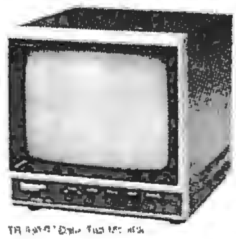

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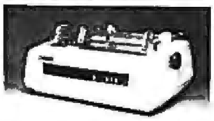

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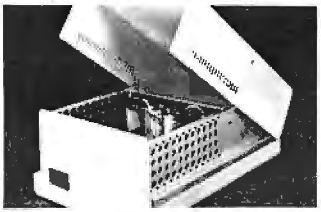

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| Z80 CPU | Model 2810 | $269 |
| MOTHER BOARD | Model 2501 | $106 |
| 16K STATIC RAM, 200ns | Model 2116C | $309 |
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| FLOPPY DISC CONTROLLER | Model 2422A | $359 |
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| 2P + 2S I/O | Model 2718A | $309 |

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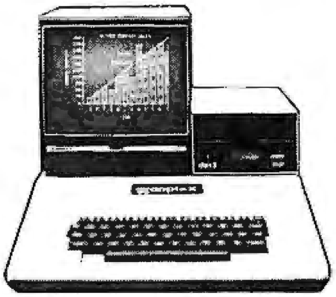

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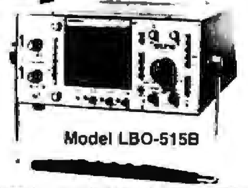
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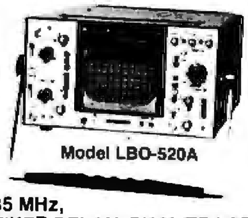
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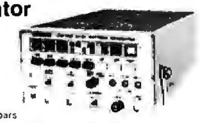

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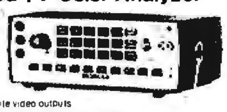

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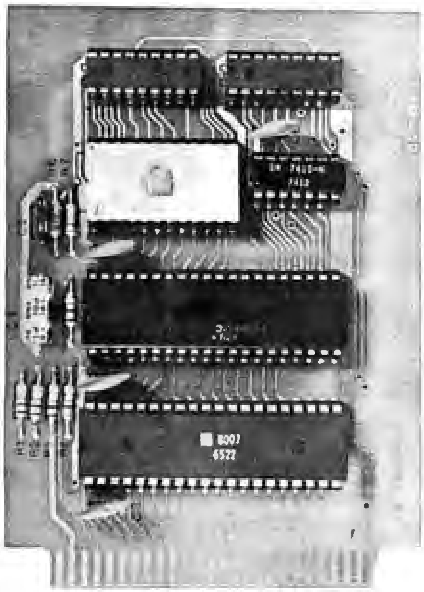

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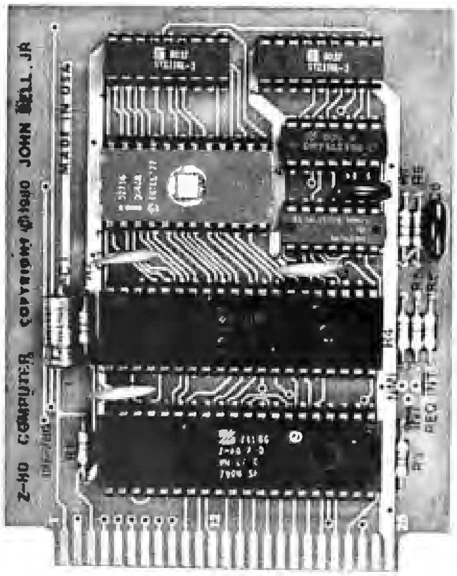

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Circle 128 on inquiry card.

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Qume DT-8 ....................................$599 – 2/$1150
Virtually the industry standard. High quality/reliability. Full featured, double-sided, double density.

Mitsubishi!!!!!! .......................................... $649
Up & coming potential giant of the double sided/double density realm.

Shugart 851R .................... $649
Double sided/double density

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Siemens FDD100-8D$395 – 2/$755

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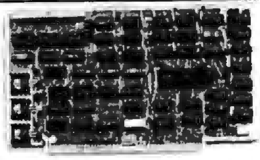
SA400 mini-floppy. 35 track, double density......................$299 – 2/$525

## CONTROLLERS



Tarbell single density kit ..............................$210
Tarbell single density A & T .........................$290
Tarbell double density A & T ......................$475
MDA LSI-11 floppy controller ..................$1175

SPECIAL!! CCS 2422A floppy disk controller with CP/M version 2.2 $375

FLOPPY POWER SUPPLY: Handles two units with the greatest of ease.

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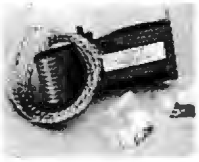

CABLE KITS:
One drive $30
Two ....... $35
Three ..... $40
Four ...... $45
Includes all wire, cable + connectors to hook up most drive systems.

DISKETTES: Single sided $39/10 – Double sided $59/10

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SBC 80/30 CPU card (used) .............. $475.
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UDS 103J modem card (used) ............ $100.
UDS 801A dialer card (used) ............. $100.
all used gear here comes with 90 day warranty.

**CRYSTALS ... most major values. Call for case size, etc.**
$2.75/ea. ....... 25/$2.50 ....... 100/$2.20
3.57954/$.99 ea – 100/$.80

**CONNECTORS... many types in stock. IDC, etc.** all connectors $3.00 ea. 50/$2.75 – 100/$2.50
– call for particulars –

## Qume S/5 – Daisy Wheel Printer

Sprint 5/45 RO ........................ $2699
Sprint 5/55 RO ........................ 2829
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| 8202CA | Two SA800 in cabinet w/power, DDC* Controller, cable and manual $1889 |
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| 5202CA | Two SA850 in cabinet w/power, DDC* Controller, cable and manual $2364 |
| LCA 22 | Double Density Controller only $599 |

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| 8212C | Two SA801 in cabinet w/power $1329 |
| 5212C | Two SA851 in cabinet w/power $1799 |

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| MODEL NO. | DESCRIPTION |
|---|---|
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| 8202C II | Two SA800 in cabinet w/power for Mod. II $1349 |
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Circle 187 on inquiry card.

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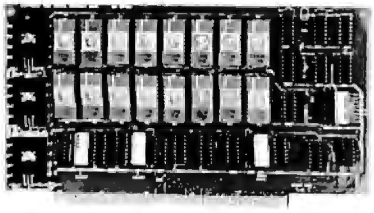
## 32K S-100 EPROM CARD
**NEW!**



**$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

**$329.00** KIT

For 2MHZ
Add $10

Blank PC Board
$50

For SWTPC
6800 - 6809 Buss

Support IC's
and Caps
$19.95

Complete Socket Set
$21.00

Fully Assembled,
Tested, Burned In
Add $30

**NEW!**

**At Last! An affordable 32K Static RAM with full 6809 Capability.**

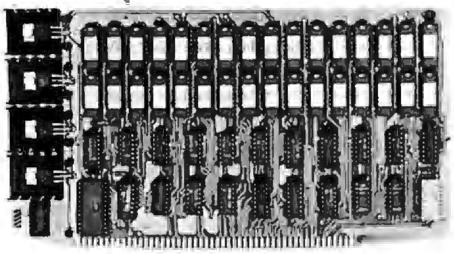
**FEATURES:**
1. Uses proven low power 2114 Static RAMS.
2. Supports SS50C - EXTENDED ADDRESSING.
3. All parts and sockets included.
4. Dip Switch address select as a 32K block.
5. Extended addressing can be disabled.
6. Works with all existing 6800 SS50 systems.
7. Fully bypassed. PC Board is double sided, plated thru, with silk screen.

## 16K STATIC RAM KIT-S 100 BUSS

PRICE CUT!

**$169.95 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.
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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!**

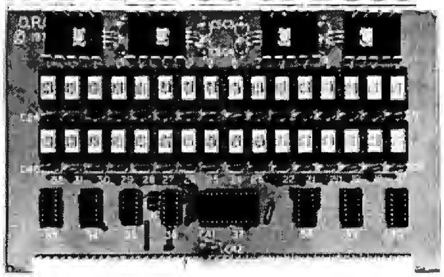
## 16K STATIC RAM SS-50 BUSS

PRICE CUT!

**$159 KIT**

FULLY STATIC!

FOR 2MHZ
ADD $10



**FOR SWTPC 6800 BUSS!**

ASSEMBLED AND
TESTED - $35

KIT FEATURES:
1. Addressable on 16K Boundaries
2. Uses 2114 Static Ram
3. Fully Bypassed
4. Double sided PC Board. Solder mask and silk screened layout.
5. All Parts and Sockets included
6. Low Power: Under 1.5 Amps Typical

BLANK PC BOARD—$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.

## (With Pin Out Data) 4K DYNAMIC RAM BLOWOUT!
### SAME AS INTEL 2107B!
### 4K RAMS AT AN UNBELIEVABLE 50¢ EACH!!!

Prime, new, National Semi., 1979 date coded, full spec. parts. N.S. #MM5280-5N. Same as INTEL 2107B-4, T.I. TMS4060, NEC uPD411, etc. We bought a HUGE QTY. from a West Coast Distributor at truly DISTRESS PRICES! One of the most popular and reliable RAM's ever made. These parts have been used by almost all Major Computer Main Frame Mfg. the world over! Arranged as 4K x 1, 270 NS Access Time, 22 Pin Dip. These units DO NOT use multiplexed addressing, thus making REFRESH and other timing very simple. See INTEL MEMORY DESIGN HANDBOOK for full application notes. The NAT. SEMI. MEMORY DATA BOOK is available at most Radio Shack Stores. Prime units in original factory tubes! **#5280-5N 4096 BITS x 1 270 NS ACCESS**

**8 FOR $4.95 32 FOR $16**

## CRT CONTROLLER CHIP
**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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Circle 117 on inquiry card.

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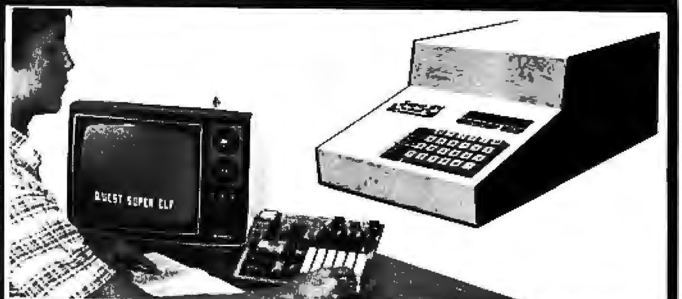


## INTEGRATED CIRCUITS

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7400N 19
7402N 20
7404N 25
7409N 27
7410N 25
7414N [illegible]
7420N 25
7422N 39
7430N 25
7442N 58
7445N 82
7447N 83
7448N 77
7450N 25
7474N 35
7475N 49
7485N 88
7489N 1.70
7490N 43
7492N 43
7493N 43
7495N 69
74100N 1.35
74107N 35
74121N 34
74123N 59
74125N 45
74145N 77
74150N 1.20
74151N 69
74154N 1.25
74157N 69
74161N 87
74162N 85
74163N 87
74174N 96
74175N .85
74190N 1.15
74192N 87
74193N 85
74221N 1.25
74298N 1.65
74365N 75
74366N 75
74367N 75

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74LS13N 55
74LS14N 1.00
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74LS22N 35
74LS28N 35
74LS30N 35
74LS33N 60
74LS38N 50
74LS74N .45
74LS75N 65
74LS90N 60
74LS93N 75
74LS95N 1.00
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74LS112N 45
74LS113N 45
74LS132N 89
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74LS151N .75
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LM340K-12 1.35
LM340K-15 1.35
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CD4049 .45
CD4050 .60
CD4051 1.13
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CD4068 .40
CD4069 .40
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|---|---|---|---|
| 8 | 15 | 22 | 30 |
| 14 | 14 | 24 | 35 |
| 16 | 16 | 28 | 42 |
| 18 | 27 | 36 | 58 |
| 20 | 29 | 40 | 57 |

2 level 14pin ww 20

**WIRE WRAP LEVEL 3**

| PIN | | PIN | |
|---|---|---|---|
| 14 | 46 | 24 | 93 |
| 16 | 49 | 28 | 1.00 |
| 18 | 67 | 40 | 1.59 |

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Before you buy another small computer, see if it includes the following features: ROM monitor; State and Mode displays; Single step; Optional address displays; Power Supply; Audio Amplifier and Speaker; Fully socketed for all IC's; Real cost of in warranty repairs; Full documentation.

The **Super Elf** includes a **ROM** monitor for program loading, editing and execution with **SINGLE STEP for program debugging** which is not included in others at the same price. With **SINGLE STEP** you can see the microprocessor chip operating with the **unique Quest** address and data bus displays **before, during** and **after** executing instructions. Also, CPU mode and instruction cycle are decoded and displayed on 8 LED indicators.

An RCA 1861 **video graphics** chip allows you to connect to your own TV with an inexpensive video modulator to do graphics and games. There is a **speaker system** included for writing your own music or using many music programs already written. The speaker amplifier may also be used to drive relays for control purposes.

A 24 key **HEX keyboard** includes 16 HEX keys plus **load, reset, run, wait, input, memory protect, monitor select** and **single step**. Large, on board displays provide output and optional **high** and **low address**. There is a 44 pin standard connector slot for PC cards and a 50 pin connector slot for the Quest Super Expansion Board. Power supply and sockets for **all** IC's are included in the price plus a detailed 127 pg. instruction manual which now includes over 40 pgs. of software info. including a series of lessons to help get you started and a music program and graphics target game. Many schools and universities are using the Super Elf as a course of study. OEM's use it for training and R&D.

Remember, other computers only offer Super Elf features at additional cost or not at **all. Compare before you buy. Super Elf Kit $106.95, High address option $8.95, Low address option $9.95. Custom Cabinet** with drilled and labelled plexiglass front panel **$24.95.** All metal Expansion Cabinet, painted and silk screened, with room for 5 S-100 boards and power supply **$57.00. NiCad Battery Memory Saver Kit $6.95.** All kits and options also completely assembled and tested.

**Questdata**, a software publication for 1802 computer users is available by subscription for $12.00 per 12 issues. Single issues $1.50. Issues 1-12 bound $16.50.

Tiny Basic Cassette **$10.00,** on ROM **$38.00,** original Elf kit board **$14.95. 1802 software;** Moews Video Graphics **$3.50.** Games and Music **$3.00,** Chip 8 Interpreter **$5.50.**

## Super Expansion Board with Cassette Interface $89.95

This is truly an astounding value! This board has been designed to allow **you** to decide how you want it optioned. **The Super Expansion Board comes with 4K of low power RAM** fully addressable anywhere in 64K with built-in memory protect and a **cassette interface.** Provisions have been made for all other options on the same board and it fits neatly into the hardwood cabinet alongside the **Super Elf.** The board includes slots for up to 6K of **EPROM** (2708, 2758, 2716 or TI 2716) and is **fully socketed. EPROM** can be used for the monitor and Tiny Basic or other purposes. **A 1K Super ROM Monitor $19.95** is available as an on board option in 2708 EPROM which has been preprogrammed with a program loader/editor and error checking multi file cassette read/write software, (relocatable cassette file) another exclusive from Quest. It includes register save and readout, block move capability and video graphics driver with blinking cursor. Break points can be used with the register save feature to isolate program bugs quickly, then follow with single step. If you have **the Super Expansion Board** and **Super Monitor** the monitor is up and running at the push of a button.

Other on board options include **Parallel Input and Output Ports** with **full handshake.** They allow easy connection of an ASCII keyboard to the input port. **RS 232 and 20 ma Current Loop** for teletype or other device are on board and if you need more memory there are two **S-100** slots for static RAM or video boards. Also a 1K Super Monitor version 2 with video driver for full capability display with Tiny Basic and a video interface board. **Parallel I/O Ports $9.85, RS 232 $4.50, TTY 20 ma I/F $1.95, S-100 $4.50. A 50 pin connector set** with ribbon cable is available at $15.25 for easy connection between the **Super Elf** and the **Super Expansion Board.**

**Power Supply Kit** for the complete system (see Multi-volt Power Supply).

## 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 $\pm 2$ 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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| 24K Static Godbout Econo XX-24 Kit | 414.00 |
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| 16K Dynamic RAM Kit | 289.00 |
| 32K Dynamic RAM Kit | 328.00 |
| 64K Dynamic RAM Kit | 399.00 |
| Video Interface Kit | **$139.00** |

## 80 IC Update Master Manual $39.00

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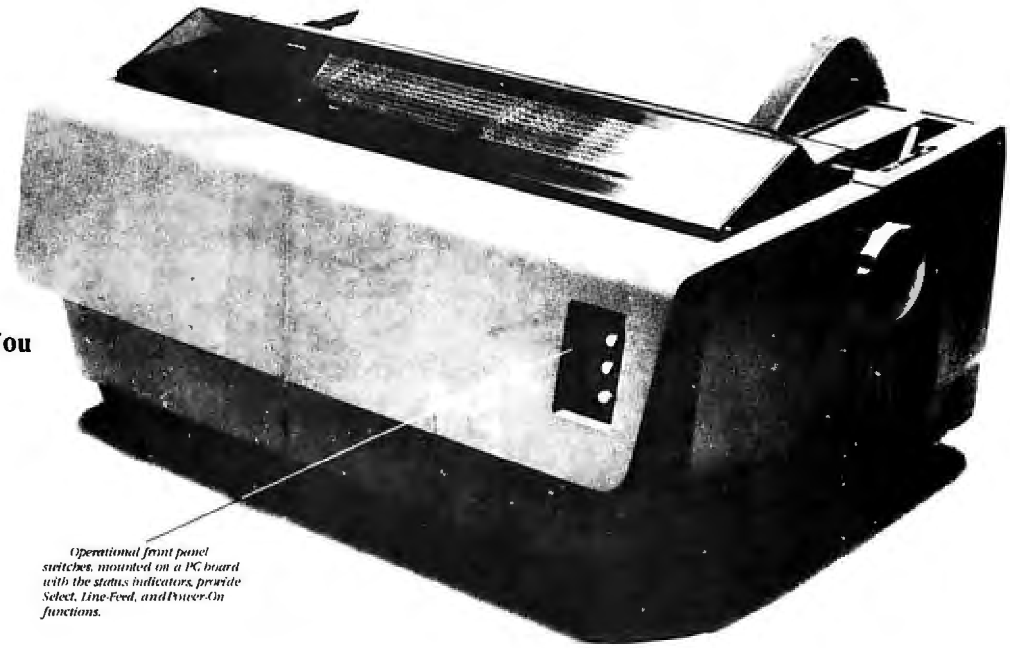

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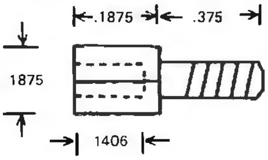


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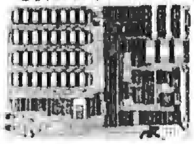

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| **col** | arrange text in columns on page |
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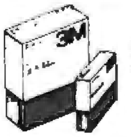

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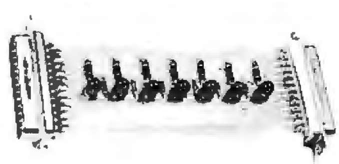

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| 8226 | 1.85 | 4025 | .38 | 4099 | 2.25 | 74C73 | .85 | 74LS37 | .79 | 74LS164 | 1.19 | 74LS348 | 1.95 |
| 8228 | 5.00 | 4026 | 2.50 | 4104 | 1.99 | 74C74 | .85 | 74LS38 | .39 | 74LS165 | .89 | 74LS352 | 1.65 |
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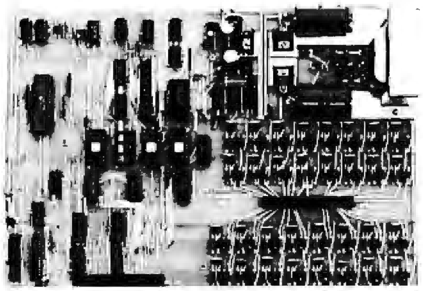

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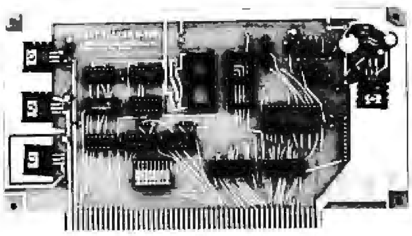

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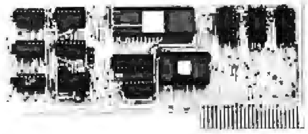

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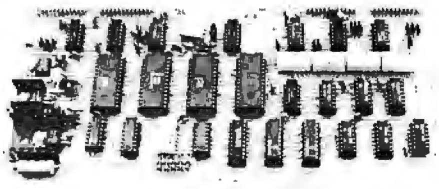

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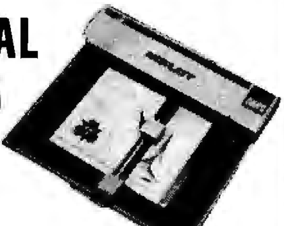

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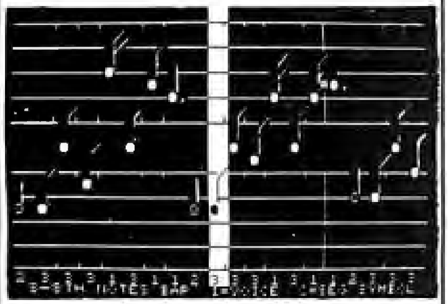

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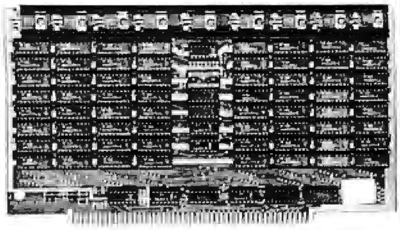

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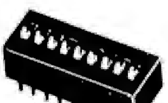

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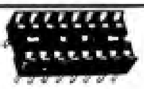

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| 16 | .16 | .32 |
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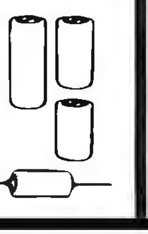

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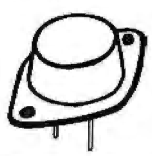

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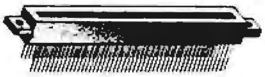

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| 74LS55 | .70 | 74LS173 | 1.25 | 74LS373 | 2.95 |
| 74LS73 | .79 | 74LS174 | 1.49 | 74LS374 | 3.95 |
| 74LS74 | .59 | 74LS175 | 1.49 | 74LS377 | 1.95 |
| 74LS75 | .79 | 74LS181 | 2.15 | 74LS378 | 1.95 |
| 74LS76 | .79 | 74LS189 | 6.95 | 74LS379 | 1.95 |
| 74LS78 | .49 | 74LS190 | .99 | 74LS386 | .59 |
| 74LS83 | .95 | 74LS191 | 1.95 | 74LS390 | 1.95 |
| 74LS85 | 1.49 | 74LS192 | 1.95 | 74LS393 | 1.95 |
| 74LS86 | .95 | 74LS193 | 1.95 | 74LS395 | 1.95 |
| 74LS90 | .75 | 74LS194 | 1.49 | 74LS490 | 4.95 |
| 74LS92 | .75 | 74LS195 | .95 | 74LS668 | 1.69 |
| 74LS93 | .95 | 74LS196 | .95 | 74LS669 | 1.89 |
| 74LS95 | 1.29 | 74LS197 | 1.95 | 74LS670 | 3.55 |
| 74LS96 | 1.29 | | | | |



Circle 371 on inquiry card.

## DEALS ☐ DEALS ☐ DEALS

OUR BUYERS ARE IN CONTACT WITH EVERY MAJOR SUPPLIER AND O.E.M. BUY HERE AT 1000 PIECE

# QUANTITY PRICES

ALL MERCHANDISE 100% GUARANTEED! 15 DAY FULL CASH REFUND!

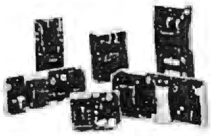
# U.S. MICRO SALES

*11 EDISON DRIVE ★ NEW LENOX ★ ILLINOIS 60451*
*CALL TOLL FREE: 1-800-435-9357 ★ MONDAY thru SATURDAY*
*(ILLINOIS RESIDENTS CALL: 815-485-4002) ★ 8:00 a.m. to 6:30 p.m.*

TERMS: Prepayment – C.O.D. up to $100.00 – M/C Visa
$5.00 Processing and Handling added to each order PLUS Shipping Charges. Please allow personal check to clear before shipment.

## JUST HOT STUFF

### POWER SUPPLIES

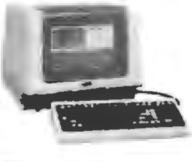


If you can beat these prices we will be truly amazed. OEM's at 500 lot pay more than this. Call or write for full spec. sheets.

| DISK POWER SUPPLIES | | | | |
|---|---|---|---|---|
| PRIAM–SHUGART–CENTURY–MICROPOLIS | | | | |
| +5V @ 9A | -5V @ .8A | +24V @ 7A | US-384 | 89.00 |
| SHUGART – SIEMANS – MPI 5¼" | | | | |
| +5V @ .5A | +12V @ .9A | | US-340 | 33.50 |
| +5V @ 2A | +12V @ 4A | | US-323 | 56.25 |
| SHUGART – SIEMANS – CDC 8" | | | | |
| +5V @ 1A | -5V @ .5A | +24V @ 1.5A | US-205 | 52.50 |
| +5V @ 2A | -5V @ .5A | +24V @ 3A | US-206 | 69.00 |
| +5V @ 3A | -5V @ .6A | +24V @ 5A | US-162 | 89.00 |
| +5V @ 1.7A | -5V @ 1.5A | +24V @ 2A | US-272 | 69.00 |
| +5V @ 2A | +12V @ .4A | -12V @ .4A | US-HTAA | 37.50 |

### TELEVIDEO 950

Televideo 950 –$950.00
Televideo 912C– 665.00
Televideo 920C– 720.00
ADDS R-25 – 710.00



Also have 920C, SOROC, HAZELTINE, etc. What we don't have is room on this page. Call Toll Free 800 number for prices.

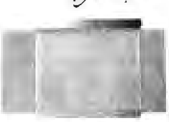
### C-ITOH PRINTER

**$499.00**

Look closely at the photo and see other adds in this rag at $995.00. Perfect units, warranteed. Only 500 pcs. Same story, manufacturerer had too many.

### S-100 CARD EXTENDER

$12.50
(Gold Contacts)



As long as there is a price war, we will fight your battle. Compare at your local Dept. store and buy U$ MICRO.

### MEMOREX – VERBATUM – WABASH BASF FLOPPIES

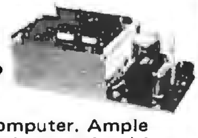
BOX OF 10 ONLY:

| | | |
|---|---|---|
| 5¼" | SOFT | $2.65 ea. |
| 5¼" | HARD 10 | 2.65 ea. |
| 5¼" | HARD 16 | 2.65 ea. |
| 8" | SOFT 1D | 3.25 ea. |
| 8" | SOFT 2D | 3.85 ea. |
| 8" | SOFT 2DDS | 5.00 ea. |

## SPECIAL OF THE QUARTER

### S1-MOD (KIT)

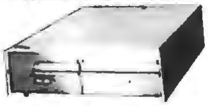
**$189.00** MADE IN USA



Complete S-100 12 Slot Computer. Ample system power with regulated power for drives. Excellent for Subsystem or Hobby use. 4 hours to build. (6 conn. incl., less fans)

### DUAL DRIVE SUBSYSTEM

**$995.00**
**$195.00 w/no Drives**

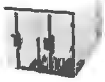


If this looks like a Lobo Drive System, don't be fooled. Just because it looks like one, works like one, smells like one, and tastes like one (?) doesn't mean it has to cost like one!

2 SHUGART 801R POWER SUPPLY

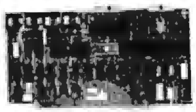
### TWIN VERTICAL DRIVE$

5" $550.00 – 8" $980.00



Attractive, convenient and compact Two Drive Mass Storage includes Power Supply, Drives, Cabinets and Cables. Double Sided, Double Track available too! $145.00 Kit (Less Cable)

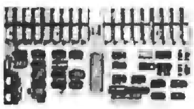
### Z-80 CPU (KIT)



The first time this world popular CPU offered in Kit. 2 serial, 3 parallel, CTC, EProm Z-80 at 4 mhz. Software buad rate, etc. (less Prom & cable) $212.00

### EXPANDABLE RAM

★SPECIAL★SPECIAL★SPECIAL★



This is the best all around 64K board you can buy. If after you see it, you don't agree return for full refund. Bank Select by extended address lines or I.O. 40H.

★$389.00 A&T★

### U$ – D$K $255.00

Double Density 8" and 5" Disk Controller disigned for S-100 IEEE standards. Uses Western Digital 1795, 1691 2143 Chip Set.

### FANS $14.95

3-1/8"

4-5/8"

These are brand new, in the box fans. Not noisey bearing pullouts. Never again at these low prices!

## SPECIALS OF THE MONTH

### 4116s

**$3.25**
200 NS

Expansion 16K Dynamic RAMs for Apple, TRS-80 S-100 systems. T.I., Mostek Intel, Call for manufacturer.

### INTEL

8251 $4.95
8255 $6.50

VERY POPULAR I.O. CHIPS BY LEADING MANUFACTURER

### 2114s

**$2.95**
200 NS

One of the world's two most popular STATIC RAMs. Factory prime tested units. Sold in lots of 8 only. FUJITSU, HITACHI, etc.

### TMS-4044 MM-5257 INTEL 2147

**$4.25**
250 NS

CMOS Version $4.50!

The other of the world's most popular STATIC RAMs. This one is 4K by 1 organization. Don't buy Gold, buy these, the price won't last!

### 2716s $7.50 (450 NS)
### 2708s $6.95 (450 NS)

Remember when 2716s were $50.00 and hard to get? These units are so beautiful it's hard to part with them. But we will, for a small price. Guaranteed!

### SHUGART DRIVE

8" 801R
**$395.00**

8" 851R $585.00

Manufacturer had too many, buys at 1000 piece rate, sales dropped, so we got'em. Fantastic buy, get them while they last! Full warranty.

### SIEMANS DRIVE

8" 100-8
**$375.00**

Very Special Price on these BRAND NEW current production units Add $10.00 for Extended 1 Year Warrantee!

# 7400

| | | | |
|---|---|---|---|
| SN7400N | .19 | SN74123N | .59 |
| SN7401N | .22 | SN74125N | .39 |
| SN7402N | .22 | SN74126N | .44 |
| SN7403N | .22 | SN74128N | .59 |
| SN7404N | .22 | SN74132N | .69 |
| SN7405N | .23 | SN74136N | .95 |
| SN7406N | .23 | SN74139N | .95 |
| SN7407N | .23 | SN74141N | .69 |
| SN7408N | .26 | SN74142N | 2.95 |
| SN7409N | .23 | SN74143N | 2.95 |
| SN7410N | .22 | SN74144N | 2.95 |
| SN7411N | .29 | SN74145N | .62 |
| SN7412N | .29 | SN74147N | 1.95 |
| SN7413N | .39 | SN74148N | 1.20 |
| SN7414N | .59 | SN74150N | .99 |
| SN7416N | .29 | SN74151N | .67 |
| SN7417N | .29 | SN74152N | .67 |
| SN7420N | .22 | SN74153N | .67 |
| SN7421N | .35 | SN74154N | 1.19 |
| SN7422N | .29 | SN74155N | .82 |
| SN7423N | .29 | SN74156N | .89 |
| SN7425N | .29 | SN74157N | .69 |
| SN7426N | .29 | SN74158N | 1.65 |
| SN7427N | .29 | SN74160N | .95 |
| SN7429N | .45 | SN74161N | .95 |
| SN7430N | .23 | SN74162N | .89 |
| SN7432N | .29 | SN74163N | .87 |
| SN7437N | .29 | SN74164N | .97 |
| SN7438N | .29 | SN74165N | .97 |
| SN7439N | .29 | SN74166N | 1.20 |
| SN7440N | .24 | SN74167N | 1.95 |
| SN7441N | .79 | SN74170N | 1.69 |
| SN7442N | .57 | SN74172N | 5.95 |
| SN7443N | .79 | SN74173N | .79 |
| SN7444N | .79 | SN74174N | .89 |
| SN7445N | .79 | SN74175N | .89 |
| SN7446N | .79 | SN74176N | .85 |
| SN7447N | .59 | SN74177N | .85 |
| SN7448N | .79 | SN74179N | 1.80 |
| SN7450N | .23 | SN74180N | .75 |
| SN7451N | .23 | SN74181N | 1.75 |
| SN7453N | .23 | SN74182N | .75 |
| SN7454N | .23 | SN74184N | 1.95 |
| SN7459N | .29 | SN74185N | 1.95 |
| SN7460N | .23 | SN74186N | 9.95 |
| SN7470N | .39 | SN74188N | 3.90 |
| SN7472N | .34 | SN74190N | 1.15 |
| SN7473N | .38 | SN74191N | 1.15 |
| SN7474N | .36 | SN74192N | .85 |
| SN7475N | .38 | SN74193N | .85 |
| SN7476N | .36 | SN74194N | .85 |
| SN7479N | 4.60 | SN74195N | .85 |
| SN7480N | .59 | SN74196N | .85 |
| SN7481N | 1.10 | SN74197N | .85 |
| SN7482N | 1.10 | SN74198N | 1.39 |
| SN7483N | .55 | SN74199N | 1.39 |
| SN7485N | .65 | SN74221N | 1.39 |
| SN7486N | .39 | SN74251N | .95 |
| SN7489N | 1.75 | SN74273N | 1.05 |
| SN7490N | .39 | SN74279N | .89 |
| SN7491N | .65 | SN74283N | 2.15 |
| SN7492N | .52 | SN74284N | 3.90 |
| SN7493N | .49 | SN74285N | 3.90 |
| SN7494N | .72 | SN74290N | 1.25 |
| SN7495N | .65 | SN74298N | .95 |
| SN7496N | .72 | SN74365N | .68 |
| SN7497N | 3.10 | SN74366N | .68 |
| SN74100N | .99 | SN74367N | .79 |
| SN74107N | .32 | SN74368N | .79 |
| SN74109N | .53 | SN74390N | 1.90 |
| SN74116N | 1.95 | SN74393N | 1.90 |
| SN74121N | .29 | SN74490N | 1.90 |
| SN74122N | .39 | | |

# 74LS00

| | | | |
|---|---|---|---|
| 74LS00N | .35 | 74LS164N | 1.19 |
| 74LS01N | .28 | 74LS165N | .89 |
| 74LS02N | .28 | 74LS166N | 2.48 |
| 74LS03N | .28 | 74LS168N | 1.89 |
| 74LS04N | .39 | 74LS169N | 1.89 |
| 74LS05N | .28 | 74LS170N | 1.99 |
| 74LS08N | .39 | 74LS173N | .89 |
| 74LS09N | .39 | 74LS174N | .99 |
| 74LS10N | .28 | 74LS175N | .99 |
| 74LS11N | .39 | 74LS181N | 2.20 |
| 74LS12N | .39 | 74LS190N | 1.15 |
| 74LS13N | .47 | 74LS191N | 1.15 |
| 74LS14N | 1.25 | 74LS192N | .98 |
| 74LS15N | .39 | 74LS193N | .98 |
| 74LS20N | .26 | 74LS194N | 1.15 |
| 74LS21N | .38 | 74LS195N | .95 |
| 74LS22N | .38 | 74LS196N | .89 |
| 74LS26N | .39 | 74LS197N | .89 |
| 74LS27N | .39 | 74LS221N | 1.49 |
| 74LS28N | .39 | 74LS240N | 1.95 |
| 74LS30N | .26 | 74LS241N | 1.90 |
| 74LS32N | .39 | 74LS242N | 1.95 |
| 74LS37N | .79 | 74LS243N | 1.95 |
| 74LS38N | .39 | 74LS244N | 1.95 |
| 74LS40N | .26 | 74LS245N | 4.95 |
| 74LS42N | .79 | 74LS247N | 1.10 |
| 74LS47N | .79 | 74LS248N | 1.10 |
| 74LS48N | .79 | 74LS249N | 1.69 |
| 74LS51N | .26 | 74LS251N | 1.79 |
| 74LS54N | .35 | 74LS253N | .98 |
| 74LS55N | .35 | 74LS257N | .98 |
| 74LS73N | .45 | 74LS258N | .98 |
| 74LS74N | .59 | 74LS259N | 2.95 |
| 74LS75N | .68 | 74LS260N | .69 |
| 74LS76N | .45 | 74LS261N | 2.49 |
| 74LS78N | .55 | 74LS266N | .59 |
| 74LS83AN | .99 | 74LS273N | 1.75 |
| 74LS85N | 1.19 | 74LS275N | 4.40 |
| 74LS86N | .45 | 74LS279N | .59 |
| 74LS90N | .75 | 74LS283N | 1.10 |
| 74LS92N | .75 | 74LS290N | 1.29 |
| 74LS93N | .75 | 74LS293N | 1.95 |
| 74LS95N | .88 | 74LS295N | 1.10 |
| 74LS96N | .98 | 74LS298N | 1.29 |
| 74LS107N | .45 | 74LS324N | 1.75 |
| 74LS109N | .45 | 74LS347N | 1.95 |
| 74LS112N | .49 | 74LS348N | 1.95 |
| 74LS113N | .49 | 74LS352N | 1.65 |
| 74LS114N | .55 | 74LS353N | 1.65 |
| 74LS122N | .55 | 74LS363N | 1.49 |
| 74LS123N | 1.19 | 74LS365N | .99 |
| 74LS124N | 1.35 | 74LS366N | .99 |
| 74LS125N | .89 | 74LS367N | .73 |
| 74LS126N | .89 | 74LS368N | .73 |
| 74LS132N | .79 | 74LS373N | 2.75 |
| 74LS136N | .59 | 74LS374N | 2.75 |
| 74LS138N | .89 | 74LS375N | .69 |
| 74LS139N | .89 | 74LS377N | 1.95 |
| 74LS145N | 1.25 | 74LS385N | 1.95 |
| 74LS148N | 1.49 | 74LS386N | .65 |
| 74LS151N | .79 | 74LS390N | 1.95 |
| 74LS153N | .79 | 74LS393N | 1.95 |
| 74LS154N | 2.49 | 74LS395N | 1.70 |
| 74LS155N | 1.19 | 74LS399N | 2.95 |
| 74LS156N | .99 | 74LS424N | 2.95 |
| 74LS157N | .99 | 74LS668N | 1.75 |
| 74LS158N | .75 | 74LS670N | 2.29 |
| 74LS160N | .98 | 81LS95N | 1.99 |
| 74LS161N | 1.15 | 81LS96N | 1.99 |
| 74LS162N | .98 | 81LS97N | 1.99 |
| 74LS163N | .98 | 81LS98N | 1.99 |

# CMOS

| | | | |
|---|---|---|---|
| CD4000 | .35 | CD4093 | .99 |
| CD4001 | .35 | CD4094 | 2.95 |
| CD4002 | .35 | CD4098 | 2.49 |
| CD4006 | 1.39 | CD4099 | 2.25 |
| CD4007 | .29 | MC14408 | 12.95 |
| CD4008 | 1.39 | MC14409 | 12.95 |
| CD4009 | .49 | MC14410 | 12.95 |
| CD4010 | .49 | MC14412 | 12.95 |
| CD4011 | .35 | MC14415 | 8.95 |
| CD4012 | .29 | MC14419 | 4.95 |
| CD4013 | .49 | CD4501 | .39 |
| CD4014 | 1.39 | CD4502 | 1.65 |
| CD4015 | 1.15 | CD4503 | .69 |
| CD4016 | .59 | CD4505 | 8.95 |
| CD4017 | 1.19 | CD4506 | .75 |
| CD4018 | .99 | CD4507 | .95 |
| CD4019 | .49 | CD4508 | 3.95 |
| CD4020 | 1.19 | CD4510 | 1.39 |
| CD4021 | 1.19 | CD4511 | 1.39 |
| CD4022 | 1.15 | CD4512 | 1.39 |
| CD4023 | .38 | CD4515 | 3.95 |
| CD4024 | .79 | CD4516 | 1.69 |
| CD4025 | .38 | CD4518 | 1.39 |
| CD4027 | .65 | CD4520 | 1.39 |
| CD4028 | .85 | CD4555 | 4.95 |
| CD4029 | 1.29 | CD4556 | .99 |
| CD4030 | .45 | CD4566 | 2.25 |
| CD4031 | 3.25 | 74C00 | .39 |
| CD4032 | 2.15 | 74C02 | .39 |
| CD4034 | 3.25 | 74C04 | .39 |
| CD4035 | .95 | 74C08 | .49 |
| CD4037 | 1.95 | 74C10 | .49 |
| CD4040 | 1.29 | 74C14 | 1.65 |
| CD4041 | 1.25 | 74C20 | .39 |
| CD4042 | .95 | 74C30 | .39 |
| CD4043 | .85 | 74C32 | .99 |
| CD4044 | .85 | 74C42 | 1.85 |
| CD4046 | 1.75 | 74C48 | 2.39 |
| CD4047 | 1.25 | 74C73 | .85 |
| CD4048 | .99 | 74C74 | .85 |
| CD4049 | .69 | 74C85 | 2.49 |
| CD4050 | .69 | 74C89 | 4.95 |
| CD4051 | 1.10 | 74C90 | 1.85 |
| CD4052 | 1.10 | 74C93 | 1.85 |
| CD4053 | 1.10 | 74C95 | 1.85 |
| CD4055 | 3.95 | 74C107 | 1.19 |
| CD4056 | 2.95 | 74C151 | 2.49 |
| CD4059 | 9.95 | 74C154 | 3.50 |
| CD4060 | 1.39 | 74C157 | 2.10 |
| CD4066 | .75 | 74C160 | 2.39 |
| CD4069 | .35 | 74C161 | 2.30 |
| CD4070 | .49 | 74C163 | 2.39 |
| CD4071 | .35 | 74C164 | 2.39 |
| CD4072 | .35 | 74C173 | 2.59 |
| CD4073 | .35 | 74C174 | 2.75 |
| CD4075 | .35 | 74C175 | 2.75 |
| CD4076 | 1.29 | 74C192 | 2.39 |
| CD4077 | .35 | 74C193 | 2.39 |
| CD4078 | .35 | 74C195 | 2.39 |
| CD4081 | .35 | 74C922 | 7.95 |
| CD4082 | .35 | 74C923 | 6.95 |
| CD4085 | 1.95 | MM80C95 | 1.50 |
| CD4089 | 2.95 | MM80C97 | 1.25 |

# LINEAR

| | | | |
|---|---|---|---|
| 78H05 | 5.95 | LM1414N | 1.90 |
| 78M06 | 1.49 | LM1458CN/N | .49 |
| 78M.G. | 1.49 | MC1488N | 1.49 |
| LM105H | .99 | MC1489N | 1.49 |
| LM108AH | 2.95 | LM1496N | .89 |
| LM300H | .79 | LM1556N | 1.50 |
| LM301CN/H | .35 | LM1800N | .79 |
| LM304H | .98 | LM1820N | .95 |
| LM305H | .89 | LM1850N | .95 |
| LM306H | 3.25 | LM1889N | 3.95 |
| LM307CN/H | .29 | LM2111N | 1.75 |
| LM308CN/H | .98 | LM2900N | .99 |
| LM309K | 1.49 | LM2901N | 2.50 |
| LM310CN | 1.25 | LM2917N | 2.95 |
| LM311D/CN/H | .98 | CA3013T | 2.29 |
| LM312H | 1.75 | CA3018T | 1.99 |
| LM317T | 2.75 | CA3021T | 3.49 |
| LM318CN/H | 1.49 | CA3023T | 2.99 |
| LM319N/H | 1.25 | CA3035T | 2.75 |
| LM320K-XX* | 1.49 | CA3039T | 1.49 |
| LM320T-XX* | 1.25 | CA3046T | 1.29 |
| LM320H-XX* | 1.25 | LM3053N | 1.49 |
| LM323K | 4.95 | CA3059N | 3.25 |
| LM324N | 1.25 | CA3060N | 3.25 |
| LM339N | .95 | CA3062N | 4.95 |
| LM340K-XX* | 1.49 | LM3065N | 1.49 |
| LM340T-XX* | 1.25 | CA3080N | 1.29 |
| LM340H-XX* | 1.25 | CA3081N | 1.69 |
| LM344H | 1.95 | CA3082N | 1.69 |
| LM348N | 1.85 | CA3083N | 1.99 |
| LM358CN | .98 | CA3086N | 1.29 |
| LM360N | 1.49 | CA3089N | 2.75 |
| LM372N | 1.95 | CA3096N | 2.49 |
| LM376N | 3.75 | CA3097N | 1.99 |
| LM377N | 3.75 | CA3130T | 2.49 |
| LM380CN/N | 1.25 | CA3140T | 2.49 |
| LM381N | 1.79 | CA3146N | 2.49 |
| LM383T | 1.95 | CA3160T | 1.49 |
| LM386N | 1.49 | CA3190N | 1.95 |
| LM387N | 1.49 | CA3401N | .69 |
| LM390N | 1.95 | MC3423N | 1.49 |
| NE531V/T | 3.75 | MC3460N | 3.95 |
| NE555V | .39 | SG3524N | 3.95 |
| NE556N | .98 | CA3600N | 3.50 |
| NE561T | 19.95 | LM3900N | .59 |
| NE562B | 7.95 | LM3905N | 1.49 |
| NE565N/H | 1.25 | LM3909N | .98 |
| NE566N/V | 1.75 | RC4131N | 2.95 |
| NE567V/H | 1.50 | RC4136N | 1.10 |
| NE592N | 2.75 | RC4151N | 4.50 |
| LM702H | 2.99 | RC4194 | 4.95 |
| LM709N/H | .29 | RC4195 | 4.40 |
| LM710N/H | .98 | ULN2001 | 1.25 |
| LM711N/H | .39 | ULN2003 | 1.50 |
| LM715N | 1.95 | SN75450N | .59 |
| LM723N/H | .75 | SN75451N | .49 |
| LM733N/H | .98 | SN75452N | .49 |
| LM739N | 1.15 | SN75453N | .49 |
| LM741CN/H | .33 | SN75454N | .49 |
| LM741CN-14 | .19 | SN75491N | .89 |
| LM747N/H | .79 | SN75492N | .89 |
| LM748N/H | .39 | SN75493N | .89 |
| LM760CN | 2.95 | SN75494N | .89 |
| LM1310N | 1.90 | | |

16K UPGRADE ONLY $39.95 SPECIFY COMPUTER

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**DIGITAL MULTIMETER**

The NLS Model Touch/Test 20 is a 3½ digit digital multimeter with capability of measuring 10 parameters including 20 functions and 44 ranges. Features touch selection and annunciator lamp indication of control settings which include function, range and on-off power

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Digital Multimeters

AS LOW AS $100

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The TECH 300 has a 0.5% vdc accuracy and all the above features, but without Insta-Ohms™ continuity function or the 10 amp current ranges

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|---|---|
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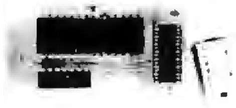
| TECH 310 Digital Multimeter | $140 |
| TECH 330 Digital Multimeter | $189 |
| VC-201 Vinyl Carrying Case | $10 |
| DC-202 Deluxe Carrying Case | $24 |
| HV-211 High Voltage Probe | $35 |
| RP-221 RP Probe | $35 |
| CI-231 AC Current Clamp | $42 |
| DL-241 Deluxe Test Lead Kit | $10 |
| TL-242 Spare Test Leads | $6 |

**VISTA COMPUTER COMPANY**

**APPLE™ 40 CHARACTER TYPE-AHEAD BUFFER**

MODEL 150



**$49.95**

**CSC CONTINENTAL SPECIALTIES**

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|---|---|
| Model LM-3 40-channel Logic Monitor | 585.00 |
| Model LM-1 Logic Monitor | 60.00 |
| Model LM-2 Logic Monitor | 147.00 |
| MAX-100 100 MHz Portable Frequency Counter | 149.00 |
| Model LP-1 Digital Logic Probe | 50.00 |
| Model LP-2 Economy Logic Probe | 28.00 |
| Model LP-3 High Speed Logic Probe | 77.00 |
| Model LPK-1 Logic Probe Kit | 21.95 |
| Model LTC-1, LTC-2 Logical Analysis Kits | 220/250 |

**Proto Clips**

| | | |
|---|---|---|
| 14-Pin Clip | PC-14 | $4.25 |
| 16-Pin Clip | PC-16 | $4.50 |
| 24-Pin Clip | PC-24 | $9.50 |
| 40-Pin Clip | PC-40 | $14.95 |

**Proto Boards**

| | | | |
|---|---|---|---|
| PB-6 | 16.95 | PB-104 | 54.00 |
| PB-100 | 18.00 | PB-203 | 97.00 |
| PB-101 | 21.00 | PB-203A | 149.00 |
| PB-102 | 25.00 | PB-203A-Kit | 129.00 |
| PB-103 | 43.00 | | |

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**Speech Synthesis System**

- Completely independent system, not requiring a processor controller
- Designed to be easily interfaced to most popular microprocessors
- 256 possible addressable expressions
- Male, female, and children's voices
- Natural inflection and emphasis of original speech
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- Communicates with static or clocked dynamic ROMs
- TTL compatible
- MICROBUS™ compatible

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National Semiconductor

# Apple® II 48K
# Apple® II Plus $1250

**DISK SYSTEM SPECIAL**

Apple II Plus w/48K Supermod Video Modulator

Disk II w/Controller Integer Based ROM Card.

**ACP PRICE $1995.00**

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| Hi-Speed Serial I/O | $18900 | DS65 Digi-Sector | $34900 | Integer ROM Card | $18900 |
| Centronics Printer I/O | 180.00 | Apple Graphics Tablet | 67500 | Proto Card | 2195 |
| Applesoft II Firmware | 18900 | DC Hayes Modem II | 34995 | M & R Modulator | 2995 |
| Apple Clock | 26900 | Disk II w/Controller & Dos 3.3 | 59500 | Cassette | 54.95 |
| Introl X-10 System | 17995 | Disk II | 45900 | 16K Upgrade Kit | 5495 |
| Introl X-10 Controller | 269.95 | Pascal Lang System | 450.00 | Desktop Plan | 9800 |
| All Music Synthesizer | 25995 | Parallel Printer Card | 16500 | 8" Floppy Controller | 35000 |
| 16 Ch Analog Input | 24995 | Communications Card | 18900 | Heuristics Speechlab | 17900 |
| 2 Ch Analog Output | 16495 | Business Software Pkg | 62500 | Romplus + | 16900 |
| 13-Key Keypad | 11995 | Corvus 10 Megabyte Drive | 4625.00 | Supertalker | 27900 |
| Visi-Calc | 12500 | | | Cashier | 25000 |

# apple /// $3995

- Apple III Option A: Apple III 96K, Information Analyst Package, 12" B/W Monitor .......... $3995.00
- Apple III Option B: Same as Option A Plus: Disk II for Apple III .......... $4395.00
- Apple III Option C: Same as Option A Plus: Disk II for Apple III, Silentype Thermal Printer .......... $4785.00
- To substitute 128K Apple III for 96K Apple III .......... Add $450.00

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- "BIT 3" – New 80 x 24 Video Board for Apple. Completely compatible with Pascal $32995
- "BARWAND" Hewlett Packard HEDS-3000 Bar Code interfaced to Apple $19900
- "SEC APPLE A/D" – 8 Channel A/D Interface completely assembled and tested $9950
- "APPLE FORTRAN" $17500
- "APPLE CRYPTEXT" for data encryption and security $44900
- "B2/A2" Graphics Interface Card by Base 2 $159.95
- 8" Disk Drives for Apple, Controller, DOS, Two 8" drives cabinet and cable $145000
- "MICROMODEM" – DC Hayes $31995
- "DIGISECTOR" Converts video input to Hi-Res graphics $34995
- California Microproducts VisiCalc Keypads Numberic keypad with space, space ESC - and · keys for VisiCalc compatibility .......... $169.00
- DOS 33 Upgrade Kits 23% more storage in 16-sector format $6500
- Mountain Hardware Music Board, best yet – 16 channels $55000
- Controller 1.1 Revision #4, 20% overall processing speed increase and supports standard printers. Reduced disk handling. Additional error checking. Improved manual. Vendor file expanded $145.00
- Pascal Revision Kit. Adds executive and chaining capabilities to Pascal environment $6500
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- Smart Term Apple 80 x 24 Video Card $61900
- Symtex X-10 $34900
- Apple Silentype With Apple Intelligent Interface Card $54900
- NEW! California Computer Systems APPLE Clock Only $12495
- NEW! Z-80 Softcard for APPLE CPM 2.2 & M BASIC 5.0 $325.00
- SEC ECHO II Speech Synthesizer $24995

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1. CYBERSTRIKE – Apple II version of Star Raiders from Atari on disk $3495
2. RTR Stock Market Analysis – Hi-Res, TrendLines, etc $109.95
3. ASTEROIDS .......... $29.95
4. "Both Barrels" – Hi-Res simulation of Western Gunfight and Skeet Shooting. Same author as Nasir $2995
5. "Apple Tax Planner Package" $89.96
6. "Non-DOS Tool Kit" $6495
7. NEW! Apple Z-80 CP/M Software Call for Price

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By popular demand! Eight more slots for your Apple. Attractive sturdy enclosure. Its own heavy duty power supply. Easy to use. Address cards in Expansion Chassis the same way as in your Apple. Only one additional command to specify in Apple or in Expansion Chassis.

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**Personal Computer System**

**ATARI 800 $825.00**

**ATARI 400 $449.00**

**ATARI 800 Includes:** Computer Console, BASIC Lang. Cartridge, BASIC Language Programming Manual, 800 Operator's Manual w/Notebook, 16K RAM Module, Power Supply, TV Switch Box.

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|---|---|---|---|---|---|
| Peripherals | | Education System Cassette Programs | | Spelling | 3500 |
| Disc Drive | 59900 | U.S. History | 3500 | Basic Electricity | 3500 |
| Printer | 49900 | U.S. Government | 3500 | Basic Algebra | 3500 |
| Program Recorder | 6900 | Supervisory Skills | 3500 | Basic Game and Program Cassettes | |
| Software – ROM Cartridges | | World History (Western) | 3500 | Guide to BASIC Programming | 1800 |
| Education System Master Cartridge | 2800 | Basic Sociology | 3500 | BASIC Game Programs | 1900 |
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| Assembler Debug | 5500 | Principles of Accounting | 3500 | 8K RAM Memory Module | 11000 |
| Basketball | 4200 | Physics | 3500 | 16K RAM Memory Module | 27500 |
| Life | 4200 | Great Classics (English) | 3500 | Diskettes | |
| Super Breakout™ | 4200 | Business Communications | 3500 | Blank Diskettes | |
| Music Composer | 5500 | Basic Psychology | 3500 | Disk File Manager | 500 |
| Super Bug™ | 4200 | Effective Writing | 3500 | Accessory Controllers | |
| Computer Chess | 5500 | Auto Mechanics | 3500 | Driving Controller Pair | 1800 |
| Home Finance | 5500 | Principles of Economics | 3500 | Paddle Controller Pair | 1800 |
| | | | | Joystick Controller Pair | 1800 |

# SINGLE BOARD COMPUTER SELECTION GUIDE

| BOARD | PROCESSOR | ACP PRICE | ENCLOSURE | BOARD | PROCESSOR | ACP PRICE | ENCLOSURE |
|---|---|---|---|---|---|---|---|
| Dig. Resch. Big Board | Z-80 64K | 64900 | N/A | SC-SBC100 | Z80 | 23900 | N/A |
| SYM-1 | 6502 | 23900 | Add 3995 | AIM 65 | 6502 | 375.00 | Add 4995 |
| Cromemco | Z80 | 40900 | N/A | Cosmac Vip | 1802 | 19900 | Inc. |

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**99/4 PERSONAL COMPUTER**

Superior Color, Music, Sound & Graphics – & a Powerful Extended Basic – All Built-In.

Now! Special T.V. Adapter lets you use your existing T.V. set as a computer display.

**$499.00**

Console only.

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**INTELLIVISION**

ACP LOW PRICE

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| AUTO RACE | MOTOCROSS | HORSE RACING |
| TENNIS | ADVENTURE | SUB BATTLE |
| GOLF | CHECKERS | ARMOR BATTLE |
| SOCCER | CHESS | SPACE BATTLE |
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### THE LAST WORD IN 8" FLOPPY-DISK ENCLOSURES

**THE VISTA V-1000 FLOPPY DISK DRIVE SUBSYSTEM** ● Deluxe chassis with internal slide easy access for drive positioning and mounting ● Built to mechanically and electrically accomodate single sided drives—including the most popular 8-inch Winchester and Shugart floppy disk drives, and 8-inch streaming tape units ● Storage capacity from 0.5 to 40 megabytes ● Industrial quality cabinet with die cast front bezel ● Meets all UL and OSHA standards ● Additional Savings! Front and rear retro rail mounts provided at no extra charge (no external slides) ● Desk or rack mountable ● Features modular construction with removeable sub-assembly that allows easy cabinet positioning and mounting ● Drives pull out for easy service and maintenance

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|---|---|
| CABINET | $ 395 |
| CABINET with (2) single sided drives (including power supply & cable) | $1595 |
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## Vista V-80 5¼" DISK

NOW SAVE ON TRS 80 ADD-ON

ONLY $299.00

2 DRIVE CABLE..... 29.95 2 FOR 279.00 ea.
4 DRIVE CABLE...... 39.95

## MINIATURE COMPUTER

MicroAce A COMPLETE COMPUTER

IMMEDIATE DELIVERY

Z-80 BASED
1K KIT ........... 149.00
2K KIT ........... 169.00
Manual ........... 10.00

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★ BOX BUILDERS
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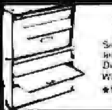

## LOW COST FLOPPY DISK SUBSYSTEM

Siemens FDD 120-8 (2) VISTA Floppy Controller (S-100) Case, Power Supply & Cable, CP/M Disk Operating System Assembled & Tested Walnut Wood Sides. $1499.00

★CHECK OUR FLOPPY DISK PRICING ON THIS PAGE★

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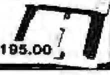

## WATANABE MIPLOT

$1195.00

## RAM BOARDS SPECIAL

16K Altair Mits Dynamic RAM Boards
Assem. & Tested $119.95 Untested $95.00 16K

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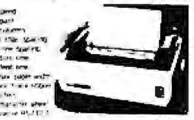
| Tandom TM100-1 5¼" Disk Drive | 249.95 |
| MPI B51 5¼", 40 tracks | 239.95 |
| Shugart SA400-5¼" 35 tracks | 295.00 |
| Shugart 800/801R 8" | 449.00 |
| Siemens Shugart Compatible Model FDD-120-8D | 429.00 |
| PERSCI Model 277 Dual | 1195.00 |
| WANGO/SIEMENS 5¼" Drive | 290.00 |
| MPI B52 5¼" Dual | 348.00 |
| WANGO/SIEMENS 282 Dual 5¼" | 395.00 |
| WANGO/SIEMENS 82 | 290.00 |
| MPI91 Double Track Density Single Side, 80 Tracks | 375.00 |
| MPI 92 Double Track Density Double Side, 160 Track | 475.00 |

## 6800 MICROMODULE™ PRICE LIST

| MODEL NO | DESCRIPTION | PRICE |
|---|---|---|
| 9600A | Single Board Microcomputer | $495.00 |
| 9609 | Advanced Single Bd Comp (6809) | 595.00 |
| 9601 | 16 Slot Mother Board | 175.00 |
| 9602 | CardCage | 75.00 |
| 9603 | 8 Slot Mother Board | 100.00 |
| 9604 | Power Supply | 275.00 |
| 9605 | DC Input Power Supply | 325.00 |
| 9610 | Utility Proto Board | 39.00 |
| 9611 | Arith Proc/Memory Module | 495.00 |
| 9612 | Buffered Utility Proto Board | 49.00 |
| 9616 | 32 K EPROM/RAM Module | 250.00 |
| 9617 | EPROM Programming Head | 250.00 |
| 9620 | 16 Channel Parallel I/O Module | 295.00 |
| 9622 | Serial-Parallel I/O Module | 325.00 |
| 9627 | 16K Static RAM Module 470ns | 395.00 |
| 9629 | 32K Static RAM 450ns | 695.00 |
| 9629A | 32K Static RAM 200ns | 895.00 |
| 9630 | Card Extender | 68.00 |
| 9640 | Multiple Programmable Timer | 395.00 |
| 9650 | 8Channel Duplex Serial I/O Mod | 395.00 |
| 9655 | Intelligent Tape Controller | 550.00 |
| 96103 | 32/32 I/O Module | 275.00 |
| 96702 | Contact Closure Module | 350.00 |

UNPOPULATED BOARDS (Also Available)

## The Vista V300 Printer



$1895.00

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| V200 E 30 | 600 | 3 Drive Single Head | 37 lbs | 1524.00 |
| V200 E 32 | 1.2 MEG | 3 Drive Double Head | 32 lbs | 1999.00 |

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★ Write Protect ★ Power 8VDC ±16VDC
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● The 737 has everything Check and compare the features
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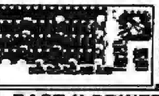
## 32K STATIC RAM BOARD



S-100

| | |
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| 16K 4MHz KIT | 159.95 |
| 16K 4MHz A&T | 217.95 |
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| 32K 4MHz A&T | 348.95 |
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● 60 Lines Per Minute
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Holds 4 Eproms at a time
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reg $69.95 NOW $52.95

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● 8" Drive with Double Density
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| Sanyo 5012 CX B/W | 279.00 | Sanyo VM 4212 15" B/W | 249.00 |
| | | Sanyo 6013 13" Color | 429.00 |
| | | Leedex 12" | 149.00 |

## DATA BOOKS • COMPUTER BOOKS

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| 1980 IC Master | $59.95 |
| INTEL Data Book | 7.50 |
| INTEL MCS 85 Manual | 7.50 |
| **SALE • OSBORNE BOOKS • SALE** | **Sale** |
| Intro to Micros Vol 0 | 12.50 |
| Intro to Micros Vol I | 12.50 |
| 8080A Programming | 12.50 |
| 6800 Programming | 12.50 |
| Z80 Programming | 16.00 |
| Vol II Some Real Microprocessors w/Binder | 27.50 |
| Vol III Some Real Support Devices w/Binder | 27.50 |
| Intro to Micros Vol III | 18.50 |
| 8086 Programming | 14.95 |
| Z8000 Programming | 14.95 |
| Intro to Pascal | 14.95 |

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| 6502 Games | $12.95 |
| Intro to Personal & Business Computing | 12.95 |
| Microprocessors, From Chips to Systems | 12.95 |
| Microprocessor Interfacing Techniques | 12.95 |
| Programming the Z80 | 12.95 |
| Programming the Z8000 | 12.95 |
| Programming the 6502 | 12.95 |
| 6502 Applications Book | 12.95 |
| CPM Handbook | 12.95 |

## MICROPROCESSORS

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|---|---|
| Z8001 16 bit/8Mb | $189.00 |
| Z8002 16 bit to 64K | 149.00 |
| Z80 | 10.75 |
| Z80A | 14.50 |
| F-8(3850) | 16.95 |
| 2650 | 18.95 |
| CD1802 | 13.95 |
| 8080A | 8.50 |
| 8080A-4MHz | 19.95 |
| SALE 8085 | 14.95 |
| 8008-1 | 14.95 |
| 2901 | 9.90 |
| 2901A | 14.95 |
| 2903 4-bit Superslice | 29.95 |
| TMS9900JL | 49.95 |
| CP1600 | 39.95 |
| 6502 | 11.50 |
| 6502A | 16.95 |
| IM6100 | 29.95 |
| 6800 | 11.75 |
| 6800B 2.0 MHz | 19.95 |
| 6802P | 17.95 |
| 8035 | 19.95 |
| 8039 | 19.95 |
| 8755 | 49.95 |
| 8748 | 69.95 |
| 6809 | 37.95 |
| 8086 | 69.95 |

## ADVANCED SUPPORT

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|---|---|
| AM9511 Arith Processor | 175.00 |
| 9512 Arith Processor | 175.00 |
| 9513 Univ Timing | 79.95 |
| AM9517 DMA Controller | 18.95 |
| AM9519Universalinterrupt | 18.95 |

## Z-80 SUPPORT CHIPS

| | | |
|---|---|---|
| Z80-PIO | 2.5 MHz | 8.75 |
| Z80A-PIO | 4.0 MHz | 12.95 |
| Z80-CTC | 2.5 MHz | 8.75 |
| Z80A-CTC | 4.0 MHz | 12.95 |
| Z80-DMA | 2.5 MHz | 29.95 |
| Z80A-DMA | 4.0 MHz | 35.95 |
| Z80-SIO/0 | 2.5 MHz | 35.95 |
| Z80A-SIO/0 | 4.0 MHz | 39.40 |
| Z80-SIO/1 | 2.5 MHz | 35.95 |
| Z80A-SIO/1 | 4.0 MHz | 39.40 |
| Z80-SIO/2 | 2.5 MHz | 35.95 |
| Z80-SIO/2 | 4.0 MHz | 39.40 |

## 8080/8085 SUPPORT

| | |
|---|---|
| 8155/8156 I/O | 24.95 |
| 8755 I/O with Eprom | 64.95 |
| 8202 Dyn Ram Cont | 34.95 |
| 8205/74S 138 Decoder | 3.95 |
| 8212 8 bit I/o | 2.75 |
| 8214 Priorityint | 5.25 |
| 8216 Bus Driver | 2.75 |
| 8224 Clock Gen | 2.95 |
| 8224-4(4MHz) | 9.75 |
| 8226 Bus Driver | 3.95 |
| 8T26 Bus Driver | 2.95 |
| 8228Sys Control | 5.50 |
| 8238 Sys Cont | 5.50 |
| 8251 Prog I/O | 6.95 |
| 8253Int. Timer | 12.95 |
| 8255Prog I/O | 6.50 |
| 8257 Prog DMA | 16.95 |
| 8259Prog Int | 17.95 |
| 8275 CRT Controller | 49.95 |
| 8279 Prog Keyboard | 15.95 |

## 6800 SUPPORT CHIPS

| | |
|---|---|
| 6810 128 x8 Ram | 4.75 |
| 6820 PIA | 5.95 |
| 6821 PIA | 6.50 |
| 6828 Priority Int | 19.95 |
| 6834-1 512 x 8 Eprom | 16.95 |
| 6845/HD46505 CRT Cont | 39.95 |
| 6847 Color CRT | 49.95 |
| 6850 ACIA | 5.95 |
| 6852 Serial Adapter | 5.95 |
| 6860 Modem | 10.95 |
| 6862 Modulator | 11.95 |
| 6871A 1.0MHz OSC | 25.95 |
| 6875 | 6.95 |
| 6880Bus Driver | 2.95 |
| MC68488 | 19.95 |
| 68047 | 24.95 |

## SHIFT REGISTER SALE

| | | | |
|---|---|---|---|
| 2504V | 1.49 | 2525 | 1.49 |
| 2507V | 1.49 | 2527 | 1.49 |
| 2517V | 1.49 | 2528 | 1.49 |
| 2524V | 1.49 | 2529 | 1.49 |
| | | 2533 | 1.49 |

## 6502 SUPPORT CHIPS

| | |
|---|---|
| 6520PIA | 7.50 |
| 6522Multi | 11.95 |
| 6530-002,003,004,005 | 21.95 |
| 6532 | 19.95 |
| 6551 | 19.95 |

## PROMS

| | |
|---|---|
| 2708 450 ns | 8.25 |
| 2708-6 650 ns | 7.50 |
| 1702A | 4.95 |
| 2732 | 44.95 |
| 2716-5V | 14.95 |
| 2716-5V, 12V | 19.95 |
| 2758-5V | 19.95 |
| 5203AO | 13.95 |
| 5204AO | 14.95 |
| IM 5610 | 3.90 |
| 82S115 512 x 8 (TS) | 16.95 |
| 82S123 32 x 8 | 4.90 |
| 82S126 256 x 4 | 4.90 |
| 82S129 256 x 4 (TS) | 4.90 |
| 82S130 512 x 4 (OC) | 6.50 |
| 82S23 | 6.95 |
| 82S131 | 14.95 |
| 82S137 | 14.95 |
| 74S387 | 8.50 |
| 74S471 | 12.95 |
| 74S472 | 12.95 |
| 74S570 | 14.95 |
| 74S571 | 14.95 |

NOTE: WE PROGRAM PROMS

## CHARACTER GEN.

| | |
|---|---|
| 2513-001 (5V) Upper | 9.50 |
| 2513-005 (5V) Lower | 10.95 |
| 2513-ADM3 (5V) Lower | 14.95 |
| MCM6571 | 11.75 |
| MCM6571A | 11.75 |
| MCM6574 | 14.50 |
| MCM6575 | 14.50 |
| MCM 6674 | 14.95 |

## UARTS/BAUD RATE

| | |
|---|---|
| TR1602B (5V, 12V) | 3.95 |
| AY5-1013 (5V, 12V) | 4.95 |
| AY5-1014A (4.5-14V) | 5.95 |
| AY51015A (4.86.3)(5V) | 6.95 |
| TMS 6011 (5V, 12V) | 5.50 |
| IM6402 | 7.95 |
| IM6403 | 8.95 |
| 2350 USRT | 9.95 |
| 1671B Astros | 24.95 |
| SALE TR1472B | 9.95 |
| MC14411 | 11.95 |
| 4702 | 14.95 |
| WD1941 | 9.95 |
| COM 5016 | 16.95 |
| AMI1883 | 7.95 |
| INS 8250 | 15.95 |

## KEYBOARD ENCODERS

| | |
|---|---|
| AY5-2376 | 13.75 |
| AY5-3600 | 13.75 |
| HD0165 | 9.95 |
| 74C922 | 9.9 |
| 74C923 | 9.95 |

## STATIC RAMS

| | 1-24 | 25-99 | 100 |
|---|---|---|---|
| 21L02 450ns | 1.30 | 1.25 | .99 |
| 21L02 250ns | 1.59 | 1.55 | 1.15 |
| 2111 | 3.75 | 3.65 | 3.55 |
| 2112-1 | 2.95 | 2.85 | 2.65 |
| 2101-1 | 2.90 | 2.70 | 2.55 |
| 2114L-250ns (4045) | 6.50 | 5.95 | 5.50 |
| 2114L-450ns (4045) | 5.50 | 5.25 | 4.75 |
| 4044 250 ns | 8.95 | 7.50 | 6.95 |
| 4044 450ns | 5.95 | 5.95 | 4.75 |
| EMM4200A | 9.75 | 8.75 | 7.95 |
| EMM4402 | 7.95 | 7.25 | 6.25 |
| AMD9140-41 | 10.95 | 10.25 | 9.25 |
| AMD9130-31 | 12.95 | 11.95 | 10.25 |
| 1101 | 1.95 | 1.75 | 1.25 |
| P2125/93425 (45ns) | 9.95 | 8.35 | 8.25 |
| 6514 1K x 1 CMOS | 7.95 | 7.95 | 7.25 |
| 2147 Low Power 4K Static | 19.95 | 18.95 | 16.95 |
| 93415 | 9.95 | 8.95 | 8.50 |
| TMS4046 | 11.95 | 10.95 | 10.50 |

SALE 2102 .89

## DYNAMIC RAMS

| | |
|---|---|
| 416-4116 16K (16 Pin) | 8.75 |
| Set of 8 4116 | 49.95 |
| 4115 8K (16 Pin) | 6.95 |
| 4050 4K x 1 (18 Pin) | 4.95 |
| 4060 4K x 1 (22 Pin) | 4.95 |
| 4096 4K x 1 (16 Pin) | 3.95 |
| 2104 4K x 1 (16 Pin) | 4.75 |
| 4027 4K x 1 (16 Pin) | 4.95 |

64K RAMS $159.95

| | | | |
|---|---|---|---|
| 5261 | 1.95 | 1103 | 1.95 |
| 5262 | 1.95 | 4008L | 4.95 |
| 5270 | 4.95 | 6605 | 7.95 |
| 5280 | 4.95 | 6604 | 4.95 |
| 5290 | 12.45 | 6002 | 1.50 |

## SOCKETS

| # Pins | Lo-Pro Solder/tail | Wire Wrap 3 Level Tin | Wire Wrap 3 Level Gold |
|---|---|---|---|
| 8 | .15 | .32 | .45 |
| 14 | .19 | .36 | .59 |
| 16 | .20 | .38 | .62 |
| 18 | .24 | .59 | .64 |
| 20 | .29 | .69 | .99 |
| 22 | .24 | .79 | 1.10 |
| 24 | .36 | .85 | 1.20 |
| 28 | .43 | 1.10 | 1.49 |
| 36 | .58 | 1.25 | 1.69 |
| 40 | .60 | 1.40 | 1.89 |

## ZERO INSERTION FORCE

16 Pin $5.50 24 Pin $7.50 40 Pin $10.25

## LED READOUTS

| Part No. | Size | Color | Description | Price |
|---|---|---|---|---|
| DL704 | 300 | Red | Comm. Cathode | .99 |
| DL707 | 300 | Red | Comm. Anode | .99 |
| FND357 | 357 | Red | Comm. Cathode | .99 |
| FND500 | 500 | Red | Comm. Cathode ±1 | .99 |
| FND503/500 | 500 | Red | Comm. Cathode | .99 |
| FND507/510 | 500 | Red | Comm. Anode | .99 |
| FND508 | 500 | Red | Comm. Anode ±1 | .99 |
| FND530 | 500 | Green | Comm. Cathode | 1.49 |
| FND656 | 500 | Orange | Comm. Cathode | 1.49 |
| FND803/800 | 800 | Red | Comm. Cathode | 1.75 |
| FND807/810 | 800 | Red | Comm. Anode | 1.75 |
| HP5082-7340 | 600 | Red | 4 x 7 Hexadecimal | 29.95 |
| HP5082-7300 | 600 | Red | 4 x 7 Sgl Digit RHP | 19.95 |
| HP5082-7751 | 500 | Red | Comm. Anode | .75 |
| TIL305 | | Red | Array 5 x 7 | 7.95 |
| TIL308 | 270 | Red | Numerical Display | 10.95 |
| TIL309 | 270 | Red | Numerical Display | 9.95 |
| TIL311 | 270 | Red | 4 x 7 Hexidecimal | 10.95 |
| MAN24 | 320 | Red | Array | 5.95 |
| MAN104 | 270 | Red | Alpha Numeric | 8.95 |
| MAN3061 | 300 | Red | Comm. Anode Right DP | 1.25 |
| MAN3067 | 300 | Red | Comm. Anode Left DP | 1.25 |
| MAN3063 | 300 | Red | Overflow CA Left DP | 1.25 |
| MAN3064 | 300 | Red | Comm. Cathode Right DP | 1.25 |
| MAN3051 | 300 | Green | Comm. Anode Right DP | 1.99 |
| MAN3052 | 300 | Green | Comm. Anode Left DP | 1.99 |
| MAN3053 | 300 | Green | Overflow CA Left DP | 1.99 |
| MAN3054 | 300 | Green | Comm. Cathode Right DP | 1.99 |
| MAN3081 | 300 | Yellow | Comm. Anode Right DP | 2.10 |
| MAN3082 | 300 | Yellow | Comm. Anode Left DP | 2.10 |
| MAN3083 | 300 | Yellow | Overflow CA Left DP | 2.10 |
| MAN3084 | 300 | Yellow | Comm. Cathode Right DP | 2.10 |

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| ICM 7045 Precision StooWatch | 23.95 |
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| MC14433P 3½ Digit A/D Converter | 13.85 |
| ICL 8211 Voltage Reference | 1.95 |
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| AY-5-3507 40MHz DVM | 9.95 |
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| G115M 6 channel Mosfet | 1.49 |
| ULN 2003A 7 channel Driver | .99 |
| 2101AL-4 | 1.95 |
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| 82S21 32 x 2 StaticRAM | 2/1.99 |
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| 2758 5V-2708 EPROM | 12.95 |
| MM5280/VPD 411/C2 107/TMS 4060/ 4Kx1 Dynamic 22 Pin RAM | 1.75 |
| 6604/VPD 414/4027/2660/MK 4096/ 4Kx1 Dynamic 16 Pin | 1.95 |
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|---|---|---|---|
| 7520/25 | .50 | LM 387 | 1/c |
| 1488/1489 | 2/1.99 | LM 3302 | 3/1.99 |
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| LM380 | 1.25 | DAC100 | 15.95 |

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| 9400 Volt to Freq. Conv | 7.25 |
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| DAC08 | 9.95 |
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| AY38606-1 Wipeout Game | 9.50 |
| AY38607-1 Shooting Gallery | 8.95 |
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| LM1889 RF Modulator | 3.95 |
| MM57100 NSC Color TV | 6.95 |
| MM57104 Clock Gen | 3.75 |
| RF Modulator w/Audio | 6.95 |
| M&R Modulator | 29.95 |

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| MC4024VCO | 2.95 |
| LM566VCO | 1.95 |
| XR2206 Function Generator | 5.25 |

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| MM5056N Dual 256 | 2.95 |
| MM5060N Dual 128 | 2.95 |
| 2510A Dual 100 | 1.95 |
| 2847 Quad 80 | 4.95 |
| 3341 Dual 80 | 4.95 |
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| 3357 Quad80 | 6.95 |
| 9403 16 x 4 FIFO | 24.95 |
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| 3347 | 5.95 |

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| CTS206-4 | 1.75 | CTS206-8 | 1.95 |
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| CTS206-6 | 1.75 | CTS206-10 | 1.95 |

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| DB25S Female | 3.75 |
| Hood | 1.25 |
| Set w/Hood, Sale | $7.50 |
| 22/44 W/W, S/T, KIM | 2.95 |
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| 50/100 S-100 Connector w/w | 4.95 |
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|---|---|
| S-100 Sound Board | $34.95 |
| Z-80 CPU/(Ithaca) | 34.95 |
| 8080A CPU | 34.95 |
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| 1702 Eprom Board | 30.00 |
| 2708/2716 Eprom | 34.95 |
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| WMC Floppy PCB | 34.95 |
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| Cromemco Sys III | 6990 | 6290. |
| Horizon I w/32K | | CALL |
| Pascal Microengine | 1995. | 1595. |
| IPSI 1620 DiabloRO | 3295 | 2695 |
| Anadex DP 8000 | 995 | 875. |
| Centronics Micro S-1 | 595. | 525. |
| Soroc IO 120 | 995. | 795. |
| Teletype Model 43 | 1349 | 1150. |
| HiPlot Plotter | 1085. | 899 |
| HiPlot Digitizer | 795. | 735. |
| Intertube II | 895. | 784 |
| Atari 800 | 999. | 825. |
| Atari 400 | 549 | 449. |
| TI99/4 | 1150 | 1025. |
| Leedex 12" Monitor | 169. | 149. |
| Centronics 737 | 995. | 899 |
| Trencom T-100 | 375. | 349. |
| Trencom T-200 | 595 | 525. |
| Sanyo 9" Monitor | 220 | 169. |
| Sanyo 15" Monitor | 295 | 249. |
| Sanyo 13" Monitor | | 395. |

## SOCKET SPECIALS

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|---|---|
| 14 Pin w/w-2L | .35 |
| 20 Pin w/w-2L | .75 |
| 18 Pin s/t | .15 |
| 22 Pin s/t | .15 |
| 14 Pin s/t | 100/12.00 |
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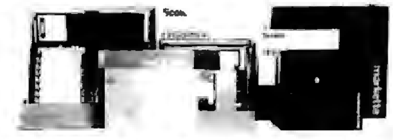

## DISKETTES

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| [illegible] | 741-0 | 45. | 43. | 3740/1d | 75. | 73. | 3090 | 37. | 35. |
| [illegible] | 740-32 | 35. | 33. | na. | | | na. | | |
| [illegible] | 743-0 | 65. | 50. | na. | | | 3115 | 40. | [illegible] |

[illegible] brand head cleaning kit. $24.95 MMA-CK(5X8) please specify 5 1/4 8"
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**16k memory (8) 4116's**

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| | | | | | |
|---|---|---|---|---|---|
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| 21L02 | 250ns | 1.49 | 1.45 | 1.39 | |
| 2114L4 | 450ns | 3.95 | 2.95 | 2.75 | 2.50 |
| 2114L3 | 300ns | 4.25 | 3.75 | 3.00 | 2.75 |
| 4044-4 | 450ns | 4.95 | 4.50 | 4.25 | 4.00 |
| 4044-2 | 250ns | 5.50 | 4.95 | 4.50 | 4.35 |
| 5257-3 | 300ns | 4.47 | 4.25 | 4.05 | 3.75 |

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| | | | | | |
|---|---|---|---|---|---|
| 2708 | 450ns | 4.95 | 4.50 | 3.75 | 3.25 |
| 2716 5V. | | 7.95 | 6.50 | 5.00 | 4.50 |
| 2716 tri-volt | | 9.95 | 9.00 | 8.25 | 7.50 |
| 2732 Intel | | 19.00 | 17.50 | 16.00 | |
| 2532 TI | | 21.50 | 19.00 | | |
| 2764 | | * | | | |

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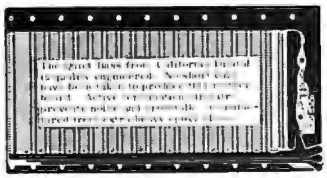
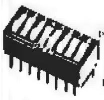
**Quiet Buss**

**8803-18 18 slot IMSAI**



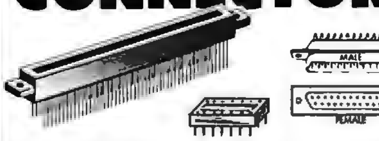
## SWITCHES



| DIP SWITCHES pos. | ea. | 100+ | 1K+ |
|---|---|---|---|
| 1 | .84 | .75 | .69 |
| 7 | .90 | .83 | .79 |
| 8 | 1.05 | .91 | .87 |
| 12 | 1.10 | .99 | .91 |

| TOGGLE | | ea. | 100+ |
|---|---|---|---|
| 7101 | on/on | 1.19 | .98 |
| 7103 | on/off/on | 1.39 | 1.19 |
| 7107 | mom. on | 1.39 | 1.19 |
| 7108 | mom. on | 1.[illegible] | 1.[illegible] |
| 7205 | dpdt mom | 1.85 | 1.65 |

## CONNECTORS



| GOLD EDGE CONNECTORS | | |
|---|---|---|
| S-100 .125" centers | each | 10+ |
| Imsai solder .250" row | $2.95 | $2.50 |
| Imsai wire wrap (TI) | 3.95 | 3.50 |
| Sullins Hi-Rel. .250" | 4.50 | 4.00 |
| Sullins Hi-Rel. W/W | 5.55 | 4.90 |
| Sullins /Altair .140" | 3.95 | 4.10 |
| .156" Centers (standard) | | |
| 22/44 Kim Eyelet | 2.50 | 2.15 |
| 36/72 Digital Group S/T | 5.95 | 5.50 |
| 36/72 Digital Group W/W | 6.60 | 6.15 |
| 43/86 Motorola 6800S/T | 6.60 | 6.15 |
| 43/86 Moto. 6800 W/W | 7.00 | 6.85 |

| INTEGRATED CIRCUIT SOCKETS | Low Profile each | Low Profile 100+ | Wire Wrap each | Wire Wrap 100+ |
|---|---|---|---|---|
| 8 pin | $.10 | $.09 | $.46 | $.41 |
| 14 pin | .10 | .09 | .45 | .41 |
| 16 pin | .12 | .11 | .50 | .45 |
| 18 pin | .15 | .13 | .68 | .61 |
| 24 pin | .26 | .24 | .94 | .87 |
| 40 pin | .42 | .40 | 1.60 | 1.47 |

| "D" Type | each | 10-24 | 25+ |
|---|---|---|---|
| DE9P male | $1.60 | $1.40 | $1.30 |
| DE9S female | 2.35 | 2.00 | 1.90 |
| DE hood | 1.50 | 1.35 | 1.20 |
| DA15P male | 2.35 | 2.15 | 2.00 |
| DA15S female | 3.25 | 3.10 | 2.90 |
| DA hood 2/P | 1.60 | 1.45 | 1.30 |
| DB25P male | 2.50 | 2.35 | 2.25 |
| DB25S female | 3.35 | 3.15 | 3.05 |
| DB hood 2/P | 1.35 | 1.15 | 1.05 |
| DC37P male | 4.30 | 4.00 | 3.70 |
| DC37S female | 6.00 | 5.75 | 5.50 |
| DC hood 2/P | 2.25 | 2.00 | 1.75 |
| DD50P male | 5.50 | 5.10 | 4.75 |
| DD50S female | 9.40 | 8.60 | 8.00 |
| DD50 hood 2/P | 2.60 | 2.40 | 2.10 |
| CENTRONICS | | | |
| 57-30360 | 7.95 | 6.75 | 5.75 |
| RIBBON CABLE CONNECTORS | | | |
| 17/34 5" disk | 1.85 | 4.15 | 3.9[illegible] |
| 20/40 TRS-80 | 5.65 | 5.0[illegible] | 4.70 |
| 25/50 8" disk | 5.90 | 5.15 | 4.90 |

**SPECIAL $295**

## SHUGART SA800/1

**Your Choice 115V. 60Hz or 230V. 50Hz.**

These Shugart eight inch disk drives were originally purchased by major computer manufacturers. Upon failing incoming inspection the drives were sent back to Shugart for realigment.

California Digital has negotiated an extremely attractive agreement to purchase the entire inventory of the SA800's We are offering the drives on a first come basis at only $295. (Subject to remaining inventory on hand.) Installation manual $10 additional. Warranty 30 days from date of receipt. NOTE: The SA800/1 is standard mount and not the "R" suffix rack mount unit.

SPC-800/115 or SPC-800/230 16 Lbs.

**Shugart Associates**

**$395**

**801/ R Disk Drive 15 lbs.**

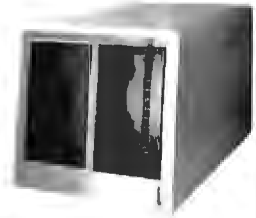
Shugart 801/R with CP 206 power supply, muffin exhaust fan, complete in dual enclosure with all the necessary harnessing cables. Documentation included. 30 pounds. MSD-1801 **$795**

Same as above but with two Shugart 801R disk drives. 50 pounds. MSD-2801 **$1195**

Disk drive cable, 6 feet 50 conductor with edge card connector at both ends. WCA-4505 $23.00

Export disk drives, 220V. 50Hz add $50.00 per disk drive.

## NEW from Shugart Technology 5 Megabyte Hard Disk Drive

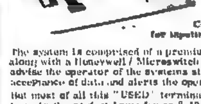


Packaged in the same physical size as the industry standard 5 1/4" minifloppy disk drive. The micro-Winchester stores thirty times as much data (6.38 megabytes unformatted), accesses data twice as fast (170 milliseconds) and transfers data twenty times faster (5.0 megabits per second.)

The ST506 is factory sealed to protect the media from environmental contaminates. Requires only DC voltage.

Dual California Digital 5 1/4" enclosure, ST506 drive and power supply. **$1500**

Shugart Associates SA400 removable media disk drive for above package. add: **$300**
S-100 & Apple controller scheduled for spring release.



## DATA INPUT TERMINAL

This keystation terminal was recently acquired from the CMC division of the P[illegible] Corporation. The unit was originally designed for inputing data directly onto magnetic tape.

The system is comprised of a premium cast aluminium and fiberglass enclosure, along with a Honeywell / Microswitch hall effect keyboard. Thirty display lamps advise the operator of the systems status. Four inch loud speaker acknowledges acceptance of data and alerts the operator of pending problems.

But most of all this "USED" terminal, with a little imagination, can be engineered to make the perfect home for an S-100 computer and video display; or with slight modification will accept the Rockwell AIM-65 micro/computer.

Five volt regulated power supply is available for an additional $20. (see June Byte) All units are in excellent condition. Original acquisition over $700. 22 lbs.

## Regulated Power Supply 5 VOLT 5 AMP

**$11.95**

This [illegible] surplus power supply was removed from working [illegible] Pass transistor regulation outputs five volts at a conservative [illegible] suitable for TTL hobby applications. SPC-PS1 4 pounds.

VISA

master charge

All merchandise sold by California Digital is premium grade.
Shipping: First five pounds $2.00; each additional add $.40
Foreign orders 10% shipping. Excess will be refunded.
California residents add 6% sales tax. COD's discouraged.
Open accounts extended to state supported educational institutions and companies with a "Strong Dun & Bradstreet."
Warehouse: 15608 Inglewood Blvd. Visitors by appointment.

**TOLL FREE ORDER LINE (800) 421-5041**

**TECHNICAL & CALIFORNIA (213) 679-9001**

**TWX 910 325-6212**

Circle 46 on inquiry card.

# California Digital

**Post Office Box 3097 B • Torrance, California 90503**

## MEMOREX 8" DISKETTES

**$25** WITH FREE LIBRARY CASE

Recently the Memorex Corporation had a cancellation on a contract for a truck load of eight inch diskettes. California Digital was fortunate to be offered this load of prime magnetic media.

These diskettes are "UNBRANDED" but are guaranteed first quality Memorex Brand. (#3060 single den.)

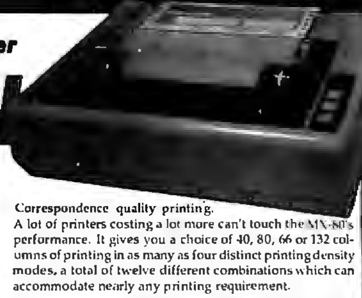
Like all diskettes sold by California Digital, a library case is supplied free with the purchase of every box.

This offer is subject to remaining inventory on hand.

## SUPER BUY

*World's Best Selling Printer*

## EPSON MX80



*Immediate Delivery*

**Only $475**

Correspondence quality printing.
A lot of printers costing a lot more can't touch the MX-80's performance. It gives you a choice of 40, 80, 66 or 132 columns of printing in as many as four distinct printing density modes, a total of twelve different combinations which can accommodate nearly any printing requirement.

Bidirectional printing. Logical seeking of shortest lines. 80 CPS. 64 graphics characters. Forms handling. The list of standard features goes on and on. The fact is that there are few printers that can compete with the MX-80 at ANY price. And none—ZERO—in its extraordinarily affordable price range.

ABCDEFGHIJKLMNOPQRSTUVWXYZABCDEFGHIJ

## NEW from INTEGRAL DATA 460 Paper Tiger

with GRAPHICS **$1150**

The 460 Paper Tiger uses a dot matrix character formation technique in which the placement of the dots overlap both horizontally and vertically to achieve a correspondence quality printing.
The printer's nine-wire print head uses staggered needle rows to create the vertically overlapping dots. The head is driven bi-directionally under microprocessor control by a stepper motor driven mechanism.
"Two K" buffer allows the printer to accept the entire content of a 1,920 character CRT screen. With graphics suggested retail price $1,395 27 lbs. PRG-460G

## NEC Spinwriter 5510P/S $2795

The word processing quality Spinwriter prints at speeds upto 55 characters per second. The Model 5510 P/S is supplied with both parallel and RS-232 serial interfacing. Also included is the tractor feed mechanism, along with print thimble and ribbon. PRN-5510 PS 70 lbs. Keyboard (KSR) Model 5520 P/S available $2995. PRN-5520 PS 75 lbs.

## TEC V-300 Word Processing Daisy Wheel Printer

**$1595**

Finally a reasonably priced letter quality printer... Bi-directional printing at 25 characters per second. Full 136 print positions wide. Proportional spacing 1/120" horizontal, 1/48 vertical.
Uses standard Diablo brand interchangable daisy print wheels.
Intel 8085 CPU microprocessor controlled. Interfaces via Centronics parallel connector. Shipping 58 lbs. PRV-300.

## TELETYPE® MODEL 43

4320 KEYBOARD MODELS

| | | |
|---|---|---|
| TTL serial output | AAA | $ 995 |
| RS232 serial | AAK | 1050 |
| Friction 80 column | AAE | 1100 |
| Friction 80 RS232 | AAL | 1195 |
| Bell 103 Modem | AAB | 1495 |

## Ultra-Violet Products UVS 11-E UV EPROM ERASER

**$65**

## CENTRONICS

| | |
|---|---|
| 730 | $595 |
| 737 | $750 |

Both the Centronics 730 and the 737 are capable of accepting standard office letterhead or pin feed continuous forms. For higher resolution the 737 implements a nine wire dot matrix print head. Parallel interfacing. Add $65 for RS232. PRC-730P (S). PRC-737P (S) 17 lbs.

## IBM 3101 Display Terminal

*IBM Direct Price $1295*

*California Digital discount price* **$1195**

## AMPEX DIALOGUE 80 CRT TERMINAL

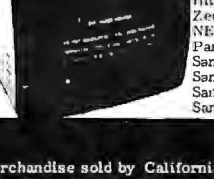
**$995**

New from the Ampex Corporation. The Dialogue 80 features removable keyboard, displayable two pages (four optional) dual program keys, half intensity protected fields and status line. Transmits data either block, line or character mode. Excellent value. VDT-D80 shipping 47 lbs.

## VIDEO TERMINALS

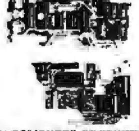
| | | |
|---|---|---|
| ADDS Regent 25 numeric cluster | VDT-R25 | $850 |
| ADDS Regent 30 25th status line | VDT-R30 | 950 |
| ADDS Regent 40 limited graphics | VDT-R40 | 1195 |
| ADDS Regent 60 Block mode | VDT-R60 | 1495 |
| Ampex Dialouge 80 two page, detatch | VDT-D80 | 995 |
| Digital Equipment VT-100 | VDT-V100 | 1595 |
| Digital Equipment VT-132 | VDT-V132 | 1895 |
| Direct VP-800A emulator | VDT-P800 | call |
| Hazeltine 1410 | VDT-H1410 | 750 |
| Hazeltine 1420 | VDT-H1420 | 795 |
| Hazeltine 1500 | VDT-H1500 | 850 |
| Hazeltine 1510 | VDT-H1510 | 1025 |
| Hazeltine 1520 | VDT-H1520 | 1225 |
| Hewlett Packard 2621A | VDT-HP21A | |
| Hewlett Packard 2621P | VDT-HP21P | |
| IBM 3101-10 character mode green | VDT-3101 | 1195 |
| IBM 3101-20 block mode | VDT-31012 | 1395 |
| Lear Seigler 3A upper case only | VDT-L3A | 850 |
| Lear Seigler ADM5 | VDT-L5 | 945 |
| Lear Seigler ADM31 | VDT-L31 | 1385 |
| Lear Seigler ADM42 | VDT-L42 | 1995 |
| Soroc IQ 120 | VDT-Q120 | 675 |
| Soroc IQ 135 NEW | VDT-Q135 | 850 |
| Soroc IQ 140 detatchable keyboard | VDT-Q140 | 1150 |
| Televideo 912C | VDT-T912 | 665 |
| Televideo 920C | VDT-T920 | 745 |
| Televideo 950C detatchable keybd. | VDT-T950 | 985 |
| Zenith Z-19 | VDT-Z-19 | 735 |

## VIDEO MONITORS



| | |
|---|---|
| BMC KG12C 18MHz P-31 grn phosphor | $259 |
| Leedex/Amdek 12"100 | 129 |
| Leedex 100 green | 169 |
| Leedex 100-80 | 197 |
| Hitachi color 13" | 389 |
| Zenith color 13" | 379 |
| NEC green phosphor | 219 |
| Panasonic color 10" | |
| Sanyo 9" BW | 149 |
| Sanyo 12" green phos. | 235 |
| Sanyo 15" BW | 259 |
| Sanyo 13" color | 419 |

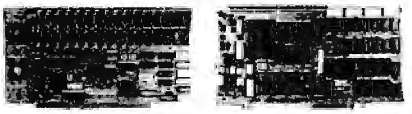
## ACCESSORIES FOR THE APPLE COMPUTER



| | |
|---|---|
| **CALIFORNIA COMPUTER SYSTEMS** | |
| Arithmetic Processor 7811 B/C | $319 |
| Asynchronous serial interface 7710 | 129 |
| Centronics interface card 7728 | 95 |
| 12K PROM Module 7114 | 69 |
| Calender/Clock, Bat. back-up 7424 | 99 |
| Parallel Interface 7720A | 99 |
| Programable Timer 7740A | 99 |
| Analog/Digital converter 7470A | 99 |
| **MICROSOFT PRODUCTS** | |
| Apple to Z-80 CPU card | 379 |
| **D. C. HAYES PRODUCTS** | |
| Micromodem for Apple | 319 |
| **COMPUTER STOP PRODUCTS** | |
| Double Vision / 80 Column Video | 250 |
| **INTERACTIVE STRUCTURES** | |
| 16 Channel A/D card AIO/2 | 275 |
| **MOUNTAIN COMPUTER PRODUCTS** | |
| Intro X-10 system for BSR | $239 |
| Intro X-10 card only | 163 |
| 16 channel AD/DA 8 bit | 319 |
| Apple Clock battery back-up | 225 |
| Supertalker SD200 | 245 |
| ROM Plus with filter | 165 |
| ROM Writer/Programmer | 149 |
| **APPLE BRAND PRODUCTS** | |
| Apple Language card | 450 |
| Floppy disk with controller | 560 |
| Floppy disk without controller | 495 |
| Apple parallel interface | 175 |
| **SSM MICROCOMPUTER** | |
| Dual serial parallel interface AIO | |
| **SORRENTO VALLEY ASSOCIATES** | |
| 8" floppy controller (Pascal) | 360 |

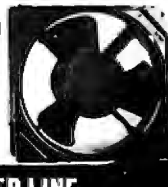
## S-100 BOARDS

**Assembled • Tested • Burned-in**



| | |
|---|---|
| **CPU BOARDS** | |
| 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 |
| Measurement Systems Z-80 4 serial 2 parallel real time clock, 8 vector BDC-MZ80 | 305 |
| SD Systems SBC-200 Z-80 with serial & parallel I/O ports BDC-SBC2 | 385 |
| Teletek FDC-I single board CPU & floppy disk controller plus I/O BDC-FDCI | 695 |
| **MAINFRAMES** | |
| Calif. Computer 2200A 12 slot & power supply ENM-C2200 | 319 |
| TEI 12 slot table ENM-T12 | 495 |
| TEI 22 slot table ENM-T22 | 650 |
| Godbout mainfrm. ENM-GMF | |
| **MEMORY BOARDS** | |
| 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 | 565 |
| Godbout Ram 17 64K static memory 16 bit BDM-G17 | 1025 |
| SD Systems Expandoram II 16K dynamic BDM-EX16 | 295 |
| 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 |
| **FLOPPY DISK CONTROLLER** | |
| Calif. Computer 2422A with 2.2 CPM BDF-C2422 | 329 |
| Godbout "Disk One" features the NEC 765 controller, DMA arbitration BDF-GDI | 395 |
| Measurement Systems 765 chip, single & double density, Error recovery BDF-MF | 419 |
| SD Systems Versafloppy II double density BDF-VF2 | 119 |
| Tarbell D/D BDF-TF2 | 119 |
| Morrow Design Disk Jockey I single density BDF-DJ1 | 195 |
| Morrow Design Disk Jockey II double density BDF-DJ2 | 355 |
| **INTERFACE BOARDS** | |
| Calif. Computer 2718 I/O 2 serial/2 par'l BDT-C2718 | |
| Morrow Designs Switchboard 2 serial/4 par'l BDT-MSB | 219 |
| Morrow Designs Multiboard 3 serial/3P, ++ BDT-MMB | 275 |
| Godbout Interfacer One 2 serial/2 par'l BDS-GB1 | 199 |
| Godbout Interfacer Two 1 serial/3 par'l BDS-GB2 | 199 |
| **SPECIALITY BOARDS** | |
| QT Computer real time clock/calendar BDS-QCK | 145 |
| Artec Elec. Wire wrap prototype board BDS-AWW | 25 |
| Artec Elec. General Purpose proto board BDS-AGP | 25 |
| Godbout Spectrum color board BDS-GSC | 295 |
| D.C. Hayes S-100 Micromodem BDS-HMM | 310 |
| Mullen Products extender board & logic probe kt BDS-MTBL | 49 |
| Mullen Products Opto-control board kit BDS-MOC | 139 |

## Rotron Muffin Fan



**$14.77** $12.00 @ 100, 10.50 @ 1000

115 VAC. 7 Watts WR2A1
Factory fresh Muffin fans
NOT pull-outs. EMF-4M

VISA — master charge

All merchandise sold by California Digital is premium grade.
Shipping: First five pounds $2.00; each additional add $.40
Foreign orders 10% shipping. Excess will be refunded.
California residents add 6% sales tax. COD's discouraged.
Open accounts extended to state supported educational institutions and companies with a "Strong Dun & Bradstreet."
Warehouse: 15608 Inglewood Blvd. Visitors by appointment.

Circle 46 on inquiry card.

**TOLL FREE ORDER LINE (800) 421-5041**

**TECHNICAL & CALIFORNIA (213) 679-9001**

**TWX 910 325-6212**

# Low Prices,

## Printers

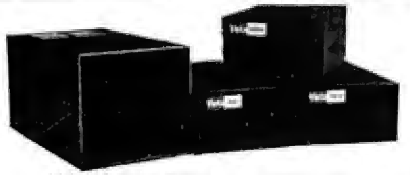
**MX-80 - Epson**
*132 column, 9 x 9 dot matrix, multiple fonts*
PRM-27080 *Save $100.00* .............. Call

*MX-70*
*PRM-27070 With Graftrax II* .......... Call

*Interface & Cable for Apple* ...... $110.00

**SPINWRITER - NEC**
*65 cps, bi-directional, letter quality printer with deluxe tractor mechanism, both parallel and serial interfaces on-board, 16K buffer, ribbon, print thimble, graphics, micro-space justification, data cable, and self test/diagnostic ROM.*
PRD-55511 *without 16K buffer* ... $2795.00
PRD-55512 *with 16K buffer* ...... $2895.00

## Accessories for TRS-80



**DISK DRIVES for TRS-80**
*23% more storage, 8 times faster, 40 track with free patch, 120 day warranty.*
MSM-12410C *Save $125.00 !!!* ...... $325.00

**8" DISK DRIVES for MODEL II**
*2 double density drives with cabinet, power supply, & cables*
END-000433 *Kit* ................. $1050.00
END-000434 *Assembled* .......... $1250.00
WCA-5036A *Cable (required)* ........ $29.95

*Special Purchase - Save $50.00*
## Novation Cat Modem
*300 baud, answer and originate*

***(We have only ~~200~~ 265 availible at this special price)***

IOM-5200A *List price $189.95* ...... $139.95

*D-CAT 300 baud, direct connect modem*
IOM-5201A *Special sale price* ...... $189.00

*AUTO-CAT Auto answer/originate, direct connect*
IOM-5230A *Special sale price* ...... $239.95

## Accessories for Apple

**16K MEMORY UPGRADE**
*Add 16K of RAM to your TRS-80, Apple, or Exidy in just minutes. We've sold thousands of these 16K RAM upgrades which include the appropriate memory chips (as specified by the manufacturer), all necessary jumper blocks, fool-proof instructions, and our 1 year guarantee.*
MEX-16100K *TRS-80 kit* ............ $29.00
MEX-16101K *Apple kit* ............... $29.00
MEX-16102K *Exidy kit* ............. $29.00

**16K RAM Card - Microsoft**
*(There is life after 48K)*
MEX-16300A *A & T* ............... $174.95

**Z-80* CARD for APPLE**
*Two computers in one, Z-80 & 6502, more than doubles the power & potential of your Apple, includes Z-80* CPU card, CP/M 2.2, & BASIC-80*
CPX-30800A *A & T* .............. $279.95

## Atari 800 $799.95

**APPLE CLOCK - Cal Comp Sys**
*Real time clock w/battery back-up*
IOK-2030A *A & T* ................. $109.95

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*Joy stick with pots for Apple II*
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**VISICALC - Personal Sftwr**
*The ultimate program for your Apple II*
SFA-24101005M *Complete package* $139.95

**DOS 3.3 UPGRADE - Apple**
*Upgrade your old DOS to the improved 3.3*
IOD-2233A *Complete kit* ........... $64.95

**DISK DRIVE for APPLE**
*5¼" disk drive with controller for your Apple*
MSM-12310C *with controller* ...... $475.00
MSM-123101 *w/out controller* ..... $375.00

**8" DRIVES for APPLE**
*Controller, DOS, two 8" double densisty drives, cabinet, power supply, & cables*
Special Package Price *Kit* ....... $1399.95

**PRINTER INTERFACE - C.C.S.**
*Centronics type I/O card w/ firmware*
IOI-2041A *A & T* .................... $99.95

**AIO, ASIO, APIO - S.S.M.**
*Parallel & serial interface for your Apple (see Byte pg 11)*
IOI-2050K *Par & Ser kit* .......... $129.95
IOI-2050A *Par & Ser A & T* ....... $159.95
IOI-2052K *Serial kit* ................ $89.95
IOI-2052A *Serial A & T* ............ $99.95
IOI-2054K *Parallel kit* .............. $69.95
IOI-2054A *Parallel A & T* ........... $89.95

**A488 - S.S.M.**
*IEEE 488 controller, uses simple basic commands, includes firmware and cable, 1 year guarantee, (see April Byte pg 11)*
IOX-7488A *A & T* ................. $399.95

## Disk Drives

*JADE's new dual disk sub-assemblies include:* ***Handsome** metal cabinet with **proportionally balanced** air flow system, **assembled & tested** dual drive power supply, **quiet whisper** type cooling fan, power-cable kit, lighted power switch, approved fuse assembly, line cord, **Never-Mar** rubber feet, and all necessary hardware to mount 2-8" disk drives - it's **all American made, guaranteed for six months**, and it's in stock!*

Dual 8" Sub-Assembly Cabinet
END-000421 *Cabinet kit* .......... $225.00
END-000420 *Bare cabinet* ........... $59.95

Single sided, double density disk drive sub-system
END-000423 *Kit w/2 8" drives* .... $975.00
END-000424 *A & T w/2 8" drives* $1195.00

Double sided, double density disk drive sub-system
END-000426 *kit w/2 8" drives* .... $1495.00
END-000427 *A & T w/2 8" drives* $1695.00

**8" DISK DRIVES**
*Highly reliable double density floppy disk drives*
Shugart 801R single sided, double density
MSF-10801R *SA-801R* ............. $425.00
*Special Sale Price* ........... *2 for $790.00*

Shugart 851R double sided, double density
MSF-10851R *SA-851R* ............. $595.00
*Special Sale Price* .......... *2 for $1150.00*

Siemens FDD100-8D2 single sided, double density
MSF-201120 *6 mo warranty* ....... $385.00
*Special sale price* ............ *2 for $750.00*

Qume Datatrak 8 double sided, double density
MSF-750080 *SA-851R compatible* .. $599.95
*Special sale price* ........... *2 for $1160.00*

**JADE DISK PACKAGE**
*Double density controller, two 8" double density floppy disk drives, CP/M 2.2 (configured for controller), hardware and software manuals, boot PROM, cabinet, powersupply, fan, & cables*
Special Package Price *Kit* ....... $1395.00

## Diskettes

**DISKETTES - Jade**
*Bargain prices on magnificent magnetic media*
5¼" single sided, single density, box of 10
MMD-5110103 *Soft sector* ........... $27.95
MMD-5111003 *10 sector* ............. $27.95
MMD-5111603 *16 sector* ............. $27.95
5¼" double sided, double density, box of 10
MMD-5220103 *Soft sector* ........... $39.95
8" single sided, single density, box of 10
MMD-8110103 *Soft sector* ........... $33.95
8" single sided, double density, box of 10
MMD-8120103 *Soft sector* ........... $39.95
8" double sided, double density, box of 10
MMD-8220103 *Soft sector* ........... $49.95

## Video Monitors

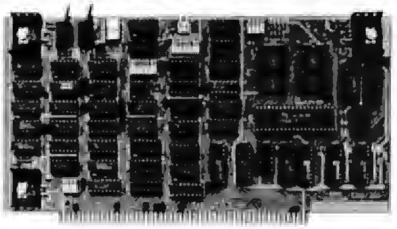
**13" COLOR MONITOR - Zenith**
*The hi res color you've been promising yourself*
VDC-201301 ....................... $449.00

**12" GREEN SCREEN - NEC**
*20 MHz, P31 phosphor video monitor with audio, exceptionally high resolution - A fantastic monitor at a very reasonable price*
VDM-651200 *12" monitor* ......... $259.95

**Leedex / Amdek**
*Reasonably priced video monitors*
VDM-801210 *Video 100 12" B&W* .. $149.95
VDM-801230 *Video 100-80 12" B& W* $189.95
VDM-801250 *12" Green Phospor* .... $189.95
VDC-801310 *13" Color I* ........... $399.95

# Fast Service.

## S-100 CPU



### CB-2 Z-80 CPU - S.S.M.
*2 or 4 MHz Z-80 CPU board with provision for up to 8K of ROM or 4K of RAM on board, extended addressing, IEEE S-100, front panel compatible.*

| | | |
|---|---|---|
| CPU-30300K | *Kit* | $239.95 |
| CPU-30300A | *A & T* | $299.95 |

### THE BIG Z* - Jade
*2 or 4 MHz switchable Z-80* CPU with serial I/O, accomodates 2708, 2716, or 2732 EPROM, baud rates from 75 to 9600*

| | | |
|---|---|---|
| CPU-30201K | *Kit* | $145.00 |
| CPU-30201A | *A & T* | $199.00 |
| CPU-30200B | *Bare board* | $35.00 |

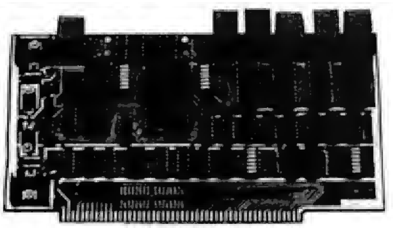
### 2810 Z-80* CPU - Cal Comp Sys
*2/4 MHz Z80A* CPU with RS-232C serial I/O port and on-board MOSS 2.2 monitor PROM, front panel compatible.*

| | | |
|---|---|---|
| CPU-30400A | *A & T* | $269.95 |

### SBC-200 - SD Systems
*4 MHz Z-80* CPU with serial & parallel I/O ports, up to 8K of on-board PROM, software programmable baud rate generator, 1K of on-board RAM, Z-80 CTC.*

| | | |
|---|---|---|
| CPC-30200K | *Kit* | $339.95 |
| CPC-30200A | *Jade A & T* | $399.95 |

## S-100 I/O



### I/O-4 - S.S.M.
*2 serial I/O ports plus 2 parallel I/O ports*

| | | |
|---|---|---|
| IOI-1010K | *Kit* | $159.95 |
| IOI-1010A | *A & T* | $219.95 |
| IOI-1010B | *Bare board* | $35.00 |

### S.P.I.C. - Jade
*Our new I/O card with 2 SIO's, 4 CTC's, and 1 PIO*

| | | |
|---|---|---|
| IOI-1045K | *2 CTC's, 1 SIO, 1 PIO* | $199.00 |
| IOI-1045A | *A & T* | $259.00 |
| IOI-1046K | *4 CTC's, 2 SIO's, 1 PIO* | $259.00 |
| IOI-1046A | *A & T* | $319.00 |
| IOI-1045B | *Bare board w/ manual* | $59.95 |
| IOI-1045D | *Manual only* | $20.00 |

## Motherboards

### ISO-BUS - Jade
*Silent, simple, and on sale - a better motherboard*

*6 Slot (5¼" x 8⅝")*

| | | |
|---|---|---|
| MBS-061B | *Bare board* | $19.95 |
| MBS-061K | *Kit* | $39.95 |
| MBS-061A | *A & T* | $49.95 |

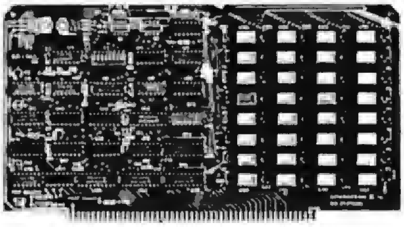
*12 Slot (9¾" x 8⅝")*

| | | |
|---|---|---|
| MBS-121B | *Bare board* | $29.95 |
| MBS-121K | *Kit* | $69.95 |
| MBS-121A | *A & T* | $89.95 |

*18 Slot (14½" x 8⅝")*

| | | |
|---|---|---|
| MBS-181B | *Bare board* | $49.95 |
| MBS-181K | *Kit* | $99.95 |
| MBS-181A | *A & T* | $139.95 |

## S-100 Memory



### EXPANDORAM II - S D Systems
*4 MHz RAM board expandable from 16K to 64K*

| | | |
|---|---|---|
| MEM-16630K | *16K kit* | $275.95 |
| MEM-32631K | *32K kit* | $295.95 |
| MEM-48632K | *48K kit* | $315.95 |
| MEM-64633K | *64K kit* | $335.95 |
| *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 |

### MEMORY BANK - Jade
*4 MHz, IEEE S-100, bank selectable, 8 or 16 bit, expandable from 16K to 256K*

| | | |
|---|---|---|
| MEM-99730B | *Bare board* | $55.00 |
| MEM-99730K | *Kit, no RAM* | $219.95 |
| MEM-16730K | *16K kit* | $249.95 |
| MEM-32731K | *32K kit* | $289.95 |
| MEM-48732K | *48K kit* | $324.95 |
| MEM-64733K | *64K kit* | $359.95 |
| *Assembled & tested* | | add $50.00 |

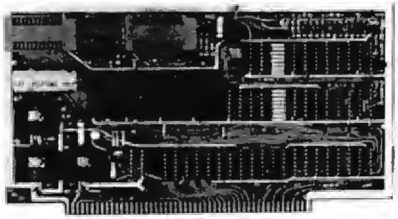
### 32K STATIC RAM - Jade
*2 or 4 MHz expandable static RAM board uses 2114L's*

| | | |
|---|---|---|
| MEM-16151K | *16K 4 MHz kit* | $169.95 |
| MEM-32151K | *32K 4 MHz kit* | $299.95 |
| *Assembled & tested* | | add $50.00 |

### 16K STATIC RAM - Cal Comp Sys
*2 or 4 MHz 16K static RAM board, IEEE S-100, bank selectable, Phantom capability, addressable in 4K blocks*

| | | |
|---|---|---|
| MEM-16160A | *16K 2 MHz A & T* | $286.95 |
| MEM-16162A | *16K 4 MHz A & T* | $289.95 |
| MEM-16160B | *Bare board* | $50.00 |

## S-100 PROM Boards



### PB-1 - S.S.M.
*2708, 2716 EPROM board with built-in programmer*

| | | |
|---|---|---|
| MEM-99510K | *Kit* | $139.95 |
| MEM-99510A | *A & T* | $199.95 |

### PROM-100 - SD Systems
*2708, 2716, 2732, 2758, & 2516 EPROM programmer*

| | | |
|---|---|---|
| MEM-99520K | *Kit* | $219.95 |
| MEM-99520A | *Jade A & T* | $269.95 |

### EPROM BOARD - Jade
*16K or 32K uses 2708's or 2716's, 1K boundary*

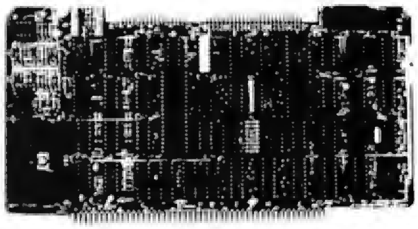
| | | |
|---|---|---|
| MEM-16230K | *Kit* | $79.95 |
| MEM-16230A | *A & T* | $119.95 |

## Mainframes

### MAINFRAME - Cal Comp Sys
*12 slot S-100 mainframe with 20 amp power supply*

| | | |
|---|---|---|
| ENC-112106 | *A & T* | $429.95 |

## S-100 Disk Controller



### 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 | *8" A & T* | $389.95 |
| IOD-1205A | *5¼" A & T* | $389.95 |
| IOD-1200B | *Bare board* | $65.00 |

### 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* | $369.95 |

### VERSAFLOPPY II - SD Systems
*New double density controller for both 8" & 5¼"*

| | | |
|---|---|---|
| IOD-1160K | *Kit* | $339.95 |
| IOD-1160A | *A & T* | $379.95 |

## S-100 Video

### VB-3 - S.S.M.
*80 characters x 24 lines expandable to 80 x 48 for a full page of text, upper & lower case, 256 user defined symbols, 160 x 192 graphics matrix, memory mapped, has key board input.*

| | | |
|---|---|---|
| IOV-1095K | *4 MHz kit* | $345.00 |
| IOV-1095A | *4 MHz A & T* | $395.95 |
| IOV-1096K | *80 x 48 upgrade* | $39.95 |

### VDB-8024 - SD Systems
*80 x 24 I/O mapped video board with keyboard I/O, and on-board Z-80A*.*

| | | |
|---|---|---|
| IOV-1020K | *Kit* | $399.95 |
| IOV-1020A | *Jade A & T* | $459.95 |

### VIDEO BOARD - Jade
*64 characters x 16 lines, 7 x 9 dot matrix, full upper/lower case ASCII character set, numbers, symbols, and greek letters, normal/reverse/blinking video, S-100.*

| | | |
|---|---|---|
| IOV-1050K | *Kit* | $99.95 |
| IOV-1050A | *A & T* | $125.00 |
| IOV-1050B | *Bare board* | $29.95 |

## 2114L Low Power 4MHz

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|---|---|---|
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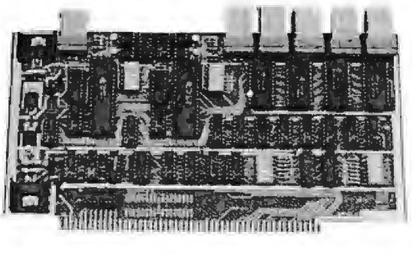
## SSM



### I/04 2 Parallel & 2 Serial I/O Board

**Number of parts** - Two serial ports with status • Two parallel inputs • Two parallel outputs • **Serial Interface** -*Current*-loop by optical isolators • 20/60 ma current-loop • EIA receivers and drivers • 55 to 9600 baud • 134.5 baud (optional) for running selectrics • UART presets by dip switch: —stop bits, —word length, —parity even and odd • + 5V, 12V & − 12V available at connector • **Parallel Interface** - Latch type—8212 • + 5V & − 12V available at connector • **Addressing** - Dip switch addressing of serial I/O to any four port boundary • Dip switch addressing of parallel I/O to any two port boundary • **Prototyping area** - 2 x 16 pin spare patterns

| | List Price | Our Price |
|---|---|---|
| SSMIO4K Kit | | $210.00 |
| SSMIO4A A&T | $290.00 | $260.00 |

### INTERFACE I 2 Serial

Our I/O board gives you inparalleled **flexibility** and operating convenience. We include such features as:

- 2 independently addressable serial ports (dip switch selectable addresses)
- Real LSI Hardware UARTs for minimum CPU housekeeping.
- RS232C, current loop (20mA), & TTL signals on both ports.
- Precision, crystal-controlled Baud rates up to 19.1 KBaud (Individually dip switch selectable)
- Transmit & receive interrupts on both channels, jumperable to any vectored interrupt line.
- Industry standard RS232 level converters with five RS232 handshaking lines per port.
- Optically isolated current loop with provisions for both on-board & off-board current sources.
- UART parameters, interrupt enables, & RS 232 handshaking lines are sotftware programmable with power-on hardware detault to customer specified hard-wired settings for maximum flexibility.

| | | List Price | OUR PRICE |
|---|---|---|---|
| GBT133U | UNKIT | | $199.00 |
| GBT133A | A&T | $249.00 | $219.00 |

### INTERFACER II 3P/1S

- 1 **independently** addressable serial port
- RS232C; 20mA current loop, & TTL signals
- Precision crystal controlled Baud rate generator
- Up to 19.2K Baud
- Transmit and receive interrupts, jumperable to and vectored **interrupt** line
- Five RS232 handshaking lines
- Optically isolated current loop
- 3 parallel I/O
- Utilizes LSTTL octal latches for latched I/O data with 24mA drive current
- Enable & strobe bits on each port (each with selectable polarity)
- Interrupts for each input port
- Separate 25 pin connector with power for each channel and a status port for interrupt mask & port status

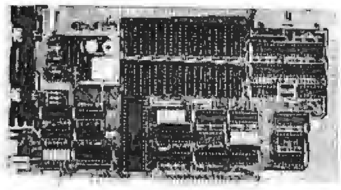
| | | List Price | OUR PRICE |
|---|---|---|---|
| GBT150U | UNKIT | | $199.00 |
| GBT150A | A&T | $249.00 | $219.00 |

## *TOLL FREE!!!*

## 1-800-423-5922

## CompuPro™ from GODBOUT

### SPECTRUM S-100 COLOR GRAPHICS BOARD

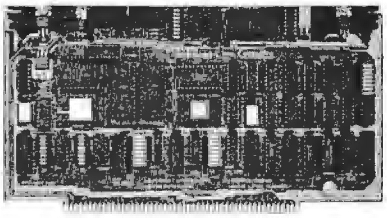


The **SPECTRUM COLOR GRAPHICS** Board is actually three products in one: a full-function color graphics generator; a parallel I/O port; and an 8K static RAM board. These three sections work together to create a new standard of flexibility in the generation of color graphics.

**ALPHANUMERIC AND GRAPHICS MODES AVAILABLE**

| MODE | DENSITY | AVAILABLE COLORS | RAM USED |
|---|---|---|---|
| ALPHA | 32 X 16 | 2 | 512 BYTES |
| SEMIGRAPH | 64 X 32 | 8 | 512 BYTES |
| GRAPHICS | 64 X 64 | 4 | 1K BYTES |
| GRAPHICS | 128 X 64 | 2 | 1K BYTES |
| GRAPHICS | 128 X 64 | 4 | 2K BYTES |
| GRAPHICS | 128 X 96 | 2 | 1.5K BYTES |
| GRAPHICS | 128 X 96 | 4 | 3K BYTES |
| GRAPHICS | 128 X 192 | 2 | 3K BYTES |
| GRAPHICS | 128 X 192 | 4 | 6K BYTES |
| GRAPHICS | 256 X 192 | 2 | 6K BYTES |

| | | LIST PRICE | OUR PRICE |
|---|---|---|---|
| GBT144U | UNKIT | | $299.00 |
| GBT144A | A&T | $399.00 | $349.00 |
| GBT144C | CSC | $449.00 | $399.00 |
| GBT20 | SUBLOGIC UNIVERSAL GRAPHICS INTERPRETER SOFTWARE | | $35.00 |



### SYSTEM SUPPORT 1 MULTIFUNCTION BOARD

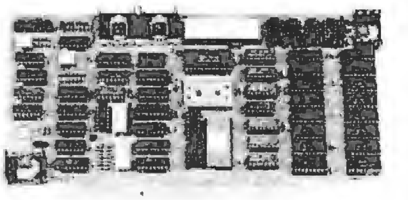
This multi-purpose S-100 board provides your computer with the most needed system support functions at less cost than buying numerous single function boards. Includes sockets for 4K of extended address EPROM or RAM (2716 pinout), 1 socket with battery backup; crystal controlled month/day/year/time clock with BCD outputs; optional high speed math processor (9511 or 9512); full RS-232 serial port; three 16 bit interval timers (cascade or use independently); two interrupt controllers service 15 levels of interrupts; power fail indicator with provision to switch CMOS memory to battery backup; and comprehensive owner's manual with numerous software examples. Conforms fully to all IEEE 696/S-100 standards.

Want to make your S-100 system more versatile? System Support 1 is the answer.

- 4K of EPROM or RAM (2716 type).
- 15 levels of vectored interrupts.
- 3 independent 16 bit interval timers.
- Real time clock/calendar with battery backup capability.
- Full RS-232C serial port with software selectable baud rate.
- Optional high speed math processor (9511 or 9512, your choice).
- 1, 2, 4 or 8 wait states selectable to accomodate the fastest CPUs.
- ROM/RAM can be enabled or disabled by PHANTOM.
- ROM/RAM can respond to full IEEE extended address (24 bits).

| | | List Price | Our Price |
|---|---|---|---|
| GBT 162U | unKit | | $295.00 |
| GBT 162A | A&T | $395.00 | $360.00 |
| GBT 9512 | Math Chip | | $195.00 |

## SSM



### VB3 80 Character Video Board

VB3 is the perfect video interface for word processing and other applications requiring 80 characters per line. It produces a standard 80 x 24 display or as much as 80 x 48 for a full page of text. VB3 can display upper and lower case characters, up to 256 user defined symbols, and a 160 x 192 matrix for graphics.

VB3 is memory mapped, but occupies memory only when activated. So one or more VB3s can be located at the same address with a full 65K of memory still available to the user.

It generates both US and European T.V. rates and includes a keyboard input. Software includes a CP/M compatible driver routine.

**SPECIFICATIONS:**
**Display** - 80 char. per line, up to 48 lines • Graphics up to 160 x 192 matrix • Upper & lower case characters • Up to 256 user defined symbols (optional EPROM) • Software controlled options: Inverted video, graphic char. (2x4), 1 level of gray, blinking char., underline, strike thru, blank-out char., cursor.
**Timing** - Software controlled timing, top & bottom margins, horiz. position • U.S. & European T.V. timing • Full interlace or non-interlace • Crystal—16 MHz (dot rate)
**Interface** - Composite video, =75 OHM • Verti./horiz. drive output & sync input • Memory mapped
**Keyboard** - Keyboard port with status • Dip switch addressing of ports
**On-board RAM** - 4096 Bytes (8192 bytes optional) • 2114L (250 nsec or 450 nsec) • Switch addressing, 8K increments • On-board bank-select of RAM
**Buffering** - All lines buffered
**Software** - CP/M compatible driver routine • Powerful terminal simulator routine

| | | List Price | SALE PRICE |
|---|---|---|---|
| SSM-VB3K24 | 80x24 KIT | $425.00 | $359.00 |
| SSM-VB3A24 | 80x24 A&T | $499.00 | $450.00 |
| SSM-VB3K48 | 80x48 KIT | $475.00 | $425.00 |
| SSM-VB3A48 | 80x48 A&T | $549.00 | $495.00 |
| SSM-VB3UP | 24x48 Line Upgrade Kit | | $50.00 |

**Video Interface Software**
CP/M Compatible 8" Disk, containing
- CP/M BIOS Driver
- Super Intelligent Terminal Routines
- Graphics Routine
- Menu-Driven Initialization Routine
- Misc. User - Contributed Programs

| | | Our Price |
|---|---|---|
| SSM-VB3SOFT | Video Interface Software | $50.00 |

### VB1C Memory Mapped Video Board

One of the most popular S-100 video boards available, this VBIB is software controlled and memory mapped. Memory Mapping means that locations in the 1K (1024 byte) on-board RAM memory correspond with locations in the 64 x 16 (1024) character display.

The 1K memory can be addressed at any 1K increment via DIP switch.

The VBIB features a 128 x 48 matrix for graphics upper and lower case, Greek letters, and black on white or white on black. Software includes a driver routine for cursor control, scroll-up, and X-Y graphic control.

| | | List Price | SALE PRICE |
|---|---|---|---|
| SSM-VB1CK | KIT | $179.00 | $159.00 |
| SSM-VB1CA | A&T | $242.00 | $205.00 |

### VB2 I/O Mapped Video Board

The VB2, is an I/O controlled video interface board. With a TV monitor, the VB2 becomes a video terminal. No other I/O card is required for keyboard input and video display.

The VB2 cursor, linefeed, carriage return, backspace, and clear-screen are hardware controlled. The display is 64 x 16, all upper case, and is selectable for white on black, or black on white. The board produces a clear, bright display, and features adjustable picture size and character width. Circuitry is provided to drive a speaker for a tone.

| | | List Price | SALE PRICE |
|---|---|---|---|
| SSM-VB2K | KIT | $199.00 | $169.00 |
| SSM-VB2A | A&T | $269.00 | $229.00 |

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# CompuPro™ division of GODBOUT ELECTRONICS

# TEAMS UP WITH *PRIORITY ONE ELECTRONICS* TO INTRODUCE THE NEXT GENERATION OF IEEE/696 S-100 COMPUTERS

## 8 BIT

There are still a lot of 8 bit machines out in the world, matched with plenty of 8 bit software - but very few of these machines are working up to their peak capacity. We want the "Big 8" system to change all that, and bring professional level computing power to all the owners of older S-100 machines. And if you're assembling an 8 bit system from the ground up, "Big 8" gets you off to the best possible start ... regardless of price.

### Here's what you get

1. CPU Z, our high speed, high performance Z80* based CPU board. Includes a 6 MHz CPU for maximum throughput and highest operating speed.
2. Disk 1 DMA floppy disk controller.
3. 64K of fast static RAM with 24 bit extended addressing.
4. Interfacer I - Dual Serial I/O card or Interfacer II 3 Parallel 1 Serial I/O Card.
5. CP/M*-80 2.2.
6. All documentation and manuals.

**It all adds up to $2712.00**

**TOTAL PACKAGE PRICE**

**$1950.00**

SAVE $762.00

**ORDER PART NO. GBT-SPEC-C**
Big 8 System with Interfacer I
**ORDER PART NO. GBT SPEC-D**
Big 8 System with Interfacer II

SAVE EVEN MORE, when you add 2 Shugart 801R disk drives, and a dual Cabinet with Power Supply.

**This package adds up to $3962**

**TOTAL PACKAGE PRICE**

**$3050.00**

**GBT-SPEC-E** with Interfacer I
**GBT-SPEC-F** with Interfacer II

## 16 BIT

Step up to the world of 16 Bit computers now and save hundreds, even thousands of dollars if you act right now! We have made a one time only special buy from Godbout on the nucleus of a Powerfull 16 Bit S-100 Computer. We have a limited number of these systems in stock, because of the special pricing we can't go back for more, so hurry! Orders will be filled on a first come basis. NO RAINCHECKS.

### Here's what you get

1. 16 bit/8 bit Dual Processor (w/6 MHz 8088)
2. System Support 1 with Serial I/O. Real time clock, Interval Timers & More!
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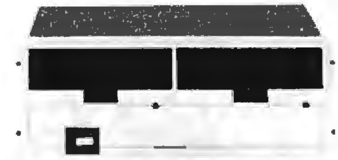

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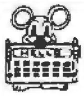

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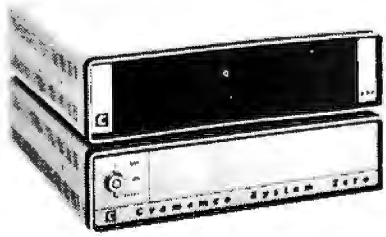

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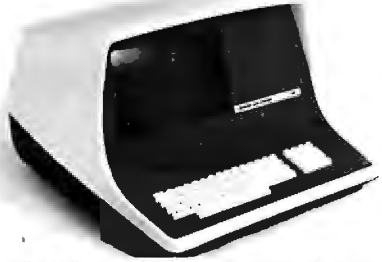

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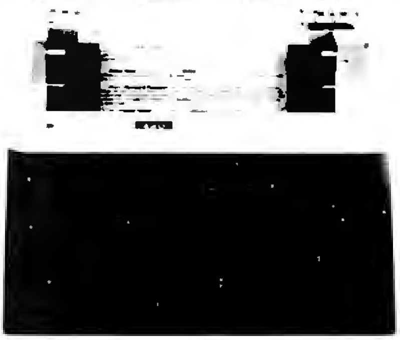

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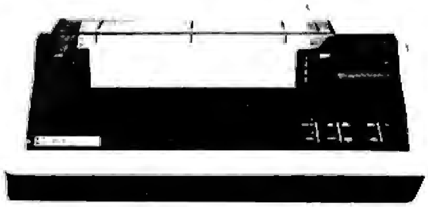

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**FOR SALE:** SwTPC 4 K memory; $50. 8 K memory; $100. JPC CK-7 real-time clock with auxiliary power supply; $50. MicroWare RT/68 monitor read-only memory; $50. All in excellent working condition with full documentation. C R Silvia, POB 234, Hines IL 60141.

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**WANTED:** Contact with owners of Disk Jockey 2D 8-inch disk system and switchboard I/O. Would like to interface Centronics 779 to system. Also, Wameco QM812 for sale. $75 or best offer. Daniel Snyder, 561 5th St, Butler PA 16001, (412) 287-1625.

**WANTED:** Manuals for Altair 8800 computer system. Will purchase. Don Averill, Eastern New Mexico University Sta #33, Portales NM 88130.

**WANTED:** Still photographs of pre-1960 computers, computer facilities, and computer scientists and engineers; also, cine footage, sound or silent, in any size, of same. Would also like to hear from other computer archivists/historians to form possible association or similar special-interest group. H Kent Craig, POB 975, Cary NC 27511, (919) 851-5017 evenings.

**FOR SALE:** Dot-matrix printer, Emako 20 (manufactured by C Itoh). 60 lpm, pin feed, 96 ASCII characters, 80-column, with cable for TRS-80, plugs into expansion interface. Original $770, asking $400. Also, twelve 5-inch diskettes; $2.50 each. Philip Crawford, 1720 E 1st St #10, Long Beach CA 90802, (213) 591-2484.

**FOR SALE:** Okidata Microline 80 printer with forms tractor, pin and friction feeds. State of the Arts 80 cps dot matrix. Includes parallel interface cable. 80- or 132-column. Excellent condition, complete with manual. $500. Clay Roberts, POB 129, Comptche CA 95427, (707) 937-4753.

**FOR SALE:** Twenty-three years of computing history. 276 issues of DATAMATION magazine. November 1957 thru December 1980. (Only two issues missing.) $500 plus shipping. R L LaFara, 10632 E 79th, Indianapolis IN 46236, (317) 823-6366 evenings.

**WANTED:** I am interested in exchanging ideas about possible ways computers can be used as an aid for guitar playing, in particular the application of computers for arranging and composing music on the guitar. I am currently writing a program that will find an optimum tuning for a given piece of music from the thousands that are possible. Bruce Johnston, 655 Sharp Ln 130, Baton Rouge LA 70815.

**GIFT:** HP-9100-A computing calculator. Sixteen registers store 197 steps. All math and trig functions, conditional jumps. In operating condition, but erratic. Will donate for cost of shipping. Winslow Palmer, 114 Montrose Dr, Fort Myers FL 33907, (813) 481-0027.

**FOR SALE:** APF Imagination Machine microcomputer. Power supply, RF modulator, cassette recorder, joysticks, and much software included—ready for hookup to television (it has color graphics and sound). Like new condition, over twenty programs, including Space Destroyers, Boxing, Baseball, and Hangman. The value of this system with software is over $800, willing to sacrifice for $600 or best offer. Bruce Chapman, 316 Newtown Rd, Richboro PA 18954.

**FOR SALE:** Pascal Microengine. Western Digital desk-top computer with 16-bit processor, 32 K words (64 K bytes) of programmable memory, floppy-disk controller, two RS-232C asynchronous/synchronous parts, and software (UCSD Pascal). $3400. G Mann, 9 Aberdeen, Irvine CA 92714, (714) 731-6145.

**FOR SALE:** Z80 Starter Kit from S D Systems, assembled and tested. Will sell for $325. Lee Rathbun, POB 1268, Minden NV 89423, (702) 782-4455.

**FOR SALE:** Altair 8800B with processor, front panel, and motherboard; $400. 3P+S; $100. 8 K static 300 ns; $100. Two Z16 16 K static memory boards; $200 each. North Star single-density disk controller board; $50. 4 K MITS static memory; $75. Will sell as package for $900. Bob Fiorella, 27 Kirkwood Dr, Glen Cove NY 11542, (516) 676-1480 after 6 PM ET.

**FOR SALE:** Hewlett-Packard (Mosely) 8.5- by 11-inch flatbed plotter, good condition; $150. Digital Group PT-96 complete printer, like new; $300. Complete DISKMON for 5-inch floppies (original, including ROM, etc); $30. Digital Group 5-slot memory-extension motherboard with all connectors installed; $20. 10-day return privilege guarantee on all above. Jerry E Flanders, 1767 Gregory Lake Rd, N Augusta SC 29841, (803) 278-0984 after 6 ET.

**FOR SALE:** 16 K Atari 800 personal computer. Brand new and unused. Unopened in original carton, with manual. Cost $1080, for $810 plus shipping. Atari disk drive, brand new. Cost $700, for $520 plus shipping. HP-97 desk-top programmable printing calculator, one month old. Cost $750, for $650 plus shipping. Extensive software library for Atari, TRS-80; write for details. Doug Solomon, 208 Overbrook, Freehold NJ 07728.

**FOR SALE:** SwTPC 6800 computer, 16 K programmable memory, teletypewriter interface, parallel interface, cassette recorder, cables, dual cassette recorder, 16 by 32 terminal, 64-character set, 9-inch black-and-white monitor. Complete with $100 worth of software and 4 K and 8 K BASIC, Editor/Assembler tapes. Asking $550 or best offer. John Antypas, 49 DeLaurenti Ct, Walnut Creek CA 94598, (415) 943-7409.

**WANTED:** Bally computer users. Would like to exchange information on the Bally home computer. Want old newsletters, system information, and read-only memory listings. If you know of a group (or person) using the Bally, I would like to have their mailing address. Also, give them my address so we can exchange information. Interested in additional unit at a good price, also other hardware. BALLYuserexch, POB 28355, Columbus OH 43228.

# BOMB
# BYTE's Ongoing Monitor Box

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## March BOMB Results

Gregg Williams and Franklin C Crow tied for first place for their articles, "Structured Programming and Structured Flowcharts" and "Three-Dimensional Computer Graphics, Part I." A check for $100 will be sent to Mr Crow. (Being a BYTE employee, Gregg is not eligible for the prize money.) The second-place prize of $50 goes to Tim Ahrens, Jack Browne, and Hunter Scales for their article, "What's Inside Radio Shack's Color Computer?" The next two places went to Steve Ciarcia's "Build the Disk-80" and Jim Howard's "What Is Good Documentation?"

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| 3 | 23 | 43 | 63 | 83 | 103 | 123 | 143 | 163 | 183 | 203 | 223 | 243 | 263 | 283 | 303 | 323 | 343 | 363 | 383 | 403 | 423 | 443 | 463 | 483 | 503 | 523 | 543 | 563 | 583 | 603 | 623 | 643 | 663 | 683 |
| 4 | 24 | 44 | 64 | 84 | 104 | 124 | 144 | 164 | 184 | 204 | 224 | 244 | 264 | 284 | 304 | 324 | 344 | 364 | 384 | 404 | 424 | 444 | 464 | 484 | 504 | 524 | 544 | 564 | 584 | 604 | 624 | 644 | 664 | 684 |
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| 19 | 39 | 59 | 79 | 99 | 119 | 139 | 159 | 179 | 199 | 219 | 239 | 259 | 279 | 299 | 319 | 339 | 359 | 379 | 399 | 419 | 439 | 459 | 479 | 499 | 519 | 539 | 559 | 579 | 599 | 619 | 639 | 659 | 679 | 699 |
| 20 | 40 | 60 | 80 | 100 | 120 | 140 | 160 | 180 | 200 | 220 | 240 | 260 | 280 | 300 | 320 | 340 | 360 | 380 | 400 | 420 | 440 | 460 | 480 | 500 | 520 | 540 | 560 | 580 | 600 | 620 | 640 | 660 | 680 | 700 |

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| Article No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
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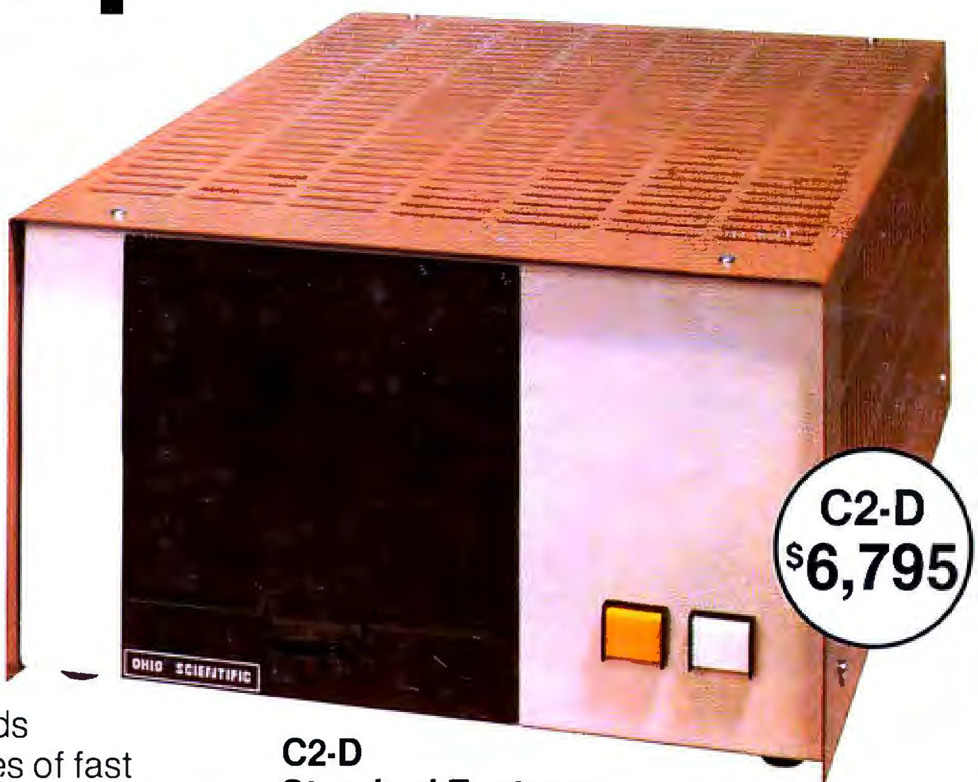


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