

# Microsystems

Volume 5/Number 5

May 1984

## S-100

Product Directory  
Digitized Sound Storage  
Stepper Motor Control

## Networking

\*WATSTAR Network

## UNIX & CP/M

C/NIX: a UNIX Front End

## System Utilities

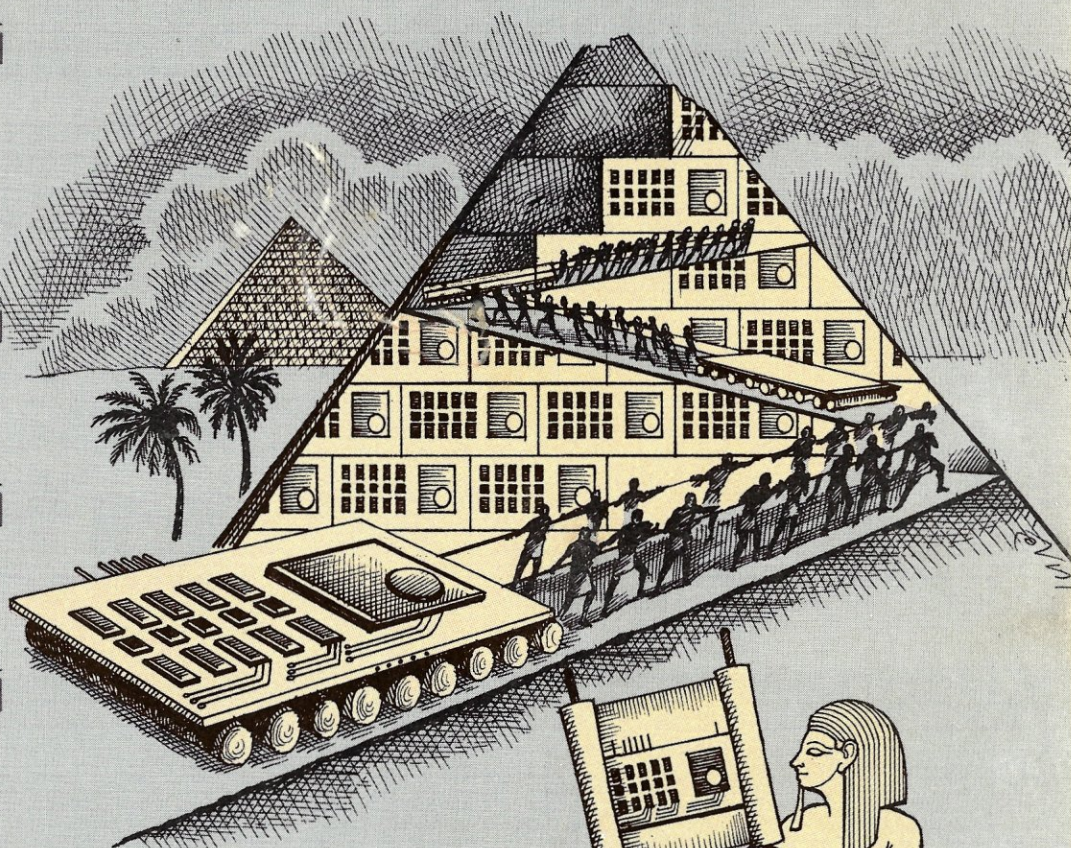
A Preprocessor in C for  
Basic

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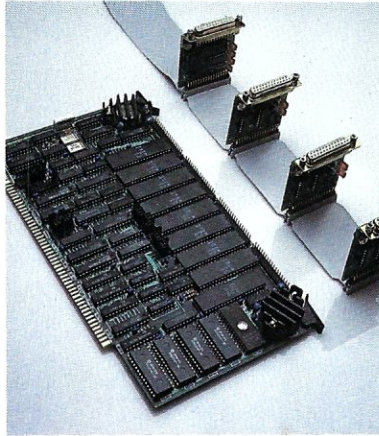


**S-100—foundation  
of the industry and  
still at the top of  
the pyramid!**





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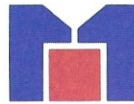
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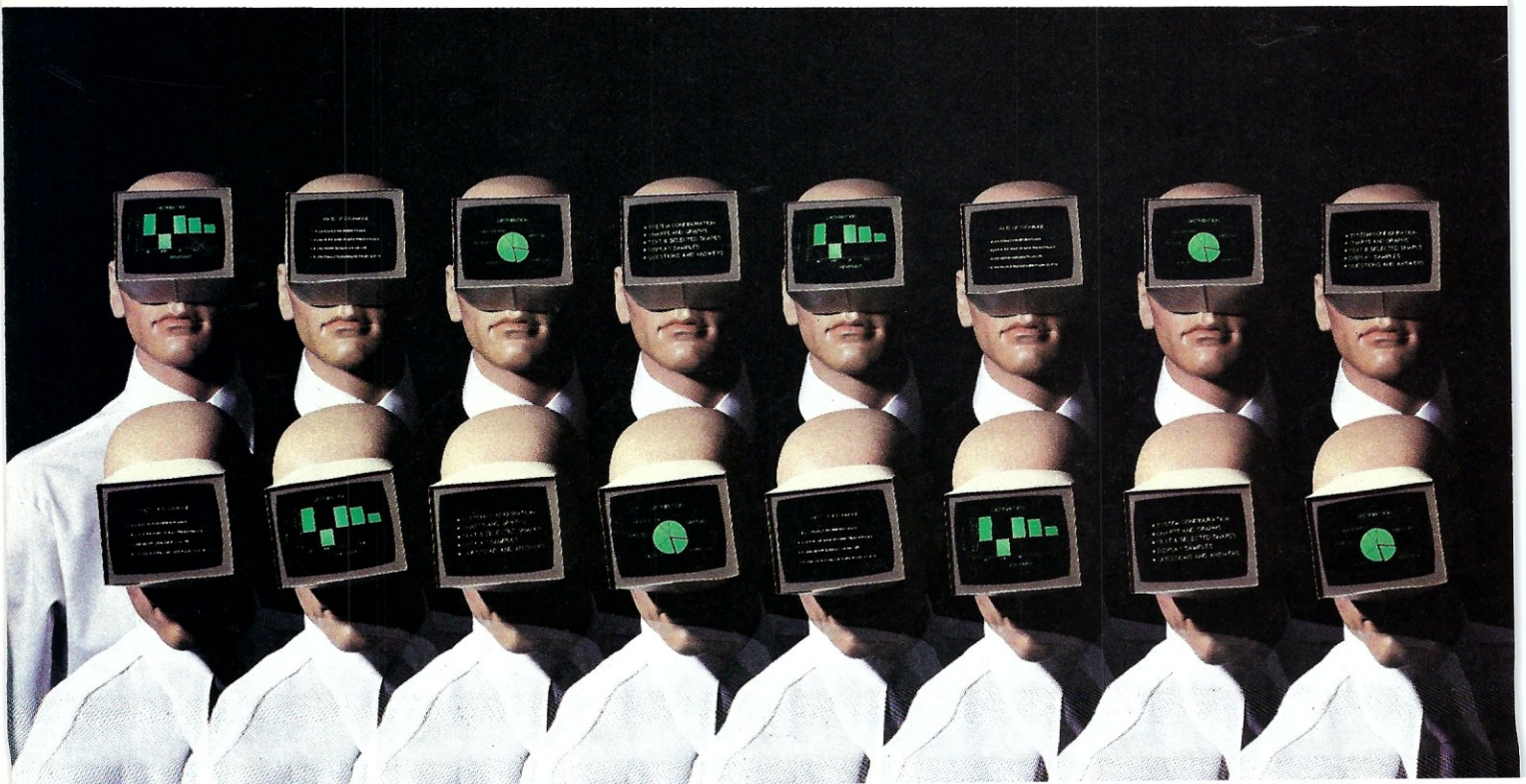
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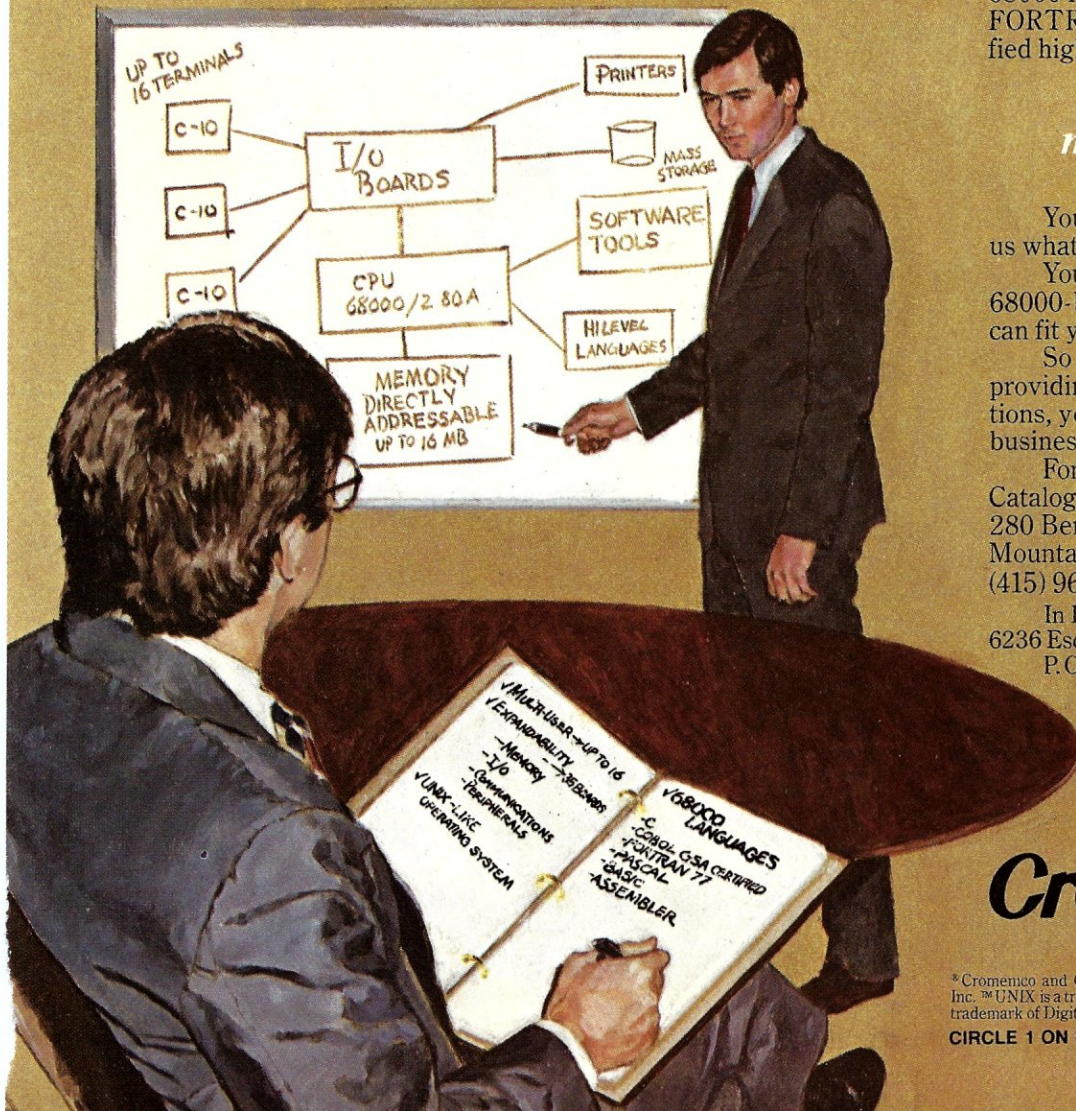
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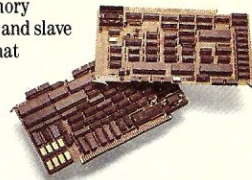
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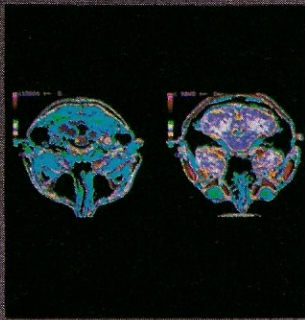


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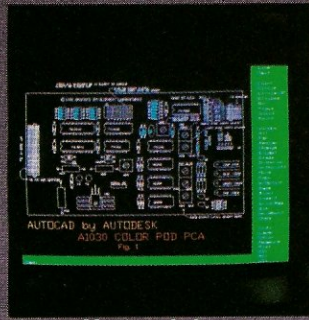


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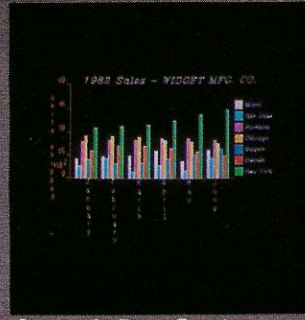
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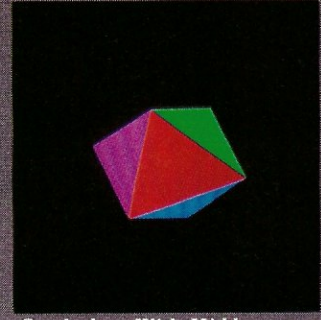
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J. Libove, Dual Systems



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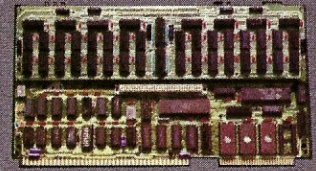


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S100/696 A1000



Multibus A1000

## Graphics Development Laboratories

has finally made high performance color graphics affordable. These S100/696 and Multibus compatible boards are currently at work in such diverse areas as Medicine, CAD, Education, Science, and Stock Market Analysis. And it's easy to see why, with their on-board 16-bit 8088 processor and extensive firmware, they act as intelligent graphics sub-systems, relieving the host of time intensive graphics processing, thus maximizing system throughput. Display memory is completely isolated from the host's bus and all communications occur through I/O ports. This simple interface and the high level commands allow for quick integration into any S100 or Multibus system.

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The A-1000 command set not only includes pixel and vector draws but also **Polygon Area Fills, 2D rotation, scaling, clipping, dither fills, terminal emulate mode, stroke and raster character sets, circles, windowing and viewporting.** A Microsoft compatible subroutine library and C driver are included with every A-1000, at no extra cost. A **PLOT 10** driver and **GIOS** driver for **GSX** are available.

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### PBG100

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### UGRAF

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GDL offers generous discounts to OEM's starting in small quantities. So whether you are a small systems integrator or large OEM, you will find our pricing attractive.

To find out more about the A-1000, call or write. **Dealer inquiries welcome.**

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TELETEK provides the system integrator, the OEM or the end-user, the most complete line of fast and efficient S-100 board products offered by any manufacturer dedicated to board level production.

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# TELETEK S-100 BUS

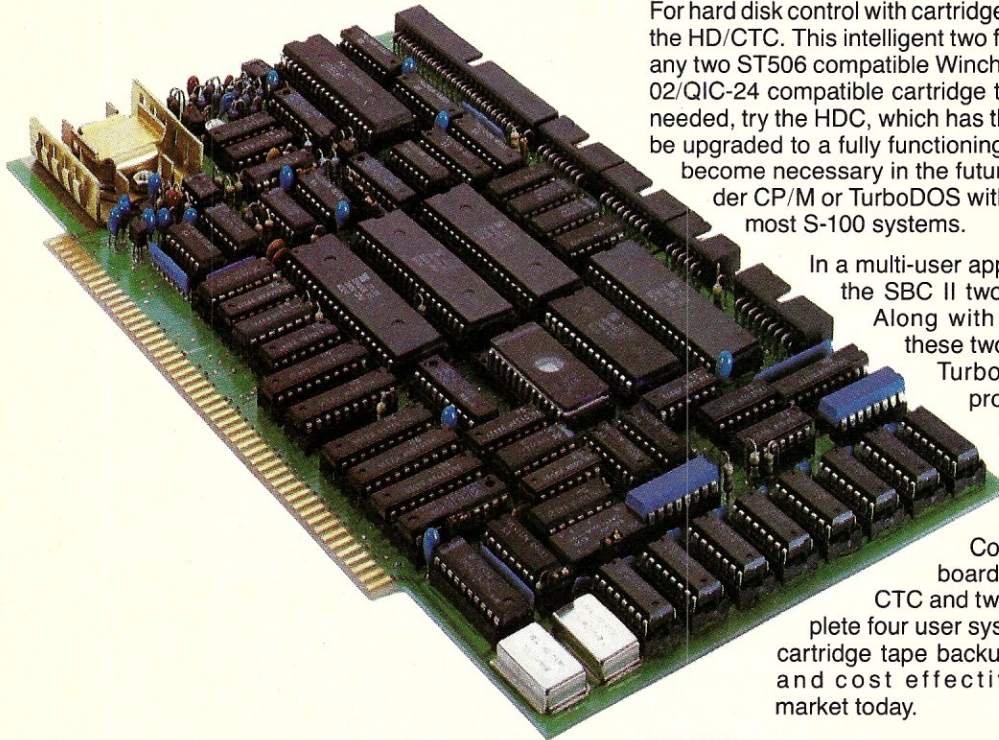
cost disk emulator will dramatically increase the speed of disk-intensive application programs.

For hard disk control with cartridge tape backup, TELETEK offers the HD/CTC. This intelligent two function controller will interface any two ST506 compatible Winchester disk drives and any QIC-02/QIC-24 compatible cartridge tape drive. If tape backup is not needed, try the HDC, which has the added advantage that it can be upgraded to a fully functioning HD/CTC should tape backup become necessary in the future. Both controllers will run under CP/M or TurboDOS without hardware modifications in most S-100 systems.

In a multi-user application, TELETEK has added the SBC II two-user slave board to the line.

Along with its predecessor, the SBC I, these two boards can be combined in a TurboDOS 1.3 based system and provide 128K of bank switched RAM, 4MHz or 6MHz clock speed and 2K FIFO buffering for quick block data transfers.

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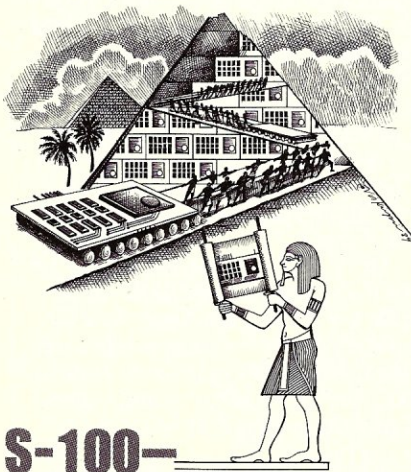
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# Microsystems

## May

Volume 5/Number 5  
May 1984



**S-100—**  
foundation of the industry and still at  
the top of the pyramid!

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by Randy Reitz

The CompuFone offers a wide range of possibilities: voice storage and forward systems, CAI, remote data entry, phone patches, and a host of other applications

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by Sol Libes

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by Joseph W. Long

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by Joseph Katz

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by Robert A. Langevin

C/NIX contributes UNIX-like features to CP/M-80 and provides the user with a practical introduction to the everyday world of UNIX

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by John G. Wilson

How a Canadian University—using off-the-shelf 8-bit hardware—created a shared disk system and cured computer congestion

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### Down With Line Numbers

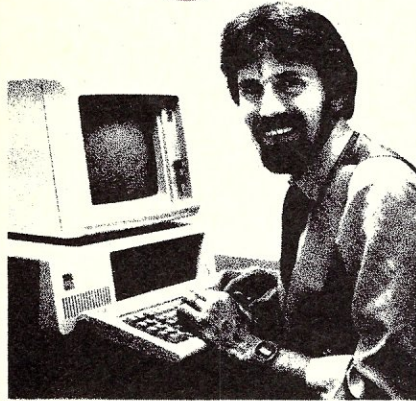
by James L. Shearer

A preprocessor, written in C, that demonstrates the utility of C and allows writing in Basic to be more structured

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# Editor's Page



**The  
microcomputer  
market:  
where it's  
going and  
where we  
fit in**

by Mark Rollins

**F**rom its inception in 1980, *Microsystems* has truly been the Journal of Advanced Microcomputing. Sol Libes, the founder, Chris Terry, the technical editor, and all the staff and writers have continually maintained the highest standards in presenting you, the readership, with the most current information on leading edge state-of-the-art microcomputer hardware and software.

Sol has retired as the active editor of *Microsystems* to pursue other career interests. He will, however, maintain his association with *Microsystems* in his new position as editorial director, and will continue to write the monthly News & Views column. It has been a rewarding experience for all to have benefited from Sol's knowledge, talents, and friendliness. We wish Sol the best in his other pursuits, and are happy that we will not lose his presence at *Microsystems*. With my recent appointment as editor, I intend to continue the same high standards to keep the magazine, and you, at the forefront of the rapidly advancing microcomputer technology.

Our feeling is that the 8-bit, CP/M-based technology is now relatively mature; hence, we can expect little change in this area in the future. The industry is moving toward 16-bit machines, a market dominated by the IBM PC and its look-alikes. This area is still changing and will probably not reach maturity for another two or three years; hence we are devoting more attention to these machines and their software.

On the other hand, S-100 systems using both 8-bit and 16-bit technology still provide powerful applications for the systems integrator. We are not abandoning S-100 and CP/M-users; we are simply enlarging our scope.

The most rapid changes in the microcomputing industry are occurring in networking, multiuser, multitasking, and graphics systems. Costs are dropping so fast in these areas that such systems are becoming commonplace.

The urgent need to have multiple systems communicate with each other is putting great pressure on systems integrators to learn networking technology. To complicate the issue, the technology itself is relatively immature and is being developed with some urgency by systems designers.

We expect the multitasking and multiuser fields to be dominated by the UNIX operating system. The built-in power of UNIX primitives and the rela-

tive portability of both applications and utility programs running under UNIX make it an especially attractive operating system. In anticipation of its growing importance and use, we have already greatly increased our coverage of UNIX, and will devote even more attention to it in the future.

We also see an explosion in the use of visual communications in various disciplines and in many segments of society. For the computer industry on the whole, that means graphics. For the micro industry in particular, it means even more powerful microprocessors, increased memory storage, faster transfer rates, and technological advances in display and output devices. This will allow more sophisticated high resolution and real-time interactive graphics, and we will begin to devote more attention to that area in future issues.

In addition, there's a term being bandied about that aptly describes the *Microsystems* readership: the systems developer. That individual is indeed the advanced microcomputer user: the systems designer, systems analyst, systems programmer, systems integrator. And, more and more, it includes another group: the individual who authorizes the purchase of the hardware and software resources for the systems developer. That person must increasingly understand the systems environment in greater depth.

The task for *Microsystems* can thus be stated simply: to provide the information the systems developer needs to get the job done. That means remaining on the forefront of the industry in order to both preview what is up and coming and provide greater understanding of existing systems.

A final note on upcoming issues of *Microsystems*. The theme topics for the remainder of the calendar year are:

June	Communications
July	Graphics
August	Networking & TurboDOS
September	Word processing
October	UNIX on micros
November	32-bit microprocessors
December	Software Directory

If you have an article or an idea for one, please feel free to send it to me or Chris Terry, or to call us. (The subject does not have to be one of the theme topics above.) We especially need articles having anything to do with MS-DOS and UNIX, and on graphics, networking, and nonstandard operating systems. Send the article or an outline to:

Mark Rollins, Editor  
*Microsystems*

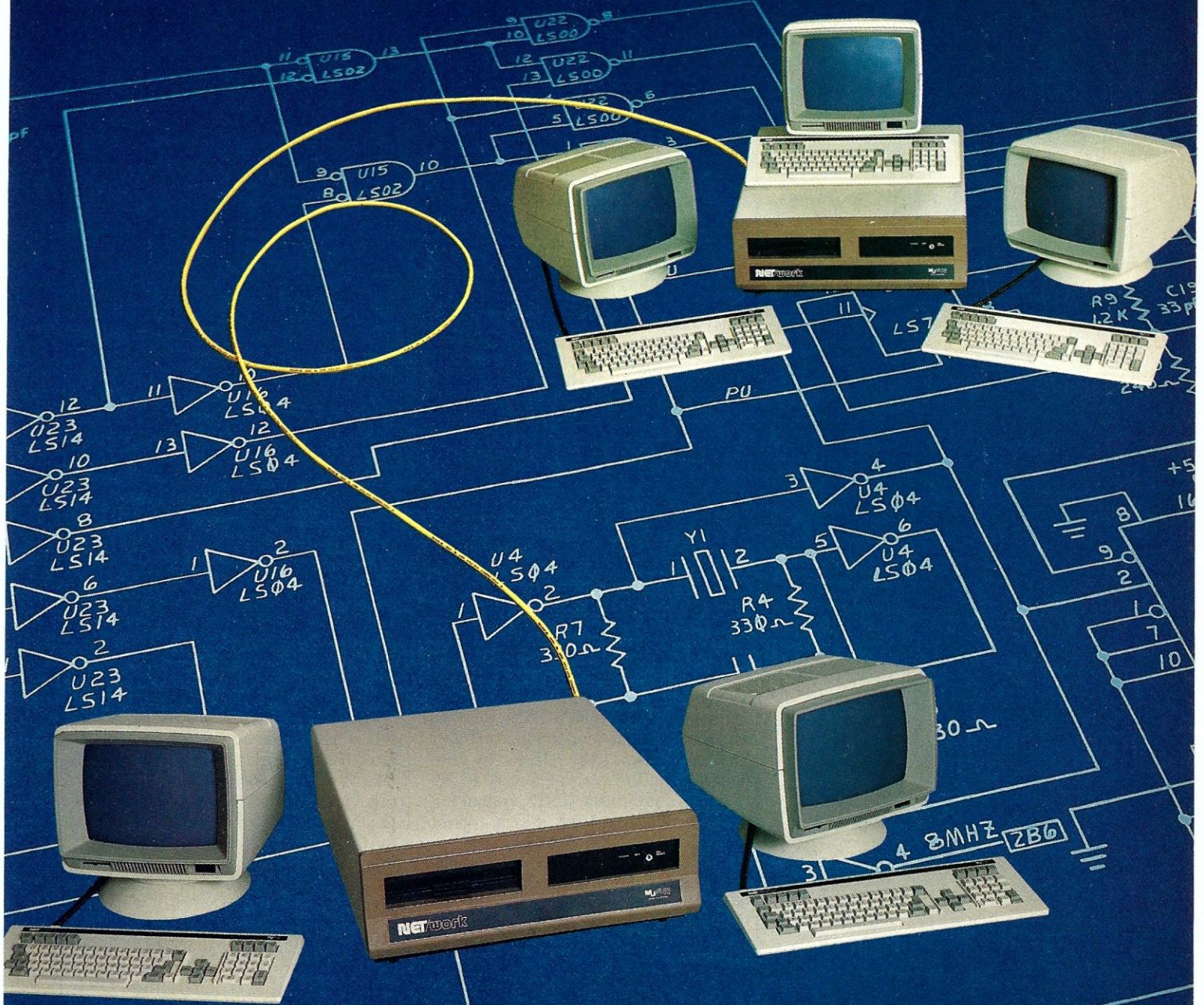
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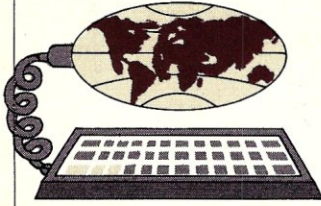
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# News & Views

**Random rumors  
and gossip,  
plus a view of  
the industry's  
latest trends**

by Sol Libes

**Z**ilog is not expected to sample their new Z800 and Z80000 microprocessor chips until late this year. The Z800 is a greatly enhanced version of the popular Z80 8-bit microprocessor, and the Z80000 is their new 32-bit microprocessor. The Z800 will have features such as memory management, hardware multiply/divide, etc. Details on both chips have appeared previously in this column. . . Digital Research is expected to augment their recent contract to port UNIX System V to the Intel iAPX family, with an agreement to add such productivity tools as graphics, additional languages, and a library of applications packages. . . Digital Research is also expected, this month, to announce between 10 and 16 consumer-oriented applications packages to run under their new Personal CP/M system. It is expected that these packages will be sold via mass merchandisers. . . Ashton-Tate has released a multiuser version of dBASE II to run under MP/M. Further, a new enhanced 16-bit version of dBASE II is expected shortly that will run under PC/MS-DOS, CP/M-86 and UNIX. . . CompuPro is rumored to have contracted for an implementation of multiuser UNIX to run on its new IEEE-696/S-100 system, using the National Semiconductor 16032 microprocessor, to be released by year-end. CompuPro is also expected to implement a multiuser UNIX system for the new System 8-16/F, which uses a 6 MHz Intel 80286 S-100/IEEE-696 CPU. The system is currently available with CP/M and MP/M and features a 40 MB hard disk, a 1.2 MB floppy, 1.5 MB M-Drive, 512K of 16-bit-wide memory, 12 serial ports, one parallel port and one Centronics port for under \$15,000. . . IBM is rumored to be donating several National Semiconductor 16032-based microcomputers to the University of California at Berkeley for a UNIX development project.

## **ISSCC features papers on new IC devices**

The International Solid State Circuits Conference, held in San Francisco in February, saw papers presented on many new IC devices currently in development. Fujitsu, Hitachi and NEC presented papers describing their new 1-megabit dynamic RAM chips. The NEC chip is organized as 128K × 8.

Stanford University, the University of California at Berkeley, and Digital Equipment Corporation presented pa-

pers on new 32-bit microprocessors. The SU device is a pipelined NMOS device. The Berkeley device featured a reduced instruction set. DEC described a CMOS 5-chip set that implemented the complete VAX instruction set.

Papers were also presented on new image sensors, GaAs circuits, data acquisition circuits, high-speed analog circuits, data processing circuits, dedicated signal processors, nonvolatile memories, and many other devices.

## **IBM announces UNIX for PC**

As previously rumored in this column, IBM has introduced a UNIX operating system for the PC-XT. But the big surprise is that IBM did not go with Microsoft's XENIX. Rather, IBM has chosen to have Interactive Systems Corp., Santa Monica CA, transport their implementation of UNIX for VAX machines to the PC. The operating system will be called "Personal Computer Interactive Executive" or "PC/IX." PC/IX, which costs \$900, is a single-user implementation of UNIX System III, and most industry pundits are looking on it as a precursor of a multiuser version to be introduced for IBM's new 80286-based PC, mini and large mainframe computers.

## **DRI drops CP/M-86 Plus**

CP/M-86 Plus, a greatly enhanced version of CP/M-86, which Digital Research Inc. has had in beta testing for several months, will not be released for sale. The new version would have offered the features currently available in CP/M-80 Plus. Reports from the beta test sites were that this would have been the fastest single-testing DOS available for 8088/8086 systems, incorporating many system enhancements.

In dropping CP/M-86 Plus, after investing several man-years of work in it, DRI is conceding that CP/M-86 has achieved too limited a market to justify the expense of introducing and supporting the enhanced version. Rather, DRI will concentrate their efforts on the new windowing version of Concurrent CP/M-86 (CCP/M-86), which they demonstrated at the Comdex show last November and which should be released by the time you read this column. The new CCP/M-86 will also be capable of running all PC-DOS software that follows proper interfacing rules. It is expected that IBM will market this new version.

CP/M-80 Plus, for 8-bit machines, was released almost a year and a half ago by DRI and has met with very limited acceptance despite the extended features and speed enhancements it offers. Only a handful of OEMs have adopted it, most users being content to run the



# Gifford has a lock on multiuser CP/M<sup>®</sup> 8-16.

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# NEWS & VIEWS

Continued from page 10

old version 2.2 of CP/M-80, of which well over 2 million copies have been sold. DRI is also releasing a new version of CP/M-80, to be called "Personal CP/M," intended for very low-cost home computers using Z80 microprocessors. It is also expected that Zilog will soon release a new version of the Z80 microprocessor with most of the CP/M code ROMed in the microprocessor chip itself. CP/M-80 is expected to continue as a very popular micro-computer disk operating system for many years to come; it is likely to domi-

nate the 8-bit micro world.

## IBM sues two rivals on PC ROM copyright

IBM filed copyright infringement suits against Corona Data Systems and Handwell Corp., charging that they copied the software contained in the BIOS ROM of the IBM PC and used it in "look-alike" machines. The companies quickly reacted by agreeing to cease marketing machines using the chip. Handwell is a California importer of Taiwanese machines.

Apple Computer has set an industry precedent by filing suits against over 50 companies (most outside the U.S.),

charging similar copyright infringement. One case against the U.S. micro manufacturer, Franklin Computer, dragged on through the courts for over two years. Apple finally won the suit and Franklin agreed to cease producing the chips and pay Apple damages. However, there has been a flood of Apple II computer copies arriving from Taiwan, Korea, and Europe. The U.S. Customs Service has confiscated many of these machines, but many have gotten through. Thus it is very common to see Apple II clone computer kits being sold at computer hobbyist flea markets for about one third the list price of Apple's machine. It is likely that the same will happen with the IBM PC.

## Predictions

Industry prognosticators are predicting that IBM will make between 1.5 and 2 million IBM PCs this year. If they can do it, this will mean that by the end of this year there will be between 2.3 to 2.8 million IBM PCs in operation. Thus the number of IBM PCs will have exceeded the number of Apple II machines sold and will be approaching the number of Commodore C64 machines sold. Of course, in dollar terms IBM PC sales are almost equal to the combined sales of both the Apple II and C64.

## Public domain software news

P.J.'s Company, 1062 Taylor St., Vista, CA 92083 is now selling and renting the entire CPMUG and SIG/M public domain software libraries, as well as an MS-DOS library. The CPMUG and SIG/M libraries are furnished on "flippy" disks so that two volumes are placed on one disk (\$6/disk). The entire CPMUG library (92 volumes) may be rented for \$45, and the SIG/M library (148 volumes) rental is \$75. The MS-DOS library (100 volumes) rents for \$99.50. Add \$7.50 for shipping, handling and insurance). They also offer an automatic subscription service. Telephone is (619) 941-0925.

## UNIX news

Motorola has announced that it has completed its port of AT&T UNIX System V to the 68000 microprocessor and has submitted the product to Bell Labs for final acceptance testing; Motorola is the first semiconductor manufacturer to do so. Intel, National Semiconductor and Zilog have also signed agreements with AT&T to port UNIX System V, but have not as yet completed their ports. Intel has entered into an agreement with Digital Research for DRI to do the port to the 80286.

Thus, it is as though Motorola would have the whole microcomputer UNIX System V market to itself for this

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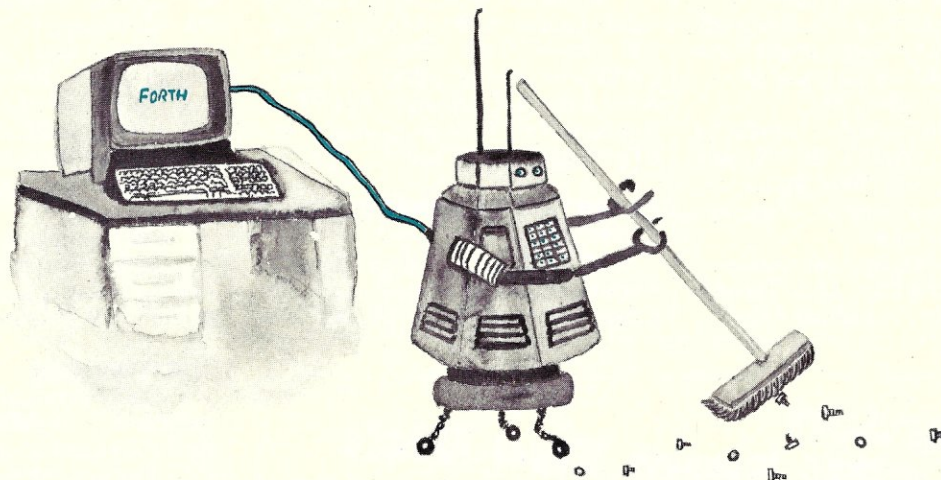
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**AUGUSTA**, Ada subset compiler from Computer Linguistics for Z-80 CP/M 2.2 systems, \$90.00

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## NEWS & VIEWS

Continued from page 12

entire year. Microsoft is continuing to push its XENIX implementation, containing many enhancements. Reportedly there are already more computer systems running XENIX than any other UNIX implementation. Also, Microsoft and National Semiconductor have announced that the XENIX operating system will soon be available for the National Semiconductor 16032 and 32032 microprocessors.

Microsoft is expected to release version 3.0 of XENIX this fall. The new version is expected to include a visual

shell with a multiplan-like user interface. Also, Microsoft is rumored to be actively working on an 80286 version of XENIX.

Readers in Australia may be interested in a new publication for Australian users of UNIX and C. Entitled *UNIX User*, it is published by *Structured Language Resources, Box 73, Mentone 3194, Victoria Australia; tel. 03-5838321 or 03-7638935.*

### Motorola and DRI announce software agreement

Motorola has announced that it has commissioned Digital Research to implement Concurrent CP/M, with win-

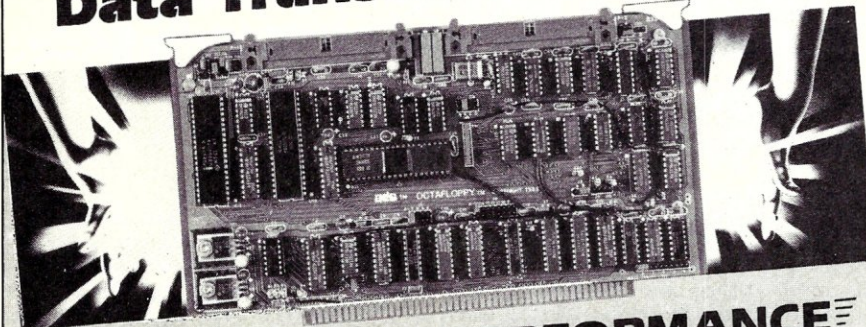
dows, on the 68000 and to implement its family of languages to run under Concurrent CP/M-68K and Motorola's new version of UNIX Version V. This arrangement is designed to allow software developers to easily port source code applications programs, developed using DRI's C, Pascal MT+, CBasic, Fortran 77, and PL/I languages, between the IBM PC running either PC-DOS or CP/M-86, and 68000-based systems running either CP/M-68K or UNIX Version V.

It is expected that the project will be complete by the end of the year and that the software packages will be sold by both Motorola and DRI.

### User group news

The *Morrow Owners Digest* is being published by the Morrow subgroup of the Valley Computer Club (Burbank, CA). For more information send a

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## Zilog's new Z80 chip will in- corporate CP/M in its ROM.

stamped self-addressed business-size envelope to: *Emma Paqui, 104 W. Wisteria, Arcadia CA 91006.*

Owners of the Epson HX-20 portable computer may be interested in a user group for the machine in England. They publish a newsletter. Write: *HX-20 Users Group, 25 Sawyers Lawn, Drayton Bridge Rd., Ealing, London W13.*

Carousel Microtools, Inc., is now publishing a newsletter (6 times a year) for owners of Carousel's Software Tools. The newsletter is furnished free for one year, after which there is a \$15/year fee. For information write: *Carousel Microtools, Inc., 609 Kearney St., El Cerrito, CA 94530.*

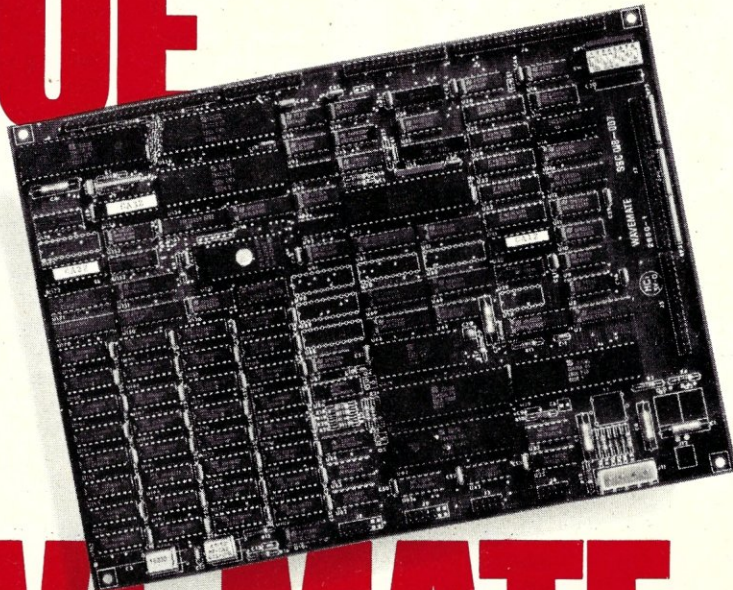
### Random News

DRI and Coleco have announced an agreement for Coleco to implement Personal CP/M, in ROM, for the Coleco Adam home computer. 

*Readers may contact me directly at Box 1192, Mountainside, NJ 07092. If a response is desired, enclose a stamped self-addressed envelope.—Sol Libes*



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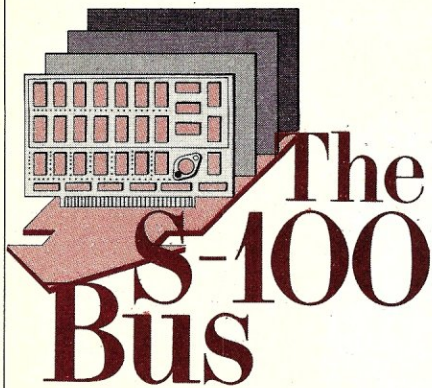
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CIRCLE 177 ON READER SERVICE CARD





# The S-100 Bus

**"Mix and match"  
problems in  
upgrading your  
system**

by Dave Hardy

**M**any of the letters I have received (in fact, more than half) are from S-100 users who are having trouble integrating "foreign" boards into their systems.

Most of the problems are caused by trying to install non-IEEE-696 compatible boards into a previously IEEE-696 system, or by trying to use new IEEE-696 compatible boards in an older frame. This month, I'd like to discuss some of these "gotchas" and cover some ways that you can avoid or correct them.

Over the last several years, I have had the misfortune of personally encountering every one of the problems about to be mentioned. Although the solutions seem obvious now (problems are always easy to understand after you've solved them), many of them were the result of a great deal of hair-pulling and many long hours of hard work (usually looking in the *wrong* place). Most of the "mix and match" problems fall into four categories: Heat and Power, Speed, Motherboard, and Bus Signals.

### Heat and power

Power supply problems are the easiest to find, although sometimes not the most obvious. The usual symptoms are blowing fuses, erratic operation, and excessive heat. For example, many frames are just not designed to deliver 10 amps of 8 volt power to a peripheral controller. So if you plug an old, power-hungry, cartridge disk drive and controller into your S-100 machine, the voltages will drop or the fuses will blow. In addition, something will probably get hotter than normal (usually the power supply), which will also cause trouble. The obvious solution is to avoid plugging devices that draw too much power into the S-100 frame. The manufacturer almost always provides information about how much power is required to run its particular device, so you can check the specs for exact power requirements. If your mainframe can't handle the load, then it should be replaced or modified, or an outboard power supply should be used to power the new peripheral device. A less ideal solution might be to provide more cooling to the frame and its power supply, but this usually works only if you are adding a very small load, or have access to a lot of liquid nitrogen.

### Speed

Speed problems arise from differences in the cycle speed of each of the

boards plugged into the S-100 bus. Obviously, you can't reliably run a 6 MHz 8085 board in a machine that uses 450 nS RAM boards, because the RAMs are just *too slow* to operate at 6 MHz. This incredibly obvious problem is often overlooked, however, because of "hidden" RAM and ROM in a machine. An almost classic case of this sort of problem is when a user upgrades his system from 2 MHz to 4 MHz by changing the CPU and RAM cards, but fails to consider the effect of the higher clock speed on the EPROMs that cold boot his machine. Also frequently overlooked in these cases is the effect that increased clock speed will have on any software timing loops used in the operating system and its application programs. Typical symptoms in these cases might be erratic disk read/write operations, slow response to system or peripheral interrupts, frequent "unaccountable" system crashes, and peripherals like printers and card readers that don't operate the way that they used to.

### Motherboard

The third source of trouble often found in improperly upgraded systems is the S-100 motherboard. Actually just a backplane, S-100 motherboards come in two basic flavors: unterminated and terminated (see last month's "S-100 Bus"). Unterminated motherboards were used in all early S-100 machines like the Altair and IMSAI, and most early "homebrews," or "do it yourself" kits. Terminated motherboards are used in virtually all new IEEE-696 compatible S-100 frames.

Unterminated motherboards usually work OK at 2 MHz, but erratically at higher speeds. Any system that is intended to run at all should have active bus line terminators of the type specified in the IEEE-696 standard. If you are planning to upgrade your system, a terminated motherboard is the best first step, if you don't already have one.

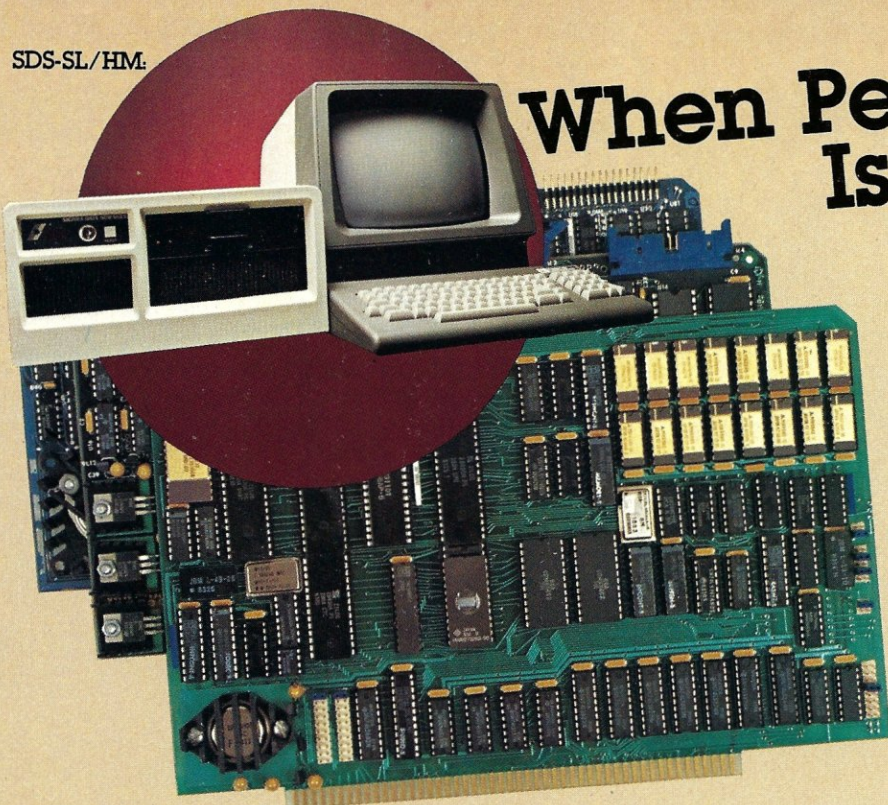
The symptoms of an improperly terminated motherboard are frequently vague, but generally are: erratic operation of certain boards in a system depending on location (i.e., which slot they are plugged into), and system "hang-ups" while performing operations in certain boards on the S-100 bus. A good oscilloscope will help you isolate this sort of problem, but if you don't have one, this sort of problem can be difficult to find.

### Bus problems

Bus problems are among the most difficult to track down and solve. Some arise from nicks or solder bridges between traces. The open or short circuits that result can cause some weird symp-



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(Shown with Sierra's new 8MHZ Boards)

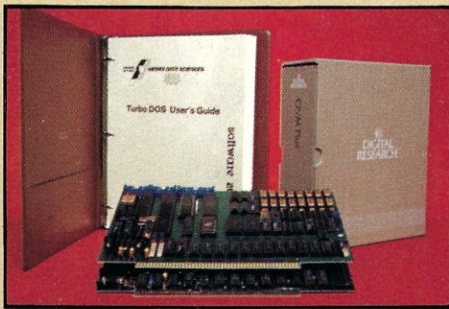
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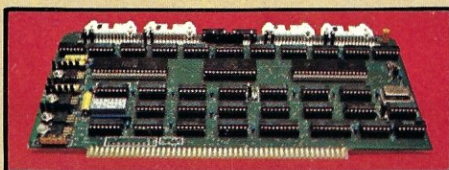
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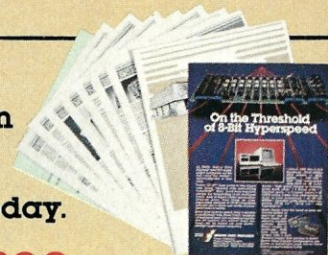


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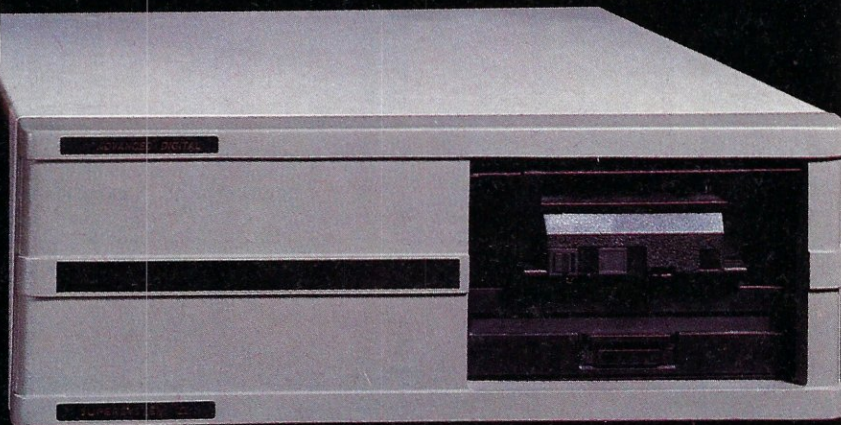
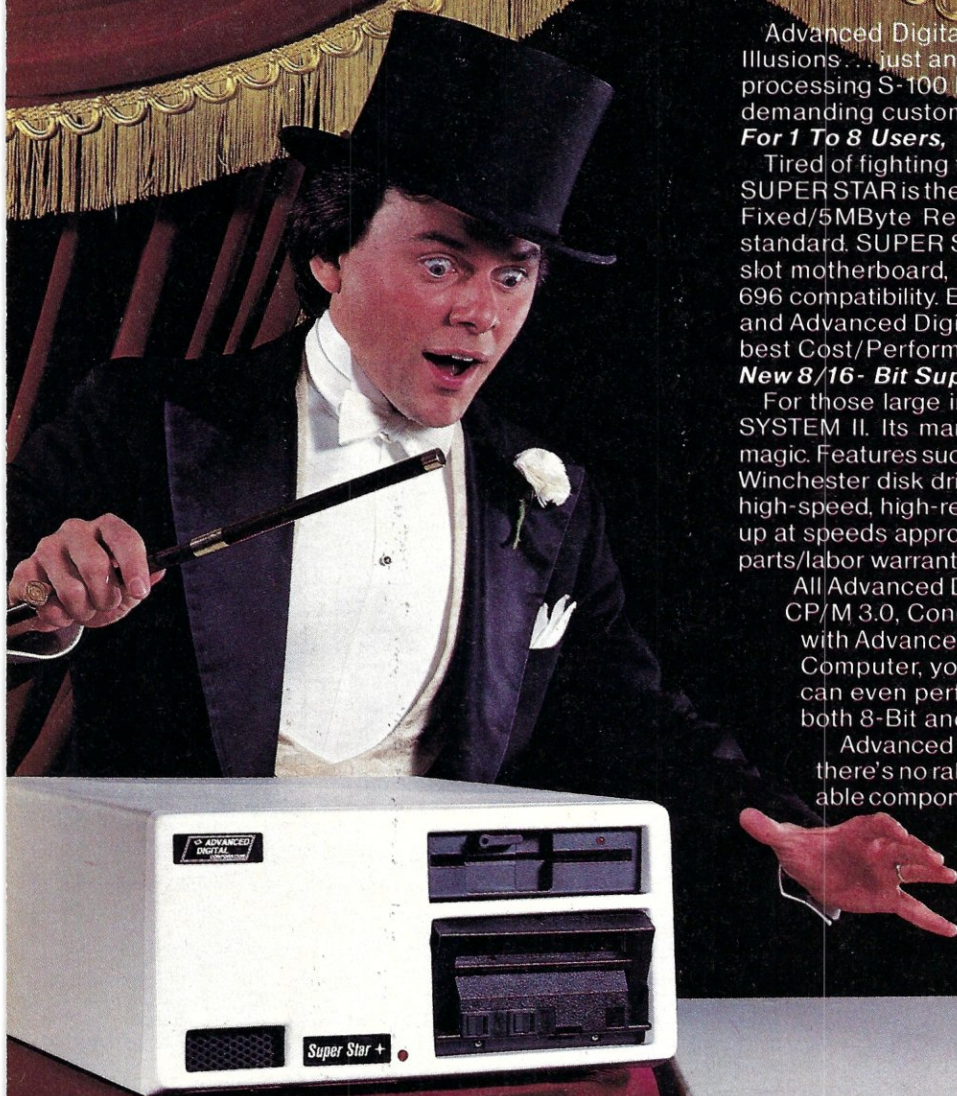
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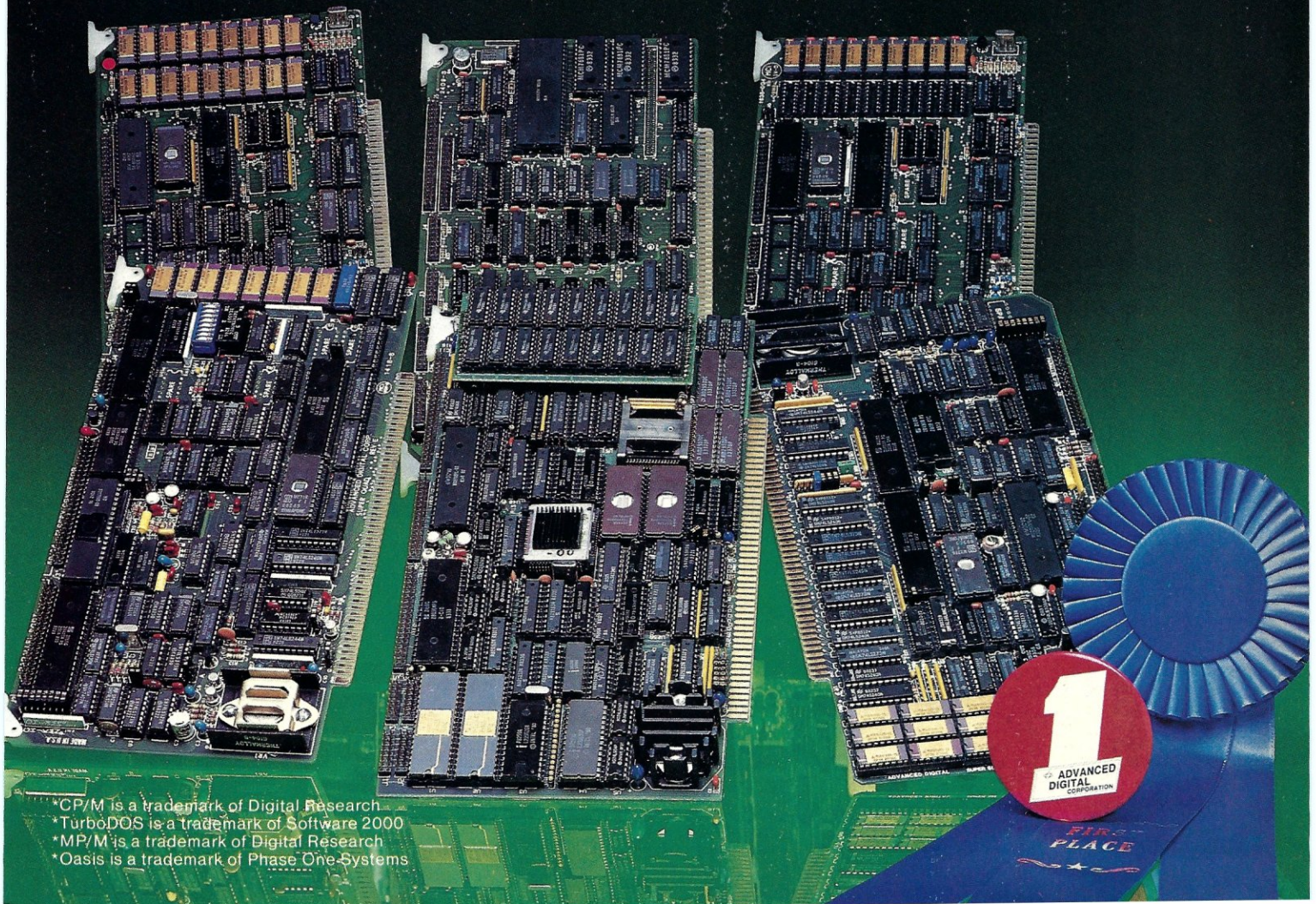
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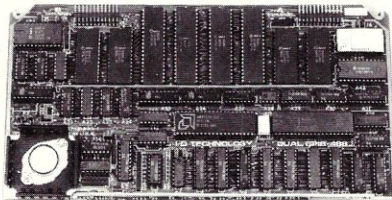
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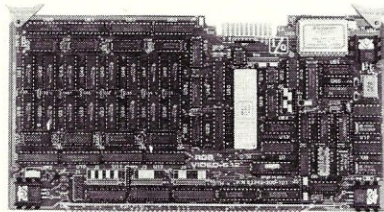
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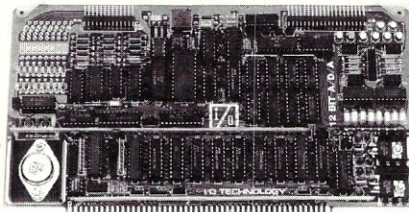
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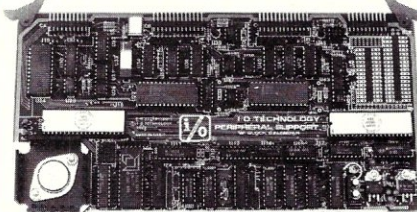
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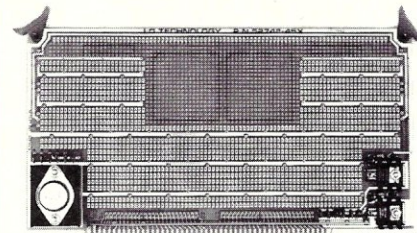
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## S-100 BUS

*Continued from page 16*

toms, not necessarily directly concerned with the defective board. Others, which are often worse, arise from incompatible signals on the S-100 bus. These are the kinds of trouble that professional systems integrators have nightmares about. There are so many that it would take several pages just to list them all. However, one of the most common offenders against IEEE-696 bus rules is the front panel. Four of the most frequent problems that arise from mixing front panels and IEEE-696 boards are described here.

**Multiple MWRT signals.** MWRT is the S-100 Memory Write strobe (pin 68). Without it, most system memory boards can't be written to, which means that the system will appear unable to boot, unless its OS is entirely in ROM. MWRT is generated from the sOUT and pWR\* signals of the S-100 bus, and so can be produced anywhere within the system. Most front panels produce MWRT. Unfortunately, most new CPU boards also produce MWRT, so you must be sure that MRWT is produced by only one board. The usual procedure is to generate MWRT on the CPU, unless the system has a front panel.

**Bus pins 20 and 70.** These pins were originally the Memory Unprotect and Memory Protect lines, before the IEEE-696 standard was adopted. Some manufacturers also used these lines to control other system functions like memory select and stall. In the IEEE-696 standard, both of these lines are connected to ground, which could cause some real problems if your system is expecting to see an active high signal on them to enable memory. Since many old front panels (most notably Altair) used pins 20 and 70 for memory protection, a ground signal (low) on either could cause the front panel to malfunction. Even the IMSAI front panel, which does not have any memory protection circuitry can be affected by these lines, depending on what previous modifications may have been performed on it.

**The sM1 signal.** sM1 (status Machine cycle 1) is the signal that the IEEE-696 bus uses to indicate when the master processor is fetching an instruction from the data bus. Commonly, it is used to simply indicate the start of each machine cycle. Many front panels were designed for use with an 8080 processor that outputs its status information on the data bus. Some of these front panels read sM1 from the data bus, and some read sM1 from bus pin 44 (the correct way). Erratic or missing front panel operations can sometimes be traced to this problem.

**Data bus reflection.** Some old front

## Speed problems arise from differences in the cycle speed of each of the boards plugged into the S-100 bus.

panels (at least the IMSAI) expect that the S-100 Data Out bus exactly duplicate the data carried on the Data In bus during a DEPOSIT operation. If you want to be able to use the front panel's DEPOSIT function, you may need to modify the CPU board so that it does not disable the Data Out bus during a read operation. This modification is required on all CompuPro CPU boards, as far as I know. CompuPro mentions this procedure but warns that it may increase the noise on the data bus and affect high-speed operation.

### Miscellaneous

**I/O port addressing.** When the 8080 processor does an IN or OUT operation, the I/O port address is placed on address lines A0-A7 and duplicated on address lines A8-A15. When the Z80 processor does an IN or OUT operation, it places the I/O port address out on A0-A7 and the contents of the A register on address lines A8-A15. Naturally, some ingenious designers of early S-100 equipment used the upper eight address lines (A8-A15) to obtain the I/O port address. This flaw is great fun to track down on many old S-100 boards which, when used with a Z80 for the first time, will try to perform I/O to whatever device is addressed by the contents of the accumulator! Other processors will produce equally strange results with this sort of I/O illness. Some Z80 CPU boards, like the Cromemco ZPU, were actually designed to mirror the lower eight address lines to the upper eight address lines during I/O operations to avoid this problem, but most were not. Needless to say, none of the 16-bit CPUs performs this feat. The IEEE-696 standard does not require address mirroring during I/O. This problem also exists in the IMSAI front pan-

el, and some others. The only solution to this problem is to hack up any boards that expect to see I/O addresses on the upper eight address bits and make them look at the lower eight bits instead.

### DMA problems

Early S-100 machines that use DMA allow for only one DMA device per system, so new IEEE-696 DMA devices that require bus arbitration probably won't work. The solution is either to add bus arbitration (i.e., remove the old DMA boards) or not to add IEEE-696 compatible DMA devices. Or, you may try to kludge a DMA arbitration circuit onto the old DMA device, which is usually impossible....

In addition, IEEE-696 DMA devices use bus pins 14, 55, 56, and 57 as their DMA control bus lines. In older S-100 machines, these lines have been defined as everything from bank-select to status-strobe to battery backup, so they should be investigated before adding any new DMA devices.

### pSTVAL\* problems

One other common "mix and match" headache that bears mentioning is a pSTVAL\* bus problem. pSTVAL\* (processor STATUS VALID, pin 25) is the IEEE-696 signal that replaced the old S-100 phase 1 clock signal. pSTVAL\* is an active low signal that, when gated with pSYNC, signifies that data on the address and status buses is valid. Although the old phase 1 clock signal is still valid as a pSTVAL\* signal, the following problem may arise when using pSTVAL\* to generate wait states: Many old S-100 boards used pin 25 as a simple inverted clock signal to start and stop a wait state generator. Unfortunately, with the new definition of pin 25, there may not be two negative edges during pSYNC to start and then stop a wait state generator. Instead, there might be only one. If this happens, the board will remain in a wait state forever. The symptoms of this problem, then, would be that the board would "go out to lunch" with the system whenever it executed a wait state. You can usually confirm this sort of problem by turning off all wait states on the suspected board (although this might not always work unless you lower the clock speed, too). The solution to this problem is to hack up the offending board and make it use an inverted clock signal (invert pin 24). □

*This column is intended as a forum on S-100 bus topics. Readers are encouraged to send in questions on the S-100 bus, which I will attempt to answer. Please write to: Dave Hardy, 736 Notre Dame, Grosse Pointe, MI 48203.*



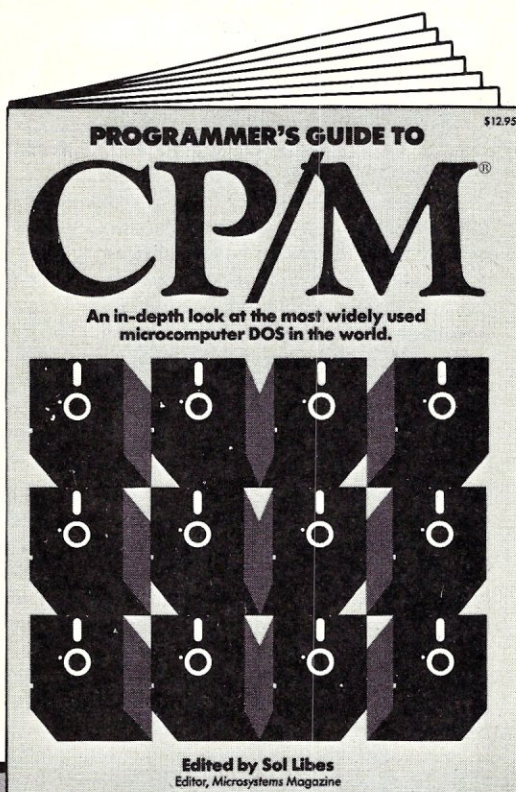
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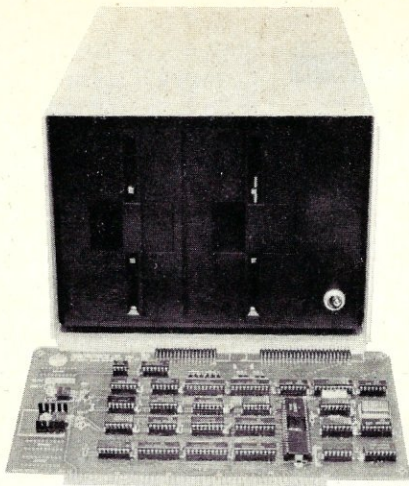
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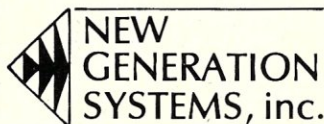
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## The PCjr finally arrives

by Hank Kee

**B**y the time this column goes to print, PCjrs will be available on dealer shelves for public sale. IBM's production goal is to deliver in excess of 900,000 units for 1984. The press has wondered if there would be sufficient corporate and home purchases to justify IBM's marketing projections. Only time will tell. Even with numbers like this, the preliminary industry forecast is still predicting a shortage of PCjrs for the year. Wouldn't all PC manufacturers like to have that kind of problem?

The relatively long incubation period from the time of announcement to general release has resulted in many erroneous conjectures about the capability of the PCjr. With each PC publication racing to outscop its competition, the press relied on IBM's promotional literature and internal product briefs rather than actual product tests. Getting access to PCjr review units has been like adopting one of the Cabbage Patch Kids. I've had a PCjr since late January, and I have been putting it through its paces.

### PCjr and PC-DOS 1.10

Originally it was noted that PC-DOS 2.1 was required for diskette operation of the PCjr. This is not absolutely true. The PCjr can run PC-DOS 1.10, which requires a smaller resident monitor. This is important, since RAM on the PCjr is presently limited to 128K. The only drawback is that 1.10 does not support some of the peripherals newly announced for the PCjr.

In addition to a gain in memory space, another major advantage of PC-DOS 1.10 is its ability to run LOTUS 1-2-3 version 1. This is an earlier release that is still available. The updated version, 1A, was implemented so that it would be usable on the IBM PC-XT, which requires PC-DOS 2.1. As a result, memory requirements went up to 192K. I had to dust off the archived files to find this particular version. I was not, however, able to properly load the LOTUS GRAPH option without modification. Otherwise the size of the available spreadsheet space was fairly decent at over 14K. Let's hope there will be a revised reintroduction of LOTUS version 1 for PC-DOS 1.10 on the PCjr. That's one step forward and two steps backwards.

A somewhat illogical thing about the PCjr is that it will not execute Basic or Basic A residing on the PC-DOS 2.1

diskette, even when the Basic cartridge for the PCjr has been inserted. Basic A or Basic only invokes the cartridge. The Basic cartridge costs \$75. This ROM cartridge actually extends your memory to about 192K. Basic does not penalize the user by occupying RAM space. If you try to call Basic A from the PC-DOS 2.1 diskette without the cartridge, the system will dutifully inform you that it is not permitted. It is, however, possible to use Basic A from the PC-DOS 1.10 version. This does not rely on the Basic cartridge.

### Gee whiz extensions

The Basic cartridge on the PCjr is an extended version of the diskette implementation. New functions and options have been added to the regular Basic. The major additions have been commands to access the hierarchical directories of PC-DOS 2.1. This makes it possible to access files across the various subdirectories within Basic. Terminal emulation has also been included on this cartridge. Not bad, considering the \$75 price. These extended Basic features will be reviewed more fully at a later time. The trend will be to offer valuable software on cartridges to decrease the chances of software piracy.

### PCjr and CP/M-86

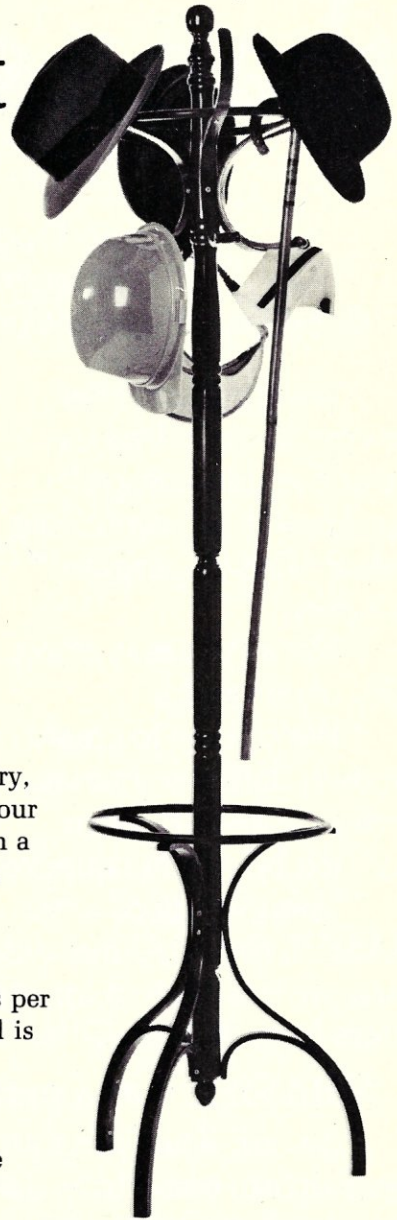
The PCjr can also run CP/M-86 version 1.0 as sold by the IBM Product Center for \$250. CP/M-86 version 1.1 with GSX, as sold by Digital Research for \$60, will not load properly. It does not properly sense the correct number of diskette drives in the system. With CP/M-86 1.0, the only problem seems to be the screen, which only displays 40 columns at system boot. There is no internal switch readily accessible as in the PC, to indicate a choice between 80 x 25 or 40 x 25 color. This is not an insurmountable problem. Use ED and DDT86 to create an escape sequence, and you then have yourself one fine little CP/M machine:

```
ED WIDTH80  invoke ED naming new
              file WIDTH80
I           ED command to insert
ABC        any three letters
[ESC]     [escape] to exit
           insert mode
E          exit ED and save file
           WIDTH80
DDT86     invoke DDT86
RWIDTH80  read file WIDTH80
SO        initial location to
           modify
1B        hex value of 'ESC'
61        hex value of 'a'
33        hex value of '3'
WWIDTH80  rewrite file WIDTH80
^C        control-C to exit
           DDT86
```

Use the command TYPE WIDTH80 to



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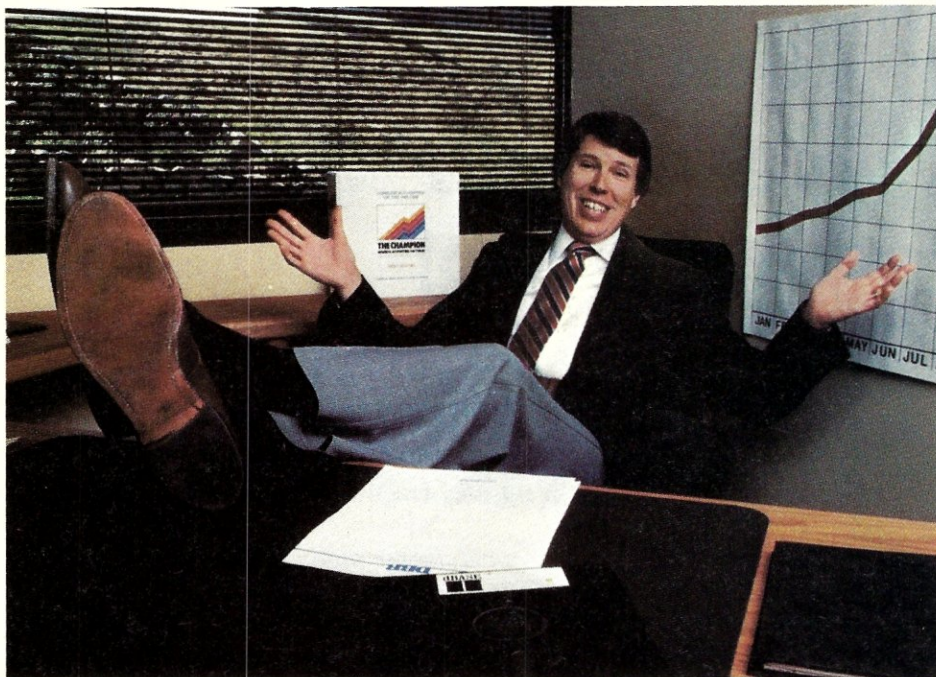
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## SIDELINES

Continued from page 22

switch to 80 x 25 screen. When the escape sequence "ESC a 7" is typed out, it switches the screen to 40 x 25. This programming tip was provided by Dennis Tillman, Technical Support Specialist at Digital Research.

The advantage of using CP/M-86 is that practically all related application programs were written with calls to the BIOS. Thus standard calls were used rather than direct mapping onto memory. If the program had its genesis in CP/M-80, use of overlays to keep within 64K will most certainly fit within the 128K limitation of the PCjr. Most commodity CP/M software running on the IBM PC will run on the PCjr. Very few commercial CP/M programs are hardware specific.

### PCjr and PC-DOS 2.1

Using the MODE 80 system command, you can easily put the PCjr system into 80-column mode. Once this has been accomplished, you will find that WordStar, Condor, Crosstalk and many other programs will have no difficulty running on the PCjr. Experiment with some of your favorites.

### PC-DOS 2.1

In a prior column, I presented an overview comparing PC-DOS 1.10 and

## Getting a PCjr review unit was like trying to adopt a Cabbage Patch Kid.

CP/M 2.2. They are, as I stated, similar and yet different. In PC-DOS 2.1, however, there is a vast departure from CP/M architecture.

PC-DOS 1.10 functions are a virtual subset of PC-DOS 2.1. The extended functions on an IBM PCjr make it a very powerful personal computing system. The Batch processing commands

have been extended. The additional internal subcommands are:

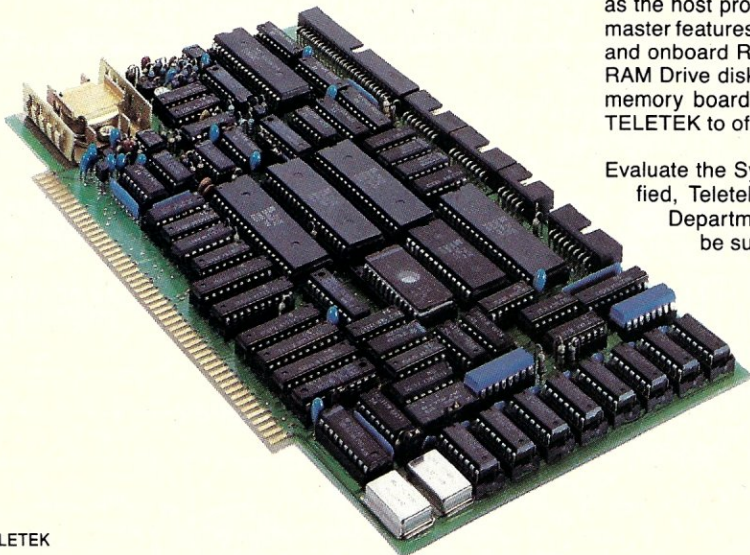
ECHO	inhibits screen display
FOR	interactive execution of commands
GOTO	transfers control to line following the label
IF	conditional execution of commands
SHIFT	allows command lines to make use of more than 10 replaceable parameters

The external command structure has been extended to include:

ASSIGN	uses a different drive from the one specified
BREAK	checks for a control break whenever a program requests a DOS operation
CHDIR	changes the current DOS directory
CLS	clears screen
MKDIR	creates a subdirectory
PATH	causes specified directories to be searched for commands
PRINT	prints a queue of data files on the printer

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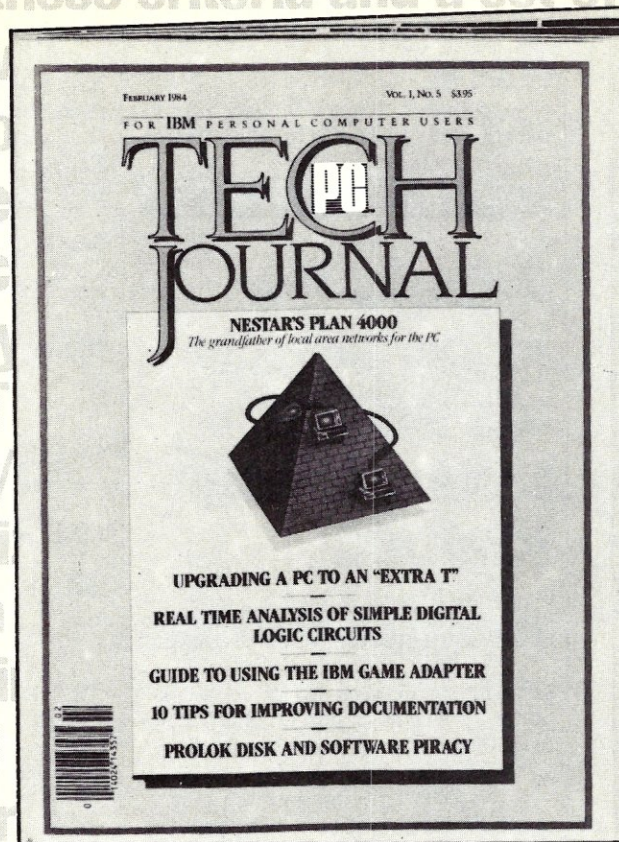
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## SIDELINES

Continued from page 27

**RECOVER** recovers a specific file that cannot be copied or otherwise used because of a defective spot on disk

**RMDIR**  
**TREE** removes a subdirectory displays all the directory paths

**VER** displays the DOS version number

**VERIFY** performs read after write on disk

**VOL** displays the volume label

If you wish to add or change the configuration, you can. Each time the DOS is started, it searches the root directory of the drive for a special configuration file called CONFIG.SYS. It reads this file (if found) and interprets the text commands to alter default values. The text control commands are:

**BREAK** sets ctrl-break (initially OFF)

**BUFFERS** allocates number of disk buffer from 1 to 99; the default value is 2

**DEVICE** specifies the name of a file containing a device driver

**FILES** allocates number of files that can be opened at one time; the default value is 8

**SHELL** specifies name of top-level command processor that DOS initialization will load in place of COMMAND.COM

PC-DOS 2.1 has input/output directional control. The standard input and output device redirection feature allows a program to receive its data from a source other than the keyboard or direct its output to a device other than the display. PC-DOS 2.1 also features piping, which allows the screen output of one program to be used as the keyboard input to another program.

Here is an example of piping and redirection:

```
DIR A: 123.*

Volume in drive A has no label
Directory of A:\

123  EXE   87269  1-18-83  3:13p
123  CNF    128  12-24-82  8:33a
123  HLP  176858  1-18-83  2:31p
      3 File(s)      0 bytes free
```

We would use the following com-

mand to sort the directory on file size and direct it to an external file:

```
DIR A: 123.* |SORT/+14>FILES
TYPE FILES

123  CNF    128  12-24-82  8:33a
123  EXE  87296  1-18-83  3:13p
123  HLP  176858  1-18-83  2:31p
Directory of A:\
      3 File(s)      0 bytes free
Volume in drive A has no label
```

These advanced commands have been added to the DOS:

**CTTY** changes to an auxiliary console (internal command)

**FIND** searches files for string of text

**MORE** displays a screenfull of data

**PROMPT** sets a new prompt (internal command)

**SET** inserts strings into the command processors environment (internal command)

**SORT** sorts text data

When PC-DOS 2.1 was announced and released, many assumed there would be a fixed disk capability for the

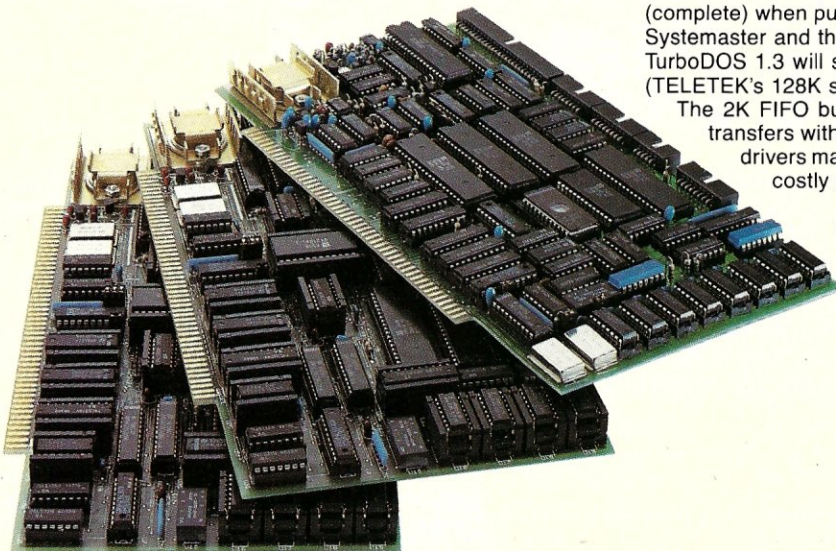
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## SIDELINES

Continued from page 29

PCjr, since these utilities are included on the distribution diskette. But so are Basic A and Basic. As previously stated, PC-DOS 2.1 is a replacement for PC-DOS 2.0. The following fixed disk commands, available under PC-DOS 2.1, are not used on the PCjr:

**BACKUP** backs up files from a fixed disk to diskettes  
**FDISK** initializes and configures a fixed disk  
**RESTORE** restores one or more files from diskettes to a fixed file

The user may also alter file attributes in the directory. But the mechanism to do this is not a part of the normal functions of the operating commands. From an overall point of view, PC-DOS 2.1 is pretty nifty, especially for a PCjr.

### Integrated systems

Lotus 1-2-3 and Context MBA have made substantial headway in offering multifunction software. Others are now making available added functions to their original product offering.

Microsoft has released Microsoft WORD, which is compatible with MultiPlan. SuperCalc 3 offers extended graphics to their spreadsheet system. And while all this is going on, OS suppliers are offering windows.

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**It would be better if vendors could standardize on an OS data format.**

---

According to Microsoft's file definitions, data integration can be achieved by windowing, or subdividing the screen into smaller windows. Each window can be "painted" with its own color

and can process a different task or program; also, data can be transferred between windows. Thus it is hoped that systems integration can be achieved via the OS—and outcome preferable to having a single package developer offer all functions to all people, with each function being state of the art. This is not a practical expectation from a package vendor.

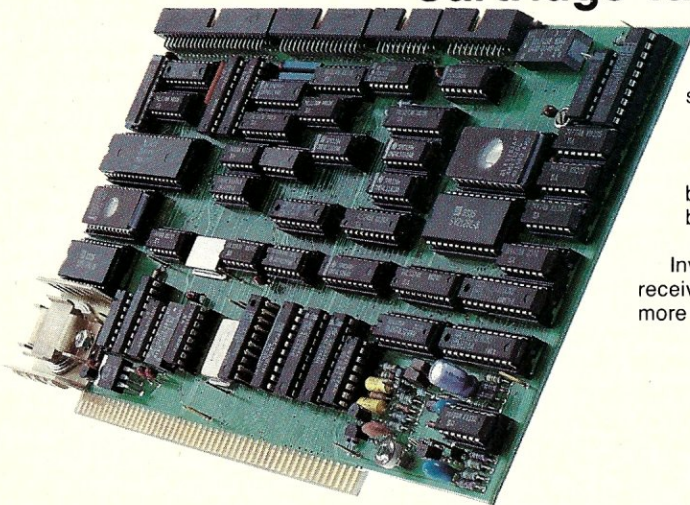
Digital Research has carried windowing a step further in their offering of Concurrent CP/M for the IBM. They are also offering MS-DOS emulation as a process available in one of the windows. All this development by DRI and Microsoft is very nice, but it is very difficult for the user to interchange data between operating systems.

It would be better if vendors could "standardize" on an operating system data format. Each offers unique functions and discrete formats that are incompatible with each other. An OS, by definition, demands that all software subsystems be able to have common formats for data files that can be accessed and/or shared. Perhaps Concurrent DOS, offered by DRI, is the answer. **D**

*Hank Kee, 42-24 Colden St., Flushing, NY 11355*

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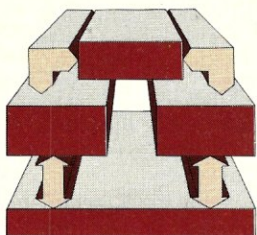
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# The UNIX File

Using the  
USENET network  
for information  
exchange;  
the shell as  
a programming  
language

by Ian F. Darwin

**B**y popular request, we start this month with some information on public domain software for the UNIX system. Then there's some information on "shell programming" again, and a new feature—the first of a series of efficiency tips for small UNIX systems. Plus a few UNIX product vendors who missed the deadline for listing in last month's software survey.

### In the public domain

In my column in the March 1983 issue of *Microsystems*, I wrote:

"Some people have claimed that there is more software available for CP/M than for UNIX. However, a lot of the public domain software for CP/M is just there to fill gaps in the system! The public domain software for UNIX consists of useful items such as a spreadsheet package, electronic mail interfaces, bibliography packages and so on.

"Most of the UNIX public domain software is written in higher-level languages such as C and is therefore movable from machine to machine, while a lot of the CP/M public domain programs are written for the 8080/Z80 machine and cannot readily be moved to the 16-bit machines."

A number of readers wrote in asking how they could get access from their small UNIX systems to this software. So here's looking at public domain software and UNIX.

The major source of public domain software for UNIX is UNIX itself. Last month I discussed the UNIX **uucp** and USENET networks. There are about 1500 machines (not counting single-user workstations) forming the USENET network for information exchange. One "newsgroup" (or classification of messages sent out on USENET) is called **net.sources**, and consists of the source code for new programs. It is here that a large amount of public domain software appears. Therefore, to get access to this software, you need only to get access to **net.sources**.

Simple, he says. What you must do, in fact, is to arrange locally with a larger computing center using UNIX to get access through them. Your access may be either as a **uucp** node or as a dumb terminal (no offense to your terminal). Your mode of access depends upon what software you have available on your system and on what arrangements you can make locally. In either case,

you should be able to send and receive mail at once, and receive news if you run UNIX or XENIX or a similar system that is generously endowed with disk storage. You shouldn't consider trying to run news unless you have about 10 megabytes of free disk storage to devote to it.

You'll have to keep the source around while you're setting it up, and you'll probably want to keep it around for bug fixes and updates. Basically, news is for sites with large reserves of hard disk storage.

The news software is itself in the public domain, and you normally get the source for it from either your news connection or from your system vendor. To install it yourself usually requires some knowledge of C programming.

I keep the source for a few public domain programs on my system. Presently these include **nro**, **tmodem** and **sc**. **nro** is Stephen Browning's version of the Software Tools text formatter. Written in C, it's a subset of the UNIX **nroff** program. It was written for CP/M, but I have it running under UNIX at present. **tmodem** is a UNIX version of the CP/M Christensen MODEM protocol. It runs on UNIX, and a CP/M system can dial in to upload or download files. In this sense, it is comparable to **xmodem**.

A simple spreadsheet program, **sc**, was written by James Gosling (of EMACS fame). If you want copies of any of these, send the request via electronic mail to my address, below. Sorry, no tapes or floppies; if you don't have UNIX, then you would not be able to use most of these programs anyway, since they depend upon the UNIX programming environment.

Another major source of public domain software is found in technical organisations such as the Software Tools User Group (see last month's column) and USENIX. The USENIX Association puts together several tapes of software each year; this often contains licensed source code, so it's available only to institutional members of the Association. Some of it, however, is not licensed and can be redistributed by the institutions that get it. In fact, there is a "no-license" version of the tape for institutional members without a UNIX license; this contains only publicly distributable material.

Last month's listing of UNIX software included several packages—Gary Perlman's statistics package and the Icon programming language—with the addresses you can contact to obtain them. More in future columns.

### More on the shell

In an earlier column I said I'd return to the use of the UNIX shell as a



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## THE UNIX FILE

*Continued from page 32*

programming language. Here are just a few tips, since a full treatise would never fit in this column. Bear in mind that my discussion is primarily for the standard “Bourne shell”; the Berkeley “C-shell” does many of the same things but in different ways.

Why do we even talk of the shell as a programming language? Most people

## A sophisticated shell feature is command substitution.

think of the shell as the program that reads and interprets commands, like CP/M's CCP. CP/M has a fixed set of commands in CCP, and you can add various “command programming” languages such as SUBMIT or SUPERSUB for looping and argument substitution.

With UNIX, the single “command language” or shell provides all these functions in a unified fashion. So unified, in fact, that you can type commands to perform a repetitive series of commands interactively, without having to edit a submit file and then submit it. CP/M and most other operating systems require these two separate steps. It's worth noting that with UNIX the command syntax is *exactly* the same whether commands are coming from the terminal or from a file of commands. To run a series of commands with filenames can, of course, be tedious. Let the shell expand some abbreviations, and make it do the repetitive typing.

```
for i in [a-k]*.c
do cc $i
done
```

This will run the C compiler (cc) for each file whose name begins with a letter from a through k and whose name ends in .c. The words **for**, **in**, **do** and **done** are shell keywords. Note that once you type the **for** statement during an interactive session, the shell recognizes that you are composing a multiline command and prompts with your continuation prompt (called PS2, normally “>”) for the remaining lines. The sequence is not actually executed until after you type **done**.

Another feature is command substitution. This allows you to use the output from one command as the operands to another. (Note that this is more sophisticated than sending the output from one command as the input to another command, for which the **pipe** mechanism is used.) Any command that can output a list of filenames is useful here. The normal

```
Grep mumble *
```

will look for the word “mumble” in all files in the current directory, and print all the lines of text that contain “mumble” with the name of the file in which each line occurred. However,

```
grep -l mumble *
```

will do the same looking, but will print only the names of the files (and only once per filename), not the actual lines containing “mumble.” And

```
pr 'grep -l mumble *' | lpr
```

will paginate all the files containing “mumble” and send them to the printer (lpr), all with one command. This is useful for listing all the programs that refer to a particular variable, or printing all the letters that talk about a particular deal or client.

A final example:

```
For i in 'grep -l mumble *'
do
    echo $i
    ed $i
done
```

This is very useful. See if you can figure out what it does (answer below)†. Just as we were going to press, I got to use the command substitution feature in a rather bizarre way. The asterisk key (“\*”) on my terminal broke. Rather than type all the filenames when I'd normally have used a “\*”, I used something like

```
pr `ls | grep "\.c"`
```

where I would have wanted to say

```
pr *.c
```

†The shell example given as an exercise above looks for “mumble” in all the files in your current directory, and puts you into the editor for each file found. This is often necessary when you need to make changes to all files containing a particular name or phrase, but when you can't guess what the changes are all going to be without looking into each file. And if the change is the same on all files? Watch for a later column to see how this can be automated.



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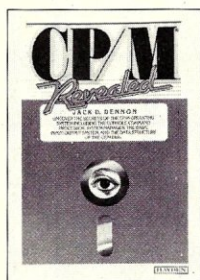
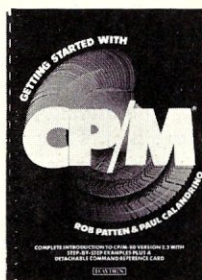
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## THE UNIX FILE

Continued from page 34

This is baroque (some would say bizarre), but I know of no other system that would have let me bypass such a glaring hardware failure so readily.

That's all the shell tips for now. If readers report that they're useful, I'll have more in future columns.

### Efficiency tip: use case instead of if/test

On many versions of UNIX, you can save some overhead by using the Bourne (standard) shell's **case** statement instead of the corresponding **if**

statement. For example, the following are logically equivalent:

```
if test $# -eq 0
then
    echo usage: $0 file
    exit 1
fi
and
case $# in
0) echo usage: $0 file
    exit 1
  ;;
+) ;;
esac
```

Both of these fragments of a shell file check to see that at least one argument (presumably the name of a file) has been given when the command file

was invoked. But the former will run faster, especially on a system with slow disks. Most UNIX versions implement the **test** command as a binary program, while **case** is handled inside the shell itself. (Look to see if you have a file called `/bin/test` on your system). The result? If you use **case** (where applicable) instead of **if**, your shell programs can run a lot faster. Another reason is that the latter is a much better programming language than the former.

Note that this particular efficiency tip applies only to the Bourne shell. The C-shell implements testing and many other functions inside the shell. But then again, C-shell is a much bigger program to load in from disk when you log in. On my system, the sizes are 29,804 bytes for `/bin/sh` and 61,460 for `/bin/csh`. This is one reason that many people who use **csh** for interactive programming still use **sh** for writing command files.

Note also that I don't want you to think that you need to spend a lot of time concentrating on "micro-efficiency" to use UNIX well. (Micro-efficiency is an undue concern for optimizing small pieces of code without concern for the overall performance or economics of the system.) Quite the contrary, UNIX lets you be productive by letting you escape from many small details. But there are a few ways to make substantial improvements in speed by minor changes in style, and this is what I'm describing under the heading of "efficiency tips."

### More vendors

I hope you recall that last month we ran a big listing of UNIX software. Naturally, information from a few vendors arrived just after the publication deadline. Here are some of them.

**Cadmus Computer Systems**, 600 Suffolk St., Lowell, MA 01854; phone (617) 453-2899; offers the "Cadmus 9000 computer system with UNIX System V and UNISON distributed environment." Contact David Schell at Cadmus for information.

**Precision Software, Ltd.**, 4 Park Terrace, Worchester Park, Surrey, England KT4 7JZ; phone John Green at 01-330-7166. They offer the "UNIGEN Electronic Manager," an office automation product. Their U.S. address is 820 2nd Avenue, Suite 1100, New York NY 10017; phone (212) 490-1825.

**Productivity Products International**, 37 High Rock Rd., Sandy Hook, CT 06482. Contact Andrew J. Iorio at (203) 426-1875 for information on the Objective-C compiler.

**Cybernetics, Inc.**, 8041 Newman Avenue, Suite 208, Huntington Beach, CA 92647 offers the RealWorld Busi-

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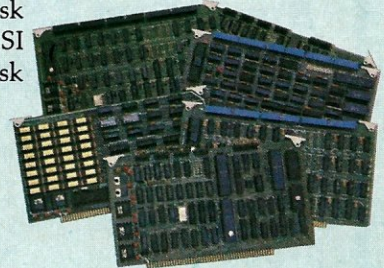
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# THE UNIX FILE

Continued from page 36

ness Software as well as something called "CRT!", a Cobol Reprogramming Tool. This product is described as "A Program Generator for RM/COBOL." I've never been fond of Cobol; if you had to use Cobol, I guess a program generator would free you from some of the tedium of coding those wonderful Cobol statements. Phone Cybernetics at (714) 848-1922 for more information. They have a demonstration kit version available for \$100.

I hope you found the "efficiency tips" helpful, as well as the rest of the column. If there are particular topics you want covered, please let me know. Until next month, keep those disks spinning! 

*The UNIX File looks at many aspects of the UNIX operating system. If you have comments or questions about UNIX or this column, feel free to write to Ian Darwin at Box 603, Station F, Toronto, Ontario, Canada M4Y 2L8. If you have UNIX mail access to the UUCP network, you can contact Mr. Darwin at "decvax!lutsstat!darwin!ian" or at "ihnp4!darwin!ian".*

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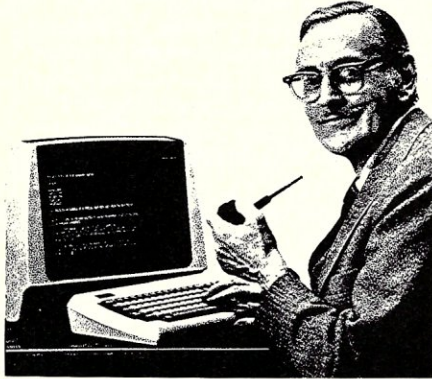
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# In the Public Domain



## Public domain software written in C

by Chris Terry

**T**his month I shall mainly be discussing public domain software written in C. The appearance of UNIX and its derivatives on a number of micros has stimu-

lated the publication of many books both on UNIX itself and on the C language, and an increasing number of micro users are trying out C and finding it to their liking. Thus, more and more programs in C are appearing in the public domain. The most prominent sources for these are the BDS C Users Group, the Software Tools Users Group, and some UNIX users reachable on USENET (refer to Ian Darwin's UNIX Software Directory, *Microsystems*, April 1984).

The BDS C Users Group has been in existence for some years now, and has issued a considerable number of volumes of public domain software. Some of these (such as TELNET, the telecommunications package) have appeared on the release disks of the BDS C compiler at various times. In the days when I was running a Processor Tech VDM-1 memory-mapped video board, I played for hours at a time with a program called LINES, which generated continuously changing patterns of lines and solid blocks much more interesting than anything in monochrome that the Cromemco Dazzler could produce—though of course the Dazzler could do far better in color.

### The BDSCUG library

As one might expect, the catalog of the BDSCUG library abounds in utilities specifically related to the CP/M-80 environment: directory displays, disk viewers, print utilities, and C functions for various purposes to supplement the standard library. Among the print utilities are two that I have found very useful: The first is LPR (in Volume CG5), which prints as many files as you can get on the command line and, when these have all been printed, prompts the user for additional files (one at a time). This program assumes 60 print lines on an 11" form, but is not difficult to modify for elite type. The second, PNUM (in the same volume), displays a file on the console with line numbers up to 999, but does no paging. It's useful for locating compiler or assembly error messages in the source.

Of much more importance are the editors, formatters, and text utilities. Among these are EDIT and ROFF (Volume CUG—"Just Like Mom's")

source code for a flexible and powerful editor and text formatter, with associated on-line help facilities and good documentation. For people who do a lot of writing, the Utilities I disk contains a series of programs that can be of great help. CONCORD, for example, scans on input file and produces an intermediate file that can be used for a number of other processors such as a word totaler, a word frequency counter, a line sorter, and, above all, a KWIC (Key Word In Context) index generator. Another word processor (WP) is to be found on the Utilities II disk; other than the fact that it is patterned after ROFF, I know nothing about it.

Utilities IV is another interesting disk, since it has the C source code for the SQUEEZE and UNSQUEEZE programs that I mentioned in my December column. While I'm on the subject of these programs, a problem has appeared. SQ15 and USQ15 cleared up some bugs that had occasionally plagued users of earlier versions, but the algorithm was not changed, and the files squeezed by that version could be unsqueezed by an earlier version.

Now, however, there appears to have been a major change in SQ/USQ19: I am still using SQ/USQ15 and have received (from different sources) two files compressed by SQ19 that could not be handled by USQ15. In each case processing aborted with the message "Write Error." This puzzled me since I knew my disks were OK, so I checked back with the senders. Both had used SQ19. This difficulty will no doubt be dealt with by the originators and RCPM sysops, but in the meantime you should be careful about what version of SQ/USQ you use when transmitting files to other people.

What I have discussed here is only a brief sample of the many programs available from the BDS C Users Group, and does not take into account volumes issued during the last six months, about which I don't have any information. If you are doing any programming in C, look into the 30 or more disks available from this Users Group; there are many programs that can be valuable to you even if you are using a compiler other than BDS.

Next month I shall discuss public domain software available for the IBM PC and MS-DOS. Addresses of the users groups mentioned here are:

*Sheila Henson*

**C Users Group**

*Box 287, 112 N. Main*

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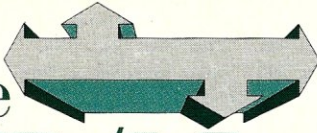
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# The CP/M BUS

More on Forth  
in the CP/M  
environment

by Randy Reitz

**C**ontinuing last month's discussion of Forth and CP/M, I now come to some of the problems raised by CP/M Plus. The CP/M Plus data structure is shown in Figure 1.

The DPB in CP/M Plus has been extended with two items over CP/M 2.x. These items can be used to determine the physical sector size. With all this information in the DPB, a gigantic Forth word can be written to decode the DPB data into four useful items. The **DECODE** word is shown in Listing 1.

This is a listing of one of the screens in the **DIRECT.BLK** file after modification for use with CP/M Plus. Line 0 is a comment. Line 1 starts the definition of **DECODE** using the **:** defining word. The stack comment indicates that one argument is expected—the address of the DPH. Line 2 picks up the contents of the first word of the DPH and saves it in the **XLT** variable. Line 3 adds 12 to the DPH and gets the contents of this address. This is the DPB address. The address is saved in the variable **DPB**. The DPH address has been replaced by the **@** word in line 3, and now the DPB address is on the stack. Line 4 uses the Forth **LENGTH** word to get the contents of the address on the stack and then bump the address by 2. This has the same immediate effect as the **@** word does, with the side effect of leaving the incremented address on the stack below the value just retrieved. The value in the first word of the DPB is the number of logical sectors (the 128-byte variety) per track (called **SPT** in CP/M documentation).

At this point you will begin to need a pencil and paper in order to keep track of the stack. The **SWAP** word at the end of line 4 flips the top two items on the stack; this brings the address of the DPB+2 to the top of the stack. Line 5 moves one more byte and then uses **COUNT** to get the byte contents of the address on the stack and increment the address. (You can see that **LENGTH** and **COUNT** are similar.) The value now on the stack is the block length mask item of the DPB. Adding one to the **BLM** will give the number of logical records per disk group. This value is the number of logical records that CP/M stuffs into each "unit" of disk space that it manages. CP/M simply numbers these units (groups) sequentially until the maximum available number is reached. This brings us to the next important item in the DPB. The **SWAP** at

the end of line 5 brings the DPB+4 address to the top.

Line 6 bumps the address to DPB+5 and uses **LENGTH** to get the value of the DSM. This is one less than the total number of groups allowed on the drive. Line 6 ends by adding 1 so the stack value will be the maximum number of groups. Line 7 rotates (**ROT**) the top three items of the stack by bringing the third item to the top. This puts the **BLM+1** value on top and the **DSM+1** value just below it. Next the **\*** word multiplies the top two items, replacing them with the product, which is the total capacity of the data area of the disk in terms of 128-byte records. Next, 2 **PICK** brings a copy of the **SPT** item to the top and **/MOD** divides the top two items, leaving the quotient on top and the remainder below. Line 8 **SWAPs** these two items, checks if the remainder is not zero with the **IF**, and, if there is a remainder, adds one to the quotient (doing, in effect, a ceiling operation). This quotient is the number of tracks in the data area of the disk. The formula is:

$$\text{Tracks in data area} = \text{ceiling} [ ((\text{DSM}+1) * (\text{BLM}+1)) / \text{SPT} ]$$

Line 9 **SWAPs** the top two items; this brings the DPB+7 address to the top. Six is added to get to DPB+13, where the number of system tracks is obtained with another **LENGTH** word. Another **SWAP** brings the DPB+15 address to the top. Adding 1 brings the address to DPB+16, where a **C@** replaces the address on the top of the stack with its byte value. This is the physical record mask (**PHM**), one of the new items added to the DPB in CP/M Plus. The **PHM** is one less than the number of 128-byte logical records per physical disk sector. Therefore 1 is added; this value is copied, multiplied by 128, and the product copied and saved in **B/SEC**—the number of bytes per physical sector.

In line 11, **B/BUF** is a Forth constant for the number of bytes per Forth screen. This value is 1024. The number of 128-byte records per physical sector is brought to the top with **SWAP** and divided into **B/BUF**. The quotient is the number of physical sectors per Forth screen and is saved in **SEC/BUF**.

Line 12 does a reverse rotation (**-ROT**) of the top three stack items. This puts the top item third on the stack, with items 3 and 2 moving up to 2 and 1. The top item moved down to third is the copy of **PHM+1** made by the first **DUP** in line 10. The items now on the top are the number of system tracks and the calculated number of tracks in the data area. These are added and saved in **TRK/DRV**, the total number of tracks on the disk. The DPB ad-



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# THE CP/M BUS

Continued from page 40

dress is no longer on the stack—it was used by the C@ word in line 10 to get the PHM.

In line 13, the PHM+1 is on the top of the stack and the SPT from line 4 is below it. The division of SPT by PHM+1 yields the number of physical sectors per track and is saved in SEC/TRK. The word DECODE thus computes the four parameters needed for Forth to do direct access. The access is accomplished by defining the following words, as shown in Listing 2.

Listing 2 defines words needed to select a drive (SET-DRV), select a sector (SET-SECTOR), select a track (SET-TRACK) and set up for the access of a desired Forth screen (sometimes called a buffer). The SET-IO word expects a "buffer header" address as its argument. The buffer header is a data structure used in the Forth 83 Model to hold relevant information about the current disk buffer. The contents of the first word of the buffer header is the desired Forth screen number. SET-IO simply converts the Forth screen number to a physical sector number by multiplying by SEC/BUF, the number of physical sectors per Forth screen. This value is then converted to physical track by dividing by SEC/TRK. The quotient is the track number; the remainder is the sector number within this track. The track number is checked against the maximum track for this drive. SET-TRACK and SET-SECTOR are then called to send these values to the BIOS. Notice that SET-SECTOR first translates the sector number to skew the sectors using the XLT table saved from the DPH. The TRANSLATE word is defined as:

```
: TRANSLATE BIOSPB 4 + ! 16
  DBIOS ;
```

if sector skewing is desired, or as

```
: TRANSLATE BIOSPB 4 + ! 0 16
  DBIOS + ;
```

if it is not desired. The sleight-of-hand shown above uses the sector translate table to determine if the sectors are numbered, starting with 0 or 1. The XLT table is used to skew sector number 0. If a 0 is returned, the disk has sector origin 0; if a 1 is returned, the disk has sector origin 1. The value returned is added to the sector desired to adjust for the origin. No skewing takes place. Other useful words are shown in Listing 3.

Listing 4 defines the words used to do the actual read and write. BLOCK-READ receives a buffer-header, uses

## Listing 1

```
0 \ DPB decoding 05Feb84rcr
1 : DECODE ( DPH -- )
2 DUP @ XLT !
3 12 + @ ( DPB ) DUP DPB !
4 LENGTH ( SPT ) SWAP
5 1+ COUNT ( BLM ) 1+ ( records/group ) SWAP
6 1+ LENGTH ( DSM ) 1+ ( groups/drive )
7 ROT * ( rec/driv in file area ) 2 PICK ( copy of SPT ) /MOD
8 SWAP IF 1+ THEN ( round up )
9 SWAP 6 + LENGTH ( OFF ) SWAP
10 1+ C@ ( PHM ) 1+ DUP 128 * DUP B/SEC !
11 B/BUF SWAP / SEC/BUF !
12 -ROT + TRK/DRV !
13 / SEC/TRK ! ;
14
15
```

## Listing 2

```
0 \ set drive, track and sector 05Feb84rcr
1 : SET-DRV ( S drive -- )
2 DUP DRIVE ! DPB @ 0= NOT BIOSPB 4 + ! 9 DBIOS
3 DUP 0= ABORT" Bad Drive" DECODE ;
4
4 : SET-SECTOR ( S sector -- )
6 DUP SECTOR ! XLT @ TRANSLATE SETSEC ;
7
8 : SET-TRACK ( S track -- )
9 DUP TRACK ! SETTRK ;
10
11 : SET-IO ( S buffer-header -- buf_adr rec/blk 0 )
12 DUP @ SEC/BUF @ * SEC/TRK @ /MOD
13 DUP TRK/DRV @ >= ABORT" Block out of range"
14 SET-TRACK SET-SECTOR
15 4 + @ ( buf_adr ) SEC/BUF @ 0 ;
```

## Listing 3

```
: SETTRK ( S track -- ) 10 DBIOS DROP ;
: SETSEC ( S sector -- ) 11 DBIOS DROP ;
: SETDMA ( S address -- ) 12 DBIOS DROP ;
: READ ( S -- error ) 0 13 DBIOS DISK-ERROR ! ;
: WRITE ( S -- error ) 0 14 DBIOS DISK-ERROR ! ;
```

## Listing 4

```
0 \ read write 03Feb84rcr
1 : +SECTOR ( S -- )
2 SECTOR @ 1+ DUP SEC/TRK @ =
3 IF DROP 0 TRACK @ 1+ DUP TRK/DRV @ =
4 IF DROP 0 DRIVE @ 1+ SET-DRV THEN
5 SET-TRACK THEN
6 SET-SECTOR ;
7
8 : BLOCK-READ ( S buffer-header -- )
9 SET-IO
10 DO DUP SETDMA B/SEC @ + READ +SECTOR LOOP DROP ;
11
12 : BLOCK-WRITE ( S buffer-header -- )
13 SET-IO
14 DO DUP SETDMA B/SEC @ + WRITE +SECTOR LOOP DROP ;
15
```

SET-IO to start a loop that runs for SEC/BUF times. Each time through the loop, the DMA address is set and a sector is read. The DMA address is bumped by B/SEC, and the next track/sector is set with +SECTOR. The final DROP throws away the last DMA address. BLOCK-WRITE is sim-

ilar to BLOCK-READ.

## Summary

I have shown some important differences between CP/M 2.x and CP/M Plus. These differences are due to the banked storage required to make effective use of CP/M Plus features, and the



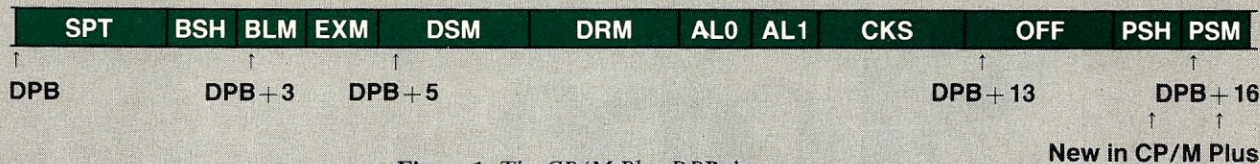


Figure 1. The CP/M Plus DPB data structure.

way CP/M Plus handles physical disk sectors. The Forth-83 implementation available in SIG/M Volume 154 is a good example of how these differences affect an application.

CP/M Plus provides BDOS function 50 for applications that require direct BIOS calls. Although the CP/M Plus documentation does not describe the action of BDOS function 50 when a data structure in bank 0 is returned, my empirical evidence shows that the BDOS makes a copy of the data structure and returns the address of this copy. This is the effect observed in requesting BIOS function 9 (select disk). The DPH address returned by BIOS function 9 is not the address returned by BDOS function 50 to the application. This is a key point for applications that need to examine the DPH for a drive.

The other key point concerning di-

rect BIOS calls under CP/M Plus is that disk I/O will be handled in units of physical sectors rather than the "usual" 128-byte logical sectors. The DPB in CP/M Plus has been augmented with two additional items at the end of the normal CP/M 2.x DPB. The first item is called the PSH, and specifies the physical record shift factor. In the Forth-83 application, I used the second item, called the PSM, which is the physical record mask. The PSM is one less than the number of 128-byte records per physical sector.

One final note, for anyone interested in Forth: whether you are just starting or are an experienced user, I recommend the Forth-83 Model available on SIG/M Volume 154. This model comes from Henry Laxen and Mike Perry, who deserve a big thanks for putting it in the public domain.

Vol. 154 can be ordered by addressing a request to:

**SIG/M Users Group, P.O. Box 97, Iselin, NJ 08830-0097.**

The cost for an 8" SSSD disk is \$5 (U.S.) per volume plus shipping; check or money order payable to SIG/M Users Group. Include \$1 for the first disk and 50¢ for each additional disk for shipping. Other disk formats are available. Current SIG/M information and selected volumes are available on these two RCPMs:

(201) 272-1874:

Hayes 212A/PPMI, Cranford, NJ;

(215) 398-1634:

Vadic 212A/PPMI, Allentown, PA.

(Note: Forth words are boldfaced in this article.)

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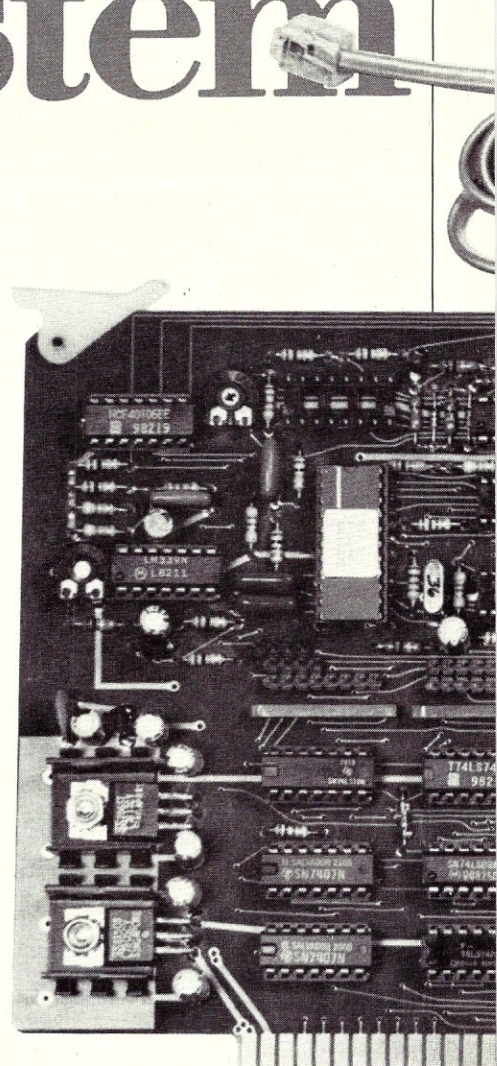
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---

# Store Speech and Music on Your System



**The CompuFone  
turns your system  
into an answering  
machine—or adds  
sound to your  
program**

---

**C**ompuFone, made by the Computalker products division of Compuvoice, Inc., is a new product combining several features that result in many possible voice technology applications. CompuFone is an S-100/IEEE-696 board that contains the following subsystems:

- An FCC-approved direct-conductor telephone interface.
- A Touch-Tone generator and decoder.
- A speech digitizer.
- An analog multiplexer that can select any of eight sources for connection to the speech digitizer/telephone line interface.

The direct-connect telephone interface is capable of recognizing tones on the telephone network such as dial tone, ringing and busy. The interface can pulse or Touch-Tone dial, allowing CompuFone to originate calls as well as answer them.

Touch-Tones can be generated at any time and can be sent to the telephone interface for transmission. Touch-Tones can also be received and

by Randy Reitz



decided to allow control of the program running the CompuFone.

The speech digitizer subsystem functions as a "solid state tape recorder" by allowing speech or other sound to be saved in either RAM or mass storage and reproduced on playback. The speech digitizer uses a hardware data compression technique to reduce the memory and mass storage space needed to record messages. This data compression technique achieves a 5-to-1 compression over an A/D converter. This allows acceptable quality speech to be recorded and played back at a rate as low as 1.25K per second. This kind of compression makes the storage of messages on floppy disk feasible. A total of five sampling rates are available, from 1.25 to 4K bytes per second.

Finally, the analog multiplexer allows any one of eight sources to be connected to the internal audio bus. The internal audio bus, which feeds both the telephone line and the speech digitizer, is buffered and is available at a connector (line-out pin) for attachment to an external amplifier and speaker. Seven of the lines connected to the multiplexer

are microphone, line-in, three aux lines, the Touch-Tone generator, and speech digitizer output. The analog multiplexer uses three bits of the base port to control the selection of input. The eighth choice is zero, which the documentation says is the telephone line. However, the telephone line is always connected to the internal audio bus. I believe this "selection" allows the telephone line to be connected to the audio bus without attenuation and without being mixed with any other source. I will say more about why I have to guess in the documentation section below. The aux lines are bidirectional paths to the internal audio bus. They allow multiple CompuFone boards to be connected together for call rerouting as well as other special applications.

### Hardware

The CompuFone is a high-quality board, fully socketed, solder masked, and has a gold-plated S-100 edge connector with all 100 pins. Options are selected with push-on jumpers. There is one user-adjustable potentiometer that controls the microphone gain. A 16-pin socket at the top of the board provides connections for all the audio lines and for synchronizing multiple CompuFone boards that can be used within a single system (each CompuFone board has a clock, but only one clock is used in a multiple-board configuration). The tele-

phone interface is mounted on the board and has a telephone wire with modular plug permanently attached to the board.

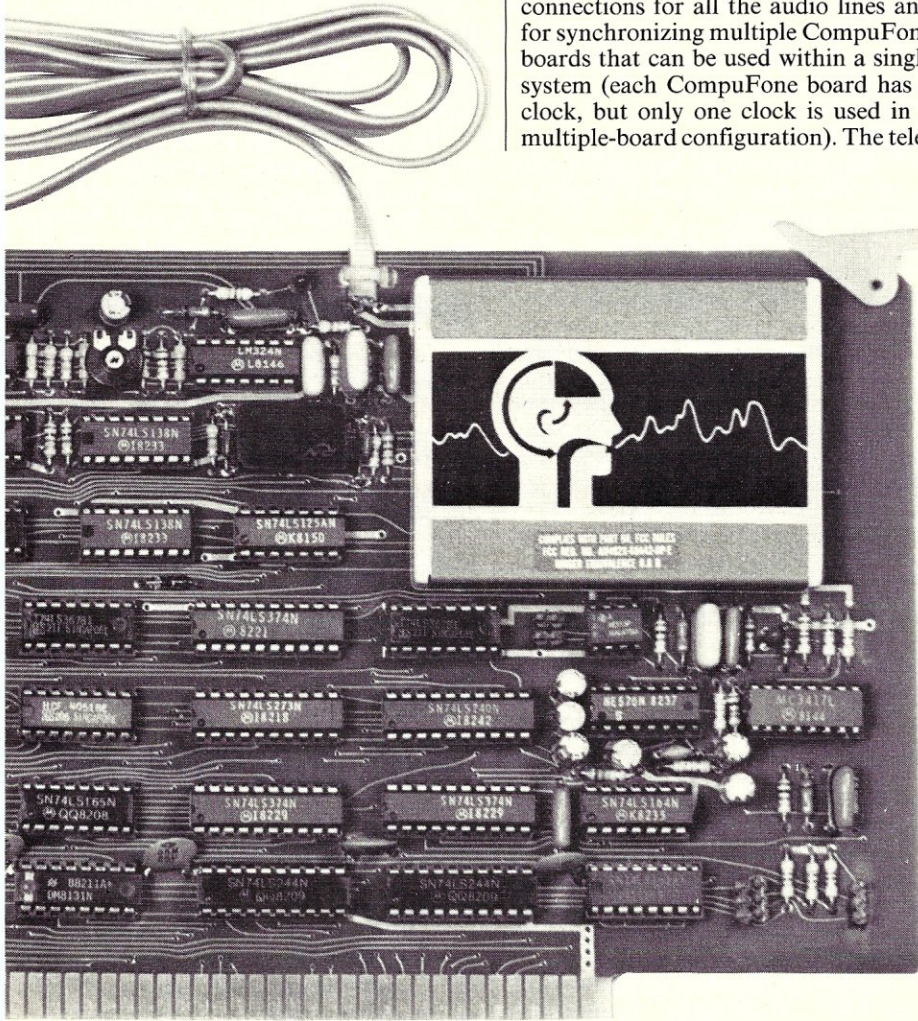
The CompuFone board occupies four consecutive I/O port addresses. Jumpers are provided that set the base address at any modulo 4 address in the

## CompuFone boards can be connected to reroute calls.

I/O space. The first (base) port output is used for analog multiplexer control, telephone interface on-hook/off-hook control and interrupt mask. The base port input provides status information that can be used to determine which of the three possible interrupts is active and provides status useful for detecting tones on the telephone network. The second port (base+1) is used to output a character to the Touch-Tone generator and read a Touch-Tone character when one is detected. The third port (base+2) is used to read and write a byte from/to the speech digitizer. The fourth port (base+3) is used in input mode only to reset the interrupt latches.

Installation is simple, since all the options are factory set to agree with the software provided. Assuming that four I/O addresses from 30 to 33 Hex are available in your system, the board can be simply plugged in and connected to the phone line. By far the hardest part of the installation is devising a way to connect audio cables to the header plug provided. A minimum of two audio cables are required, one for the mike and one for the external amplifier. A header with a ribbon cable attached is provided, but this just puts off the connection problem to the end of the ribbon cable. I chose to use the blank header plug and soldered three small shielded cables to the header (the third cable was used for the high-level line input). Once I had the cables connected to my amplifier and microphone, the demonstration software ran without a hitch.

The speech digitizer sampling rate is selected by plugging in one of the five headers supplied. In addition to setting the sampling rate, the header also optimizes the low-pass filters for the given rate. Consequently, the headers sup-





# COMPUFONE

*Continued from page 45*

plied have the CompuFone's serial number stamped on them and shouldn't be used on other CompuFone boards.

Headers are provided for rates of 1.25K, 2K, 2.5K, 3K and 4K bytes per second. The board comes with the 2.5K header installed, and I found this rate to be adequate for the experiments I performed. The higher sampling rate produces better speech quality, but at a cost

## The jumper options provide the flexibility for system integration.

of using up more disk storage space.

When the speech digitizer is running, it produces a byte of data (or requires a byte of data if it is reproducing speech) at a rate determined by the particular sampling header installed on the board. This requires that the speech digitizer port be serviced periodically—a requirement can easily be met by polling the port—but interrupts are a more efficient way to handle the data. The board provides full interrupt support; it can produce an interrupt using either the INT\* (S-100 pin 73) or one of the vectored lines VI0\* through VI7\* (pins 4 through 11). The board can handle the interrupt acknowledge (INTA—pin 96) request resulting from any one of these interrupt choices by generating a (jumper) selected RST instruction. Even if your system doesn't have an interrupt controller, you can use the interrupt features of the CompuFone.

Even though the speed demands of the speech digitizer can be handled by polling, interrupts are important in a practical system using the CompuFone. This is because eventually something must be done with all the data that the speech digitizer either produces or consumes. That is, a mass storage device of some type is needed for a practical message storage/playback system. Otherwise, message length is limited by the amount of available RAM. The CompuFone interrupts are necessary to be sure that no data servicing needs of

the digitizer are missed while I/O with the mass storage device is in progress. This means that whatever controller is being used for communicating with mass storage, the controller must coexist with interrupts.

Unfortunately, neither my North Star nor Versafloppy floppy disk controllers will tolerate interrupts. I was still able to use the CompuFone, however, since I have a "bubble disk" that will work fine with interrupts. The software I will describe later builds a simple telephone answering machine using the bubble disk for temporary message storage. Since the bubble disk is small (127K available for data storage), the software moves messages between the bubble disk and the other disks in my system. This is an important point, however. To make full use of the CompuFone, the host system must have a mass storage controller that can allow interrupts. RAM disks and DMA-type disk controllers (whether ported or memory mapped with sector buffering) should have no problem with interrupts.

The other interrupts the CompuFone can generate are for local ring detect and Touch-Tone detect. All the interrupts can be masked under software control, and the jumper options provide all the flexibility required to integrate into any system.

### Software

The CompuFone is supplied with an 8" SSSD disk of software (other formats are available).

The CFDEMO program quickly introduces all the features of the board and is used for CompuFone checkout. This program is menu driven, and provides selections for taking the telephone line off-hook and on-hook, recording speech from the telephone, microphone or line-in, and for playback of recorded speech. No interrupts or mass storage are used, and messages are saved in available RAM. With a 60K TPA, about 20 seconds of speech can be saved using the 2.5K per second header. Telephone numbers can be entered into CFDEMO so that the dial-out feature of the CompuFone can be demonstrated. While dialing and waiting for an answer, tones on the telephone line are displayed on the console (such as dial tone, ringing, busy). Finally, Touch-Tones are generated whenever a number key on the console is typed. If a telephone connection is active, an indication of any Touch-Tone on the telephone line appears on the terminal. The CFDEMO program is a good checkout for the board and effectively demonstrates its capabilities.

A CFDMOI program is the same functionally as CFDEMO with the ad-

dition of interrupts. This provides a stepping-stone approach to system integration.

The next steps are disk recording and playback. CFRECORD and CFSPEAK test this feature without interrupts. These programs use available RAM to record and then write the data on disk. For playback, the disk file is first read to RAM and then transferred to the CompuFone. As with CFDEMO, the length of messages is limited to available RAM. But these programs are valuable in providing one more step in system integration.

The RECDISK and SPKDISK programs use interrupts to record or play back messages to or from disk files. Messages are limited by the size of the disk space available. These programs are likely to require some modification before they will run. They quickly demonstrated several points about my system. First, since I am running CP/M Plus, the interrupt vectors must be present in *all* memory banks. After placing the interrupt vectors in all banks, I found that the interrupt service routines must be located in memory common to all banks. After fixing this, I found that disk controllers that don't allow interrupts really do cause problems with the CompuFone. However, I was able to successfully record and play back to my bubble disk.

All of the demonstration programs worked as advertised and were a big help in understanding system integration. Several prerecorded speech files are also provided that demonstrate the

## Touch-Tones are generated whenever a number key on the console is typed.

quality available with the various sampling rate headers supplied.

### Applications

But what about "useful" software? The uses for the CompuFone board are truly many. An automatic dialer with information solicitor and a sophisticat-



ed telephone message center are just two possibilities. An application note is provided in the documentation that discusses implications of automatic call placement. A program for either one would be a significant undertaking. It isn't feasible for Computalker to supply such an application, since it would likely require extensive customizing for each particular installation.

A compromise provided by Computalker is a module of subroutines that provide the basic functions the above applications need. The final piece of software provided on the disk is called the CompuFone Interface Module.

The CompuFone Interface Module provides 14 functions. The module is written in 8080 assembler and is intended to be included in whatever application software is developed. The module uses a jump table to access the functions and an argument block for exchanging data with the application. This arrangement is sufficient for using in an application developed in assembler or a high-level language. I know of an interface for C, and I used Forth to develop a simple telephone answering machine. The interface module is best described in the context of an application.

### **A simple telephone answering machine**

I invariably use Forth in my hardware projects because it provides the development speed of an interpreter and the execution speed of machine code. I use the Mountain View Press MVP-Forth that implements a successor to FIG-Forth that conforms to the Forth-79 standard. This Forth is in the public domain and is available from Mountain View Press. The Telephone Answering Machine application is contained in 15 "screens" that are provided in Listing 1. I will refer to the screen numbers contained in the listing as I describe the application.

*Screen 120*, the load screen for the application, initializes the CFMODULE code and runs the application. *Screens 121 and 122* are CP/M interface words and contain utilities I need to copy message files between disk drives. I mentioned earlier that the bubble disk is the only suitable mass storage I have for recording and playing back messages. Since the bubble disk is only 127K, I used another disk for permanent storage of messages. This complicates the application only slightly.

*Screen 123* defines the location of the CFMODULE code and argument block. The CFMODULE begins with 13 jump vectors. I have made free RAM available above my system at F000 Hex. I assembled the CFMODULE code with this origin and loaded the Hex out-

put of the assembler into a CFMODULE.IMG file using SID. This is a straightforward application of ASM and either DDT or SID. The documentation contains a section that describes what changes you may want to make in CFMODULE before using it in an application. The only changes I made to

---

## **A mass storage device of some type is needed for a practical message/play-back system.**

---

the CFMODULE code was to be sure that interrupt vectors were set in each RAM bank. This is required since I am using banked CP/M Plus; for CP/M 2.x no changes other than the interrupt option described in the installation documentation are required.

The argument block follows the CFMODULE code at FA00 Hex. The CFMODULE code is ROMable, and all of the RAM usage is confined to the argument block.

In order to handle the data requirements of the speech digitizer and do mass storage I/O as well, a double buffering scheme is used in CFMODULE. The size of the buffers is determined by the speed of transfer between the mass storage and RAM. *Screen 123* defines the start of the buffer area as C000 Hex, and the size of each buffer is 16 128-byte sectors (2K). I found that the speed of the bubble disk was high enough that a smaller buffer could be used. The CFMODULE defaults to 4K buffers. The CompuFone documentation discusses a procedure that can be used to determine the minimum buffer size. Again, banked CP/M Plus requires that the buffer be located in RAM common to all banks, hence the high address. With CP/M 2.x, both the CFMODULE code and disk buffers could be located anywhere in RAM.

*Screen 124* defines the locations in the argument block. A defining word ARGUSER creates a word that will leave the address of the particular argument on the Forth stack. The ARGUSER word is similar to the Forth

USER word. The offset from the base (in the case of the argument block, the base is in the variable ARGBLK) is saved in the definition of each argument block variable and used to compute the argument address when the word is executed.

Most of the argument locations will be described below. TPSW is not used; it contains a switch to indicate whether pulse or Touch-Tone dialing is desired. MAXRING is not used; it contains the maximum number of rings to count before aborting an outgoing call. The MUX argument contains the desired selection of the analog multiplexer. The two values used are defined in the TELE and MIKE words.

*Screen 125* defines the CFMODULE jump vector locations. In order to use the CFMODULE code, an 8080/Z80 call instruction to the appropriate location in the jump vector is all that is required. The CFMODULE code saves all registers and uses its own local processor stack. The defining word FUNCALL takes the jump vector offset as an argument and compiles a word that will perform the necessary call instruction. The ARGUSER and FUNCALL words are all that is required to define the CFMODULE interface. This little bit of Forth demonstrates the defining word that is a key "power" of Forth.

*Screen 126* continues the Forth "defining word power" by using PHONE# to compile telephone words in the Forth dictionary. The FILENM defining word is defined in *screen 121* and is used to save CP/M filename strings in the Forth dictionary. TESTFIL and DELFIL are words that expect a CP/M filename string on the Forth stack and use the CFMODULE code to test if the file exists or to delete the file respectively.

*Screen 127* contains words that are used for demonstrating the dialing and calling capabilities of CFMODULE. CALLNUM needs a telephone number string on the Forth stack; the string is put in the start of the first disk buffer in the argument block and then the CALLOUT function of CFMODULE is used. TESTFIL and DELFIL also use the first disk buffer to pass the CP/M filename string to CFMODULE. INITBUF is the word that takes a string from the Forth stack and loads it into the BUF1BEG disk buffer (INITBUF is defined in *screen 126*). String arguments are passed to the CFMODULE by using the BUF1BEG disk buffer. All the strings must be null terminated. RECORD and PLAY are words used in the telephone answering machine application. These words expect a CP/M filename string; they use the CFMODULE LISTEN for record-



# COMPUFONE

Continued from page 47

ing to the file and SPEAK for playback from the file. If no filename string is found on the Forth stack, the DEFAULT word puts the default name C:TEST on the stack. CFMODULE functions that refer to CP/M files append the extension .SPH if no extension is supplied in the filename.

The RECORD word sets the FLAG argument to 10 in order to produce a one-second tone prior to recording. The FLAG argument is multipurpose; it is used to specify tone length (in 100 msec units) and also contains return status information. In the CFMODULE LISTEN function, FLAG contains the code explaining why the recording terminated. The possible values are: -1 for data transfer timing error (this means that the disk buffers are too small), 2 for a Touch-Tone detect during recording, 3 for a key strike on the local console, 4 for a disk I/O problem (DONECODE contains additional information), 5 for DEADTIME time-out, and 6 for MAXTIME time-out. FLAG contains similar codes for return from the CFMODULE SPEAK function. DONECODE is another argument that is used to return information to the application program. The Forth word VALUES is used to print the contents of these two arguments after a CFMODULE call. VALUES is used for debugging.

Screen 128 loads the CFMODULE code into RAM and calls CFINIT to initialize the code. The INIT\_\_COMPUFONE word performs these tasks. It is called from screen 120 after all the screens have been loaded. The contents of the arguments BUF1BEG, BUF2BEG and BUFSIZE are initialized after CFINIT returns to override the default values provided by CFINIT.

Screen 129 defines a local telephone ring counter. Two words are needed to count three rings. The first, LONG\_\_WAITRNG, will loop until a local ring is detected or until a key is struck on the console. The CHKRING function of CFMODULE is used to see if the telephone is ringing. The second word, WAITRNG, used after the first ring is detected, will wait only 15 seconds. If it gets a ring indication during that time, it will return the local ring flag on the Forth stack. Two successful WAITRNG returns are determined by the AND word that will terminate the BEGIN-UNTIL loop. The last line of WAIT3RNG will return to the Forth interpreter if a console key has been struck. This is how the ANSWER\_\_MACHINE word is killed.

Screen 130 handles the CP/M files

for messages. The MESSAGE word contains the CP/M filename used for recording and playback on the bubble disk. The SAVMSG word contains the CP/M filename used for permanent message storage. The SET\_\_MESSAGE word will modify the SAVMSG filename by changing the last character of the filename. FREEMSG changes the filename in SAVMSG until an unused filename is found. The FEXIST function in CFMODULE is used by TESTFIL to determine if the file exists. NEXTMSG changes the filename in SAVMSG until a used filename is found.

Screen 131 defines the use of DO\_\_MESSAGE. This word is used to wait for the telephone to ring three times, answer, play the HELLO message, record a message and hang up. The comments in the screen explain the function of each line. OFFHOOK is the CFMODULE routine that switches the telephone line to the active or off-hook condition; this is similar to lifting the handset off the cradle. The OFFHOOK function returns immediately, but there is a 2.7 second delay before the phone line connection is established. I suspect

this delay is used to meet an FCC requirement that insures the answered call is billed.

The CFMODULE WAIT function is used to wait for the connection to be made. WAIT expects the FLAG argument to contain the length of the wait in 100 msec units. The TELE word is used before PLAY to set the value of the MUX argument so the analog multiplexer will connect the full-level telephone line to the speech digitizer. The HELLO word contains the CP/M filename for the previously recorded hello message. PLAY uses the CFMODULE SPEAK function to play back this message to the telephone line after the call is answered. The RECORD word is used to record a message into the CP/M filename contained in MESSAGE; but first two timers are initialized.

The LISTEN function of CFMODULE uses two timers. Both are programmable in 100 msec units. MAXTIME is used to set the maximum length of the recording. This essentially sets an upper boundary on the size of the resulting disk file. I picked 30 seconds for MAXTIME, which will produce a

```
SCR #120
0 ( Load Screen for COMPUFONE words                27JAN84RCR)
1
2 121 134 THRU
3
4 254 SET_ERROR_MODE \ CP/M+ Display error and RETURN mode
5
6 INIT_COMPUFONE \ Load and Initialize the CFMODULE code
7
8 ANSWER_MACHINE \ Word to run the Telephone Answering app
9
10 PLAY_MESSAGES \ Word to playback recorded messages
11
12
13
14
15

SCR #121
0 ( CP/M Interface, Make FCB, Open, Close, Read, Write 17JAN84RCR)
1 : CHKSTK DEPTH - 0< NOT ABORT" NEED ARG(S)" ;
2 : NULLTERM DUP COUNT + 0 SWAP C! DUP C@ 1+ SWAP C! ;
3 \ Create a FILE NaMe string
4 : FILENM CREATE BL WORD DUP NULLTERM C@ 2+ ALLOT DOES> ;
5 VARIABLE PFCB 2 ALLOT
6 \ Initialize an FCB variable with a FILENM string
7 : INITFCB 2 CHKSTK ( FCB_addr FILENM --- ) 1+ PFCB ! PFCB 2+ !
8 152 PFCB SYSCALL 255 =_ABORT" BAD FILE NAME" ;
9 : SET_ERROR_MODE 1 CHKSTK 45 SWAP SYSCALL ;
10 : FSIZE 35 OVER SYSCALL ABORT" FILE NOT FOUND" 33 + @ ;
11 : OPEN 1 CHKSTK 15 SWAP SYSCALL ABORT" FILE NOT FOUND" ;
12 : MAKE 1 CHKSTK 22 SWAP SYSCALL ABORT" FILE EXISTS" ;
13 : CLOSE 16 SWAP SYSCALL ABORT" FILE NOT FOUND" ;
14 : SEQ_READ 20 SWAP SYSCALL ABORT" READ ERROR" ;
15 : SEQ_WRITE 21 SWAP SYSCALL ABORT" WRITE ERROR" ;

SCR #122
0 ( CP/M Utilities, load a file, copy a file                27JAN84RCR)
1
2 \ Load the file in FCBaddr into RAM starting at load_addr
3 : LOAD_FILE 2 CHKSTK ( FCBaddr load_addr --- )
4 OVER OPEN OVER FSIZE 0 DO DUP 26 SWAP SYSCALL DROP
```



Even the fastest fingers slow down when they struggle with computer commands. And no matter what software you use, you still have to enter the same things over and over again.

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**CIRCLE 95 ON READER SERVICE CARD**

# The ten slowest parts of your computer.





# COMPUFONE

Continued from page 48

75K file at the 2.5K per second sample rate. DEADTIME is used to set the maximum interval of silence. This timer, reset by the LISTEN function whenever sound is detected during the recording, allows LISTEN to end before MAXTIME times out. Most recorded messages in this application end with the DEADTIME timer time-out due to the caller's hanging up after leaving a message. These two timers provide flexibility in using LISTEN. The DEADTIME timer is also used in the CFMODULE GETTONE function. GETTONE will wait for a Touch-Tone from the receiver. This function can be used to enter codes that play back messages over the telephone or to record data solicited by a prerecorded message. Each timer can be disabled by setting its argument value to zero.

An application note in the documentation discusses experimentation needed to find an acceptable value for these timers. For example, if the DEADTIME timer is too long, the local telephone exchange may return a busy signal after the called party hangs up and the calling party is still off hook. This situation would produce a "sound" that would reset the DEADTIME timer, and recording would continue. The DEADTIME timer provides an acceptable solution to the problem of there not being a way to electrically detect whether the called party has hung up.

DO\_MESSAGE ends by checking the LISTEN return code in FLAG. If LISTEN terminated due to MAXTIME time-out or due to a disk full condition, the SORRY message is PLAYed.

Screen 132 defines the words used to move messages between the bubble disk and a conventional floppy disk. SAVE\_MESSAGE moves a message off the bubble for permanent storage after recording. The RESTORE\_MESSAGE word returns a message for playback.

Screen 133 defines the use of the ANSWER\_MACHINE word. The telephone answering application requires a HELLO and SORRY file, so it begins by checking that these files exist. The first FREEMSG filename is found and an endless loop is entered. DO\_MESSAGE is used to record a message, SAVE\_MESSAGE moves the message off the bubble disk, and FREEMSG gets the next filename.

Screen 134 defines the PLAY\_MESSAGES word used to listen to the recorded messages. Its structure is similar to ANSWER\_MACHINE. Saved messages are deleted if the response to QUERY is a "Y".

```
5 OVER SEQ_READ 128 + LOOP DROP CLOSE ;
6
7 \ Copy contents of file fromFCB to file toFCB
8 : COPYFILE 2 CHKSTK ( fromFCB toFCB --- )
9 DUP MAKE OVER OPEN 26 128 SYSCALL DROP
10 OVER FSIZE DUP 0= IF DROP EXIT THEN 0 DO
11 OVER SEQ_READ DUP SEQ_WRITE
12 LOOP CLOSE CLOSE ;
13
14
15
SCR #123
0 ( Define CFMODULE area and DISK storage area 27JAN84RCR)
1
2 HEX
3 \ Define RAM for CFMODULE code
4 VARIABLE ENTRY F000 ENTRY !
5
6 \ Define RAM for CFMODULE argument block
7 VARIABLE ARGBLK FA00 ARGBLK !
8
9 \ Define size of buffers (NRECS in units of 128-byte records)
10 VARIABLE NRECS 10 NRECS !
11
12 \ Define location of disk buffers
13 VARIABLE DBUFF C000 DBUFF !
14 DECIMAL
15
SCR #124
0 ( Define ARGUMENT BLOCK locations 27JAN84RCR)
1 \ ARGUSER is a defining word similar to the FORTH USER word
2 : ARGUSER CONSTANT ;CODE
3 D INX XCHG M E MOV 0 D MVI ARGBLK LHL
4 D DAD HPUSH JMP END-CODE
5
6 \ Here are the arguments available in ARGBLK
7 0 ARGUSER FLAG 1 ARGUSER DONECODE
8 2 ARGUSER DEADTIME 3 ARGUSER MAXTIME
9 5 ARGUSER MUX 6 ARGUSER TPSW
10 7 ARGUSER MAXRING 8 ARGUSER BUFSIZE
11 9 ARGUSER BUF1BEG 11 ARGUSER BUF2BEG
12
13 \ Here are the values used for the MUX argument
14 : TELE 0 MUX C! ; \ Select telephone line
15 : MIKE 7 MUX C! ; \ Select microphone input

SCR #125
0 ( Define CFMODULE calls 27JAN84RCR)
1
2 \ FUNCALL will define a word that will call a CFMODULE function
3 : FUNCALL CONSTANT ;CODE
4 D INX XCHG M E MOV 0 D MVI ENTRY LHL
5 D DAD NEXT D LXI D PUSH PCHL END-CODE
6
7 \ Here are the 13 functions available in CFMODULE
8 0 FUNCALL CFINIT 3 FUNCALL ONHOOK
9 6 FUNCALL OFFHOOK 9 FUNCALL GETTONE
10 12 FUNCALL DIALER 15 FUNCALL GENBEEP
11 18 FUNCALL CHKRING 21 FUNCALL CALLOUT
12 24 FUNCALL LISTEN 27 FUNCALL SPEAK
13 30 FUNCALL PEXIST 33 FUNCALL FDELETE
14 36 FUNCALL WAIT
15
SCR #126
0 ( define PHONE#s and FILE NaMes 27JAN84RCR)
1 \ PHONE# will define a word that will leave a string address
2 \ on the FORTH stack, FILENM is the same idea
3 : PHONE# CREATE BL WORD DUP NULLTERM C@ 2+ ALLOT DOES> ;
4
5 PHONE# TIME 9761616 \ TIME OF DAY NUMBER
6 PHONE# DUM 1111111
7
8 FILENM TEST C:TEST \ DEFAULT FILE NAME
```



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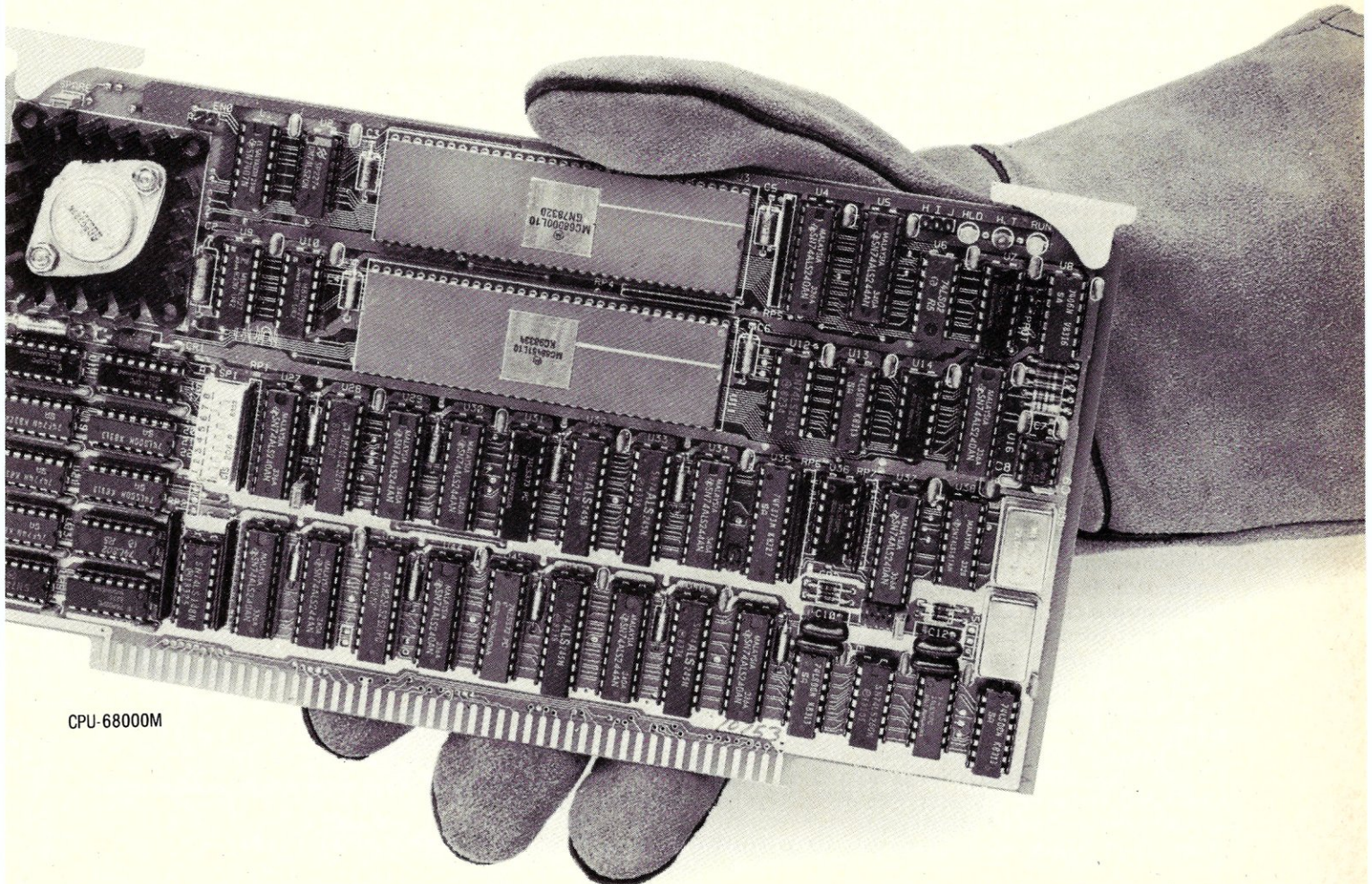
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THERE'S ONLY ONE

# DUAL

CIRCLE 127 ON READER SERVICE CARD



CPU-68000M



# COMPUFONE

Continued from page 50

I have used this telephone answering machine for a few days and it works fine. There are more features I would like to add, and the CFMODULE software has the functions I would need to add an automatic playback of messages controlled by a telephone connection. GETTONE is a function that inquires about the status of the Touch-Tone receiver. Using GETTONE to detect Touch-Tones is the primary way to control application software from the telephone line. Both recording (the LISTEN function) and playback (the SPEAK function) are interrupted by a Touch-Tone signal. All sorts of control possibilities are available with this function.

The only CFMODULE function I haven't mentioned is GENBEEP. This function generates a tone (the FLAG argument is used to specify the duration) that can be sent to the telephone line and line-out connector.

The telephone number string accepted by the CFMODULE functions DIALER and CALLOUT can contain two special characters. The : character in a string will wait for another dial tone. This is useful in dialing from a PBX that requires an access code such as 9 to get an outside line. The + character in a string to CALLOUT will cause CALLOUT to complete the call progression in progress and then start over with the rest of the string. This is useful in accessing long-distance services that first require a call to a local number, which then supplies a dial tone for placing a long-distance call. Call progression refers to the CALLOUT sequence of dial tone, dialing, ring and answer. CALLOUT uses DONECODE to return a value that indicates how far the call progression has gone. I used CALLOUT for a simple call to a local number for the time check, and it performed as advertised.

## Documentation

The CompuFone comes with a large manual. Over half of the manual is devoted to assembler listings of all the supplied software. The listings are well commented, so that a person familiar with assembler can glean some information about hardware aspects of the board that are not documented. Including the listings in the documentation prevents you from having to list the programs yourself.

Chapter 1 covers installation; Chapter 2 deals with checkout using the CFDEMO software. Chapter 3 describes the hardware, with some notable exceptions mentioned below. Chapter 4

```
9 FILENM HELLO C:HELLO      \ HELLO MESSAGE
10 FILENM SORRY C:SORRY     \ MAX TIME MESSAGE
11
12 : INITBUF 1 CHKSTK DUP C@ SWAP 1+ BUF1BEG @ ROT CMOVE ;
13 : DEFAULT DEPTH 0= IF TEST THEN INITBUF ;
14 : TESTFIL INITBUF FEXIST DONECODE C@ ;
15 : DELFIL INITBUF FDELETE DONECODE C@ ;

SCR #127
0 ( Calling Words, Record/Playback Words                27JAN84RCR)
1 \ Print the values of the arguments FLAG and DONECODE
2 : VALUES ." FLAG=" FLAG C@ . 9 EMIT
3 ." DONECODE=" DONECODE C@ . ;
4
5 \ "PHONE#" must be on stack
6 : DIALNUM INITBUF DIALER CR ." DIALER RETURNS:" VALUES ;
7 : CALLNUM INITBUF CALLOUT CR ." CALLOUT RETURNS:" VALUES ;
8
9 \ If no "FILENM" is on stack, default name is used
10 \ set FLAG, MUX, MAXTIME and DEADTIME before call
11 : RECORD DEFAULT 10 FLAG C! LISTEN
12 CR ." LISTEN RETURNS:" VALUES ;
13 : PLAY DEFAULT SPEAK
14 CR ." SPEAK RETURNS:" VALUES ;
15

SCR #128
0 ( Load CFMODULE code and Initialize COMPUFONE        17JAN84RCR)
1
2 VARIABLE FCB_CFMODULE 34 ALLOT          \ FCB for CFMODULE code
3 FILENM CFMODNM F:CFMODULE.IMG         \ FILE Name of CFMODULE
4
5 : INIT_COMPUFONE
6 FCB_CFMODULE CFMODNM INITFCB          \ set up FCB_CFMODULE
7 FCB_CFMODULE ENTRY @ LOAD_FILE        \ load the code
8
9 CFINIT          \ let the CFMODULE code initialize itself
10
11 DBUFF @ BUF1BEG !          \ set up the two buffers
12 DBUFF @ NRECS @ 128 * + BUF2BEG !
13 NRECS @ BUFSIZE C! ;
14
15

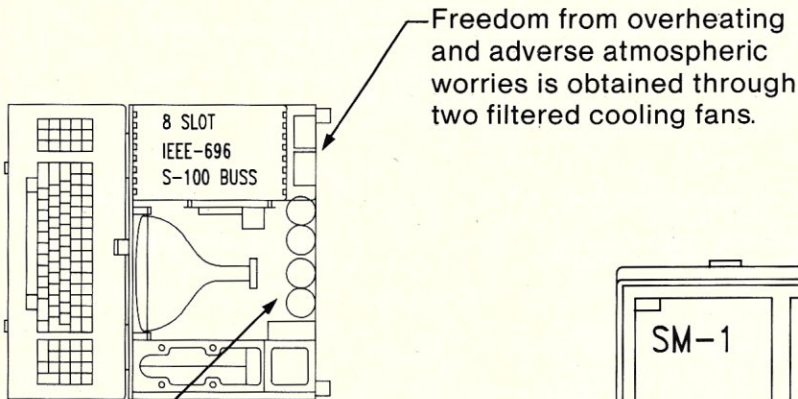
SCR #129
0 ( Telephone Ring counter                               17JAN84RCR)
1 : TESTRNG DONECODE C@ ?TERMINAL OR ;
2 : WAIT1SEC 10 FLAG C! WAIT ;
3 \ Wait for a ring or terminal interrupt
4 : LONG_WAITRNG BEGIN CHKRING TESTRNG UNTIL ;
5
6 : WAITRNG          \ Wait up to 15-seconds for a ring
7 15 0 DO WAIT1SEC CHKRING TESTRNG IF LEAVE THEN LOOP
8 TESTRNG ;
9 : WAIT3RNG          \ Wait for 3 consecutive rings
10 BEGIN
11 LONG_WAITRNG          \ Returns on first ring
12 WAITRNG WAITRNG AND  \ Two more rings within 30-sec
13 UNTIL                \ Until 3 rings total
14 ?TERMINAL ABORT" INTERRUPT!" ; \ This is way to stop it
15

SCR #130
0 ( Message handler                                     17JAN84RCR)
1 FILENM MESSAGE C:MESSAGE.SPH          FILENM SAVMSG B:MESSAGE1.SPH
2
3 \ Get address of last character of filename
4 : ADDR_CHAR SAVMSG DUP C@ + 5 - ;
5 \ Set SAVMSG filename to n ( n --- )
6 : SET_MESSAGE 1 CHKSTK 48 + ADDR_CHAR C! ;
7 : FREEMSG          \ Find next available save message file name
8 10 1 DO SAVMSG TESTFIL
9 IF I SET_MESSAGE ELSE LEAVE THEN LOOP
10 SAVMSG TESTFIL ABORT" ALL MESSAGE FILES IN USE" ;
11
```



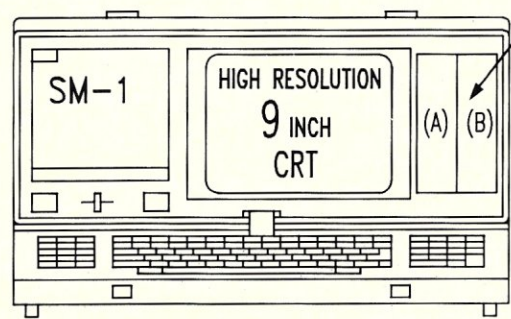
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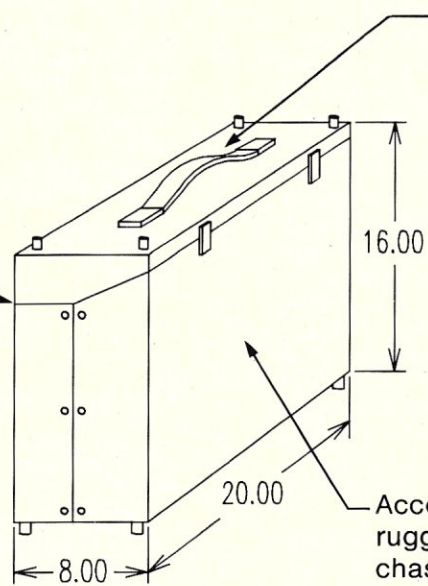
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# COMPUFONE

Continued from page 52

covers disk recording and playback, and Chapter 5 describes the CFMODULE software. Chapter 5 ends with some applications notes that deal with special characters in dial strings, buffer allocation, timers and automatic call placement. The appendices contain the program listings and a one-page schematic. There is no index.

A board schematic is supplied for the S-100 bus interface only (page one of a three-page schematic). I requested a complete schematic and was told that the circuit was proprietary. I guess an OEM with a large order could get a complete schematic.

Lacking a complete schematic, I had to rely on the documentation to supply the details. The documentation is complete as far as setting the options, describing the sample programs, and describing each function available in CFMODULE; but no technical description is provided.

The three "trunk status" bits that appear on the base input port are not documented. The only reference in the documentation is that "the trunk status lines are used by the call progression software to detect dial tone, busy, remote ring, connection established and dead line." This means that you have to depend on the assembler listings if you want to know how to detect dial tone or busy or any other status information. If you can't figure out the meaning of these trunk status bits from the assembly listing, you are left with the functions provided in CFMODULE.

Details of the hardware data compression technique used by the speech digitizer subsystem are not provided. I inquired about the possibilities for signal processing of the digitized speech and was told that essential information for speech recognition was removed by the digitizing process; therefore, speech recognition after digitization is not possible. A special buffered output is provided on the audio socket with this inscription: "special connection for experimental speech recognizer—contact factory for details." One piece of information supplied was that silence is digitized to a string of AA or 55 Hex bytes. This could be useful if it was desired to further compress silent stretches out of recorded files.

I am not accustomed to the technical details of a board being proprietary. The only other experience I had with this was when I inquired into the telephone interface used by my PMMI modem board. I guess getting a two- to four-wire duplexer with a high degree of transmit/receive isolation working on

```
12 : NEXTMSG          \ Find next occupied message file
13   58 ADDR_CHAR C@ 1+ DO
14   I ADDR_CHAR C! SAVMSG TESTFIL IF LEAVE THEN LOOP
15   SAVMSG TESTFIL NOT ABORT" ALL MESSAGE FILES SCANNED" ;

SCR #131
0 ( Take a message                                     27JAN84RCR)
1
2 : DO_MESSAGE      \ Answer phone and take a message from caller
3   WAIT3RNG        \ wait for 3 rings, then
4   OFFHOOK         \ answer call
5   27 FLAG C! WAIT \ answer delay
6   TELE HELLO PLAY \ play "hello" message
7   50 DEADTIME C! \ a 5-second pause will stop recording
8   300 MAXTIME !   \ a 30-second message maximum
9   MESSAGE RECORD CR \ record the message
10  \ 1-second beep tone set-up in RECORD
11  \ check record result and play sorry message if MAXTIME
12  \ exceeded or disk is full
13  FLAG C@ DUP 4 = SWAP 6 = OR IF SORRY PLAY THEN
14  ONHOOK ;      \ finally, hangup
15

SCR #132
0 ( Copy message to another disk                       23JAN84RCR)
1
2 VARIABLE MSG_FCB 34 ALLOT          \ FCB for message
3 VARIABLE SAV_FCB 34 ALLOT          \ FCB for copy
4
5 : SAVE_MESSAGE
6   MSG_FCB MESSAGE INITFCB
7   SAV_FCB SAVMSG INITFCB
8   SAVMSG DELFIL DROP
9   MSG_FCB SAV_FCB COPYFILE ;
10
11 : RESTORE_MESSAGE
12  MSG_FCB MESSAGE INITFCB
13  SAV_FCB SAVMSG INITFCB
14  MESSAGE DELFIL DROP
15  SAV_FCB MSG_FCB COPYFILE ;

SCR #133
0 ( A simple Telephone Answering Machine              27JAN84RCR)
1
2 : ANSWER_MACHINE
3   HELLO TESTFIL NOT ABORT" HELLO FILE NOT FOUND"
4   SORRY TESTFIL NOT ABORT" SORRY FILE NOT FOUND"
5   1 SET_MESSAGE      \ prepare to receive first message
6   FREEMSG           \ get name of next free message file
7   BEGIN
8     DO_MESSAGE      \ get a message
9     SAVE_MESSAGE    \ save message on another disk to free
10    \ space on BUBBLE disk
11    FREEMSG         \ prepare to receive another message
12    1 WHILE         \ do for all 9 messages files
13  REPEAT ;
14
15

SCR #134
0 ( Play-back recorded messages                       17JAN84RCR)
1
2 : PLAY_MESSAGES
3   0 SET_MESSAGE      \ start with first one
4   BEGIN
5     NEXTMSG         \ get next message filename
6     RESTORE_MESSAGE \ copy message back to BUBBLE disk
7     CR SAVMSG COUNT TYPE \ print message name
8     MESSAGE PLAY    \ play it back
9     ." Delete? "    \ answer "Y" or "YES" to delete message
10    QUERY BL WORD COUNT 0= NOT SWAP C@ 89 = AND
11    IF SAVMSG DELFIL THEN
12    1 WHILE         \ do for all 9 message files
13  REPEAT ;
14
15
```



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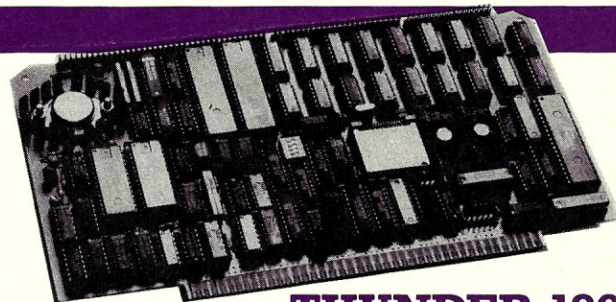
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## MACROTECH MAX: DUAL FUNCTION MEMORY BOARDS

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## INTERCONTINENTAL MICRO SYSTEMS (ICM):

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## ENCRYPTOR from LEHIGH VALLEY LOGIC:

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## IMS INTERNATIONAL (Industrial MicroSystems)

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# COMPUPHONE

Continued from page 54

any telephone connection with its varying impedance requires a clever design, and the design would be kept proprietary. Every telephone interface I have seen has been sealed up tight so that it can't be reverse engineered. But I don't agree with the practice of keeping the major portion of a board's theory of operation proprietary—especially such useful information as what three trunk status bits mean.

In order to understand the analog multiplexer, I used a block diagram given in the hardware chapter. This diagram shows seven connections, but the description talks about eight. I found the chip on the board and consulted the data sheet. Sure enough, there are eight connections in/out and one common out/in.

A phone call to Computalker clarified what the eighth connection to the analog multiplexer is used for. My curi-

**OEMs will see an opportunity to develop software and package it with CompuFone.**

osity was piqued because I thought that a telephone amplifier was available by using the microphone and external speaker. This does work, but the level of the signal from the telephone line is attenuated and therefore hard to hear in the speaker. The eighth connection to the analog multiplexer is the unattenuated telephone line. Since only one "switch" can be closed at any one time, a practical telephone amplifier is not feasible. Too bad, it would have been a nice extra feature.

The description of the jumper-selectable options in the hardware chapter is good. I had no problem understanding them because I had the S-100 interface schematic to augment the text, but generally, I found the hardware description incomplete.


## Conclusion

The CompuFone board adds significant flexibility for S-100 machines. The voice digitizer, telephone interface and

Touch-Tone generator/decoder provide the capability for many interesting and useful applications such as voice store and forward systems, computer-aided instruction, remote data entry, remote control of computer applications, Ham radio repeaters and phone patches. Since software for these applications would have to be user developed, I wouldn't recommend this board for the novice user. OEMs will be likely to see the possibilities here, and will develop software to package with the board. I have a brochure from Applied Voice Technology that offers CompuFone software for a full-featured voice message system (PhoneXpress), a voice-

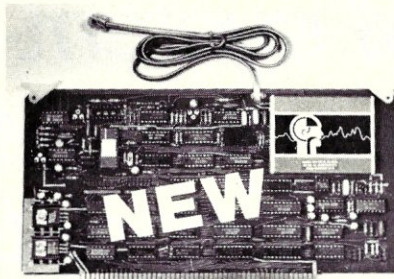
oriented data retrieval system (PhoneForms), and Pascal routines to control the CompuFone (VoicePak).

The single unit price of \$995 will prevent competition with simple telephone answering machines like the application I described. However, the more sophisticated uses of the board will support its price.

A brochure is available from **Computalker**, 1730 21st Street, Santa Monica, CA 90404. **Applied Voice Technology** is located at 2103 W. Harrison Ave., Suite 5A, Olympia, WA, 98502. 

*Randy Reitz, 26 Maple Street, Chatham Twp., NJ 07928*

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# S-100

## Product Directory

**T**his is the second annual S-100/IEEE-696 Product Directory to appear in *Microsystems*. It contains a concise listing of over 500 S-100/IEEE-696

products available from over 150 companies. The number of companies listed here has risen slightly from last year, and the number of products has increased by about 15%. Thus the S-100 market, although nowhere as dynamic as that for the integrated personal computer, is healthy and growing. However, there is no doubt that the S-100 market can now be considered a mature industry with only moderate growth potential, compared to the IBM PC-compatible market.

Markets for other bus-oriented computer systems, such as Multibus and Standard Bus, are also thriving and expanding. Whereas the early growth of the S-100 marketplace relied mainly on hobbyists and early personal computer users, the industry is now concentrating on OEM multiuser systems, and applications requiring more computer power. Thus, as one looks through this directory, one sees many listings for the more powerful 16-bit systems, based on the Motorola 68000, Intel 80286 and National Semiconductor 16032 microprocessors, as well as high-density color graphics systems.

S-100 systems therefore continue to make progress in the multiuser, multi-

by Sol Libes

processing marketplace running MP/M, TurboDOS, UNIX, and UNIX-like operating systems. Hence there is no doubt that the adoption of the IEEE-696 Standard for S-100 systems has stimulated industry growth, as virtually all manufacturers are now making a concerted effort to make their equipment conform to the Standard.

### Using the directory

Of necessity, it was not possible to include detailed specifications on the many products listed. In some cases, however, I was able to list some of the specifications. For example, I was able to indicate the microprocessors used in the complete systems, single board computers and CPU cards. In these cases the following abbreviations were used:

- 80 = Intel 8080
- 85 = Intel 8085
- 86 = Intel 8086
- 88 = Intel 8088
- 186 = Intel 80186
- 188 = Intel 80188
- 286 = Intel 80286
- 032 = National Semiconductor 16032
- 68K = Motorola 68000
- Z80 = Zilog Z80
- Z8K = Zilog Z8000

In the columns under RAM and ROM cards, I have indicated the maximum memory each could contain. Under RAM cards, S or D following the memory size indicates either Static or Dynamic memory.

For the I/O interface cards, I have indicated the maximum number of serial and parallel ports. For example, the designation "3S + 2P" indicates that the board can contain up to three serial and two parallel I/O interfaces. Note that many of the I/O cards also contain interrupt controllers and/or ROM circuits. Regretfully, I could not fit this information into the chart.

For the video and graphic controller cards, I have indicated either the number of lines and columns (e.g., 24 x 80) or the pixel resolution, and whether the board has color capability. On the local area networking cards (where the manufacturer included the information), I was able to indicate the type of LAN system used. In the address section, where a company has supplied the name of a person to contact, that name is given last.

I recognize that this directory is not complete, since many companies did not respond to our questionnaire (we mailed to almost 250 companies). Therefore, companies that produce S-100/IEEE-696 products and wish to be listed in future directories should send me information on their products.

Sol Libes, P.O. Box 1192, Mountainside NJ 07092



# S-100 PRODUCT DIRECTORY

Company	Complete Systems		Single Board Computers		CPU		Memory		I/O	Video (lines x cols.)	Graphics (pixels)	Local Area Network	Modem	Floppy	Hard	Tape Controller	Analog I/O	Disk Controller	EPROM Programmer	Clock/Calendar	Speech Synthesizer	Prototyping	Extender	Card Cage	Motherboard	Monitors	Power supplies	Other	Reader Service Card Number
	8-bit	16-bit	RAM (K)	ROM (K)	RAM (K)	ROM (K)																							
ABACUS Technology Systems			T11																									1	
Ackerman Digital Systems		6809	6809 6800		32S 128S	2- 512																					S-100/PDP-11 peripheral card incl. RT-11 V/S software with CPM emulation	2	
Action Computer Enterprise, Inc.		86 Z80	Z80	86		4K	8S/8P																				Interrupt Controller	3	
Adaptive Data & Energy Systems																												4	
Advanced Computer Products					32/ 64S																							5	
Advanced Computer Technology, Inc.	Z80	Z80																										6	
Advanced Digital Corp.	Z80	Z80																										7	
Alloy Computer Products																												8	
Applied Innovations				88,86		256																						9	
Artec Electronics		85			8/16/ 32S	32																						10	
Automated Control Systems							7P																					11	
BG Computer Applications					64/ 256S	64/ 256																						12	
Brown Dog Engineering																												13	
California Computer Systems		Z80			64D 16/ 32S	4,6S 4P 2S + 2P																				DPM interface board/industrial controller boards	14		
California Data Corp.																												15	
California Digital, Inc.					256D/ 64S																							16	
Caimbridge Development Lab.							28x80																					17	
Casheab																												18	
CER-TEK, Inc.																												19	
Chrislin Industries, Inc.					64D																							20	
Communications Research, Inc.	186	186																										21	
Components Express, Inc.					64S																							22	
CompuPro Systems	Z80 85/88 86/ 68K Z86		Z80 85	88/86 286/ 68K 16032	64/ 128S 256/ 512D	2S, 8S 3P + 1S 1P + 3S																					I/O processor, multifunction RAM disk, interrupt controller & disk emulator cards	23	
Computalker																												24	
Computer Dynamics, Inc.																												24	
Computer Systems	86/88 /68K	86/88 68K		86/88 68K	256S	128	8S/6P	25x 80	512x 480 color																			25	
Compu/Time					256D																							27	



# Move up to Microsystems

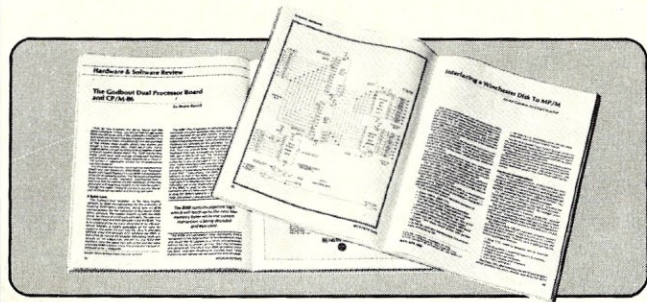
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- A simple 6-byte hexadecimal ASCII conversion routine.
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- A comparison of five popular S-100 disk controller cards.
- OS-1—a UNIX-like DOS with a CP/M adapter.

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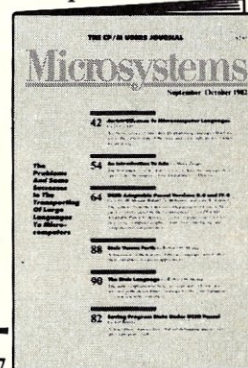
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# S-100 PRODUCT DIRECTORY

Company	Complete Systems		Single Board Computers		CPU		Memory		I/O		Video (lines x cols.)		Graphics (Pixels)		Local Area Network		Disk Controller		Other		Reader Service Card Numbers
	8-bit	16-bit	RAM (K)	ROM (K)	I/O	Video (lines x cols.)	Graphics (Pixels)	Local Area Network	Modem	Floppy	Hard	Language	EPROM	Clock/Calendar	Speech Synthesizer	Card Copier	Extender	Monitors	Motherboard	Power Supplies	
Futronics						24 x 80															56
Genesis Computer Corp.	Z80																				58
GMR, Inc.	Z80																				59
Graphics Development Labs							512 x 480 color														60
GSR Computers				256D																	61
Hayes Microcomputer Products																					62
Illuminated Technologies, Inc.							1Kx1K color														64
IMS International	Z80	Z80	64D		1P+2S	24X 80															63
Independent Business Systems	Z80 186	Z80 186	186	64-256	2S+1P																65
Inner Access Corp.	68K		68K	256S	256	8S+RCM															66
InnerVision Computers			Z80	16032																	67
Integrand																					68
Intercontinental Micro Systems Corp.		Z80 86	Z80	86	256D	2S+2P			Arc-net												69
Interlogic Industries		Z80		256D		4S+1P															70
I/O Technology				128S		3P+2S	512 x 512 color														63
Ithaca Intersystems	Z80 Z8K	Z80	Z8K	64D 256D		6S 2S+2P															71
Jade Computer Products, Inc.	Z80		Z80	64S 256D																	72
JC Systems	Z80 186 68K	Z80	186 68K	256D		4S+2P															73
J.E.S. Graphics							144x 192 288x 192 color														74
Jones Futurex, Inc.																					75
JVB Electronics																					76
Konan Corp.						1P+8S															77
Kramer Systems International																					78
Lexicom Data Systems		68K		64S																	79



# S-100 PRODUCT DIRECTORY

Company	Complete Systems		Single Board Computers		CPU		Memory		Video (lines x cols.)		Graphics (pixels)		Local Area Network		Disk Controller		Other		Reader Service Card Number
	8-bit	16-bit	RAM (K)	ROM (K)	I/O	Video	Graphics	Local Area	Network	Type	Controller	EPROM	Programmer	Speech	Calendar	Prototyping	Extender	Other	
Lomas Data Products			86, 88, 186, 286	126, 256D, 64, 128S		25 x 80	620 x 200 color												80
Macrotech International				1M8D, 256D		16S												Intelligent I/O card	81
Matco																		EPROM emulator	82
Matrox Electronic Systems, Ltd.						80 x 24	512 x 256												83
MCP Computer Products	Z80, 188	188	Z80, 188	64S		80 x 24													84
Measurement Systems & Controls	Z80		Z80, 128D	64S		8S													85
Memory Merchant			Z80	8088	64S														86
Methode Electronics, Inc.																			87
Micro Designs																		Floating point processor card	88
MicroDynamics Corp.							256 x 192 color												89
Micro Mike's, Inc.	Z80																		90
Micromint, Inc.							256 x 192												91
Mimic, Inc.						1P													92
MOM'S Computing, Inc.																		CAD/CAM & Data acquisition systems	93
Monitor Dynamics, Inc.																			94
Morrow Designs	Z80		Z80	64S		1P+, 3S, 4P+, 2S													95
Mullen Computer Products																			96
MUSYS Corp.	Z80	Z80	Z80	86															97
National Instruments																			98
Netronics R & D, Ltd.	85	85		16/32/48/64D	8														99
New Generation Systems																		Disk formatter and drive tester	100
New World Computer Co., Inc.																		Hard disk system, 10MB	101
North Star Computers	Z80		Z80	32, 64D	4S													Floating point processor card	102
Octagon			NSC-800	88	256D														103
Optronics Technology						256S, 512D, 1M8D													104



## S-100 PRODUCT DIRECTORY

	Complete Systems		Single Board Computers		CPU		Memory		Video (lines x cols.)	Graphics (Pixels)	Local Area Network	IEEE-488	Modem	Floppy	Hard	Tape Controller	Analog I/O	EPROM	Clock/ Programmer	Speech Synthesizer	Prototyping Extender	Card Copier/ Motherboard	Monitram	Power Supplies	Other	Reader Service Card Numbers
	8-bit	16-bit	RAM (K)	ROM (K)	I/O	I/O	I/O	I/O																		
Para Dynamics Corp.																										105
paraGraphics								24x80 40x80	512 x 576																	106
PCE Systems																										107
Perex, Inc.																										108
Performics, Inc.																										109
Pickles & Trout																										110
Plicon																										111
Pixeltronics																										112
PolyMorphic Systems																										113
North Atlantic/Qantex																										114
Quality Computer Services (QCS, Inc.)																										115
QDP Computer Systems (Quasar Data Products, Inc.)																										116
QT Computer Systems																										117
Random Factors Ltd.																										118
Ronsan Electronics																										119
S-100/696 Corp.																										120
S.C. Digital																										121
Scion Corp.																										122
Scitronics, Inc.																										123
SDSystems																										124
Seattle Computer Products, Inc.																										125
SemiDisk Systems																										126
Sierra Computer Products																										127
Sierra Data Sciences																										128



# S-100 PRODUCT DIRECTORY

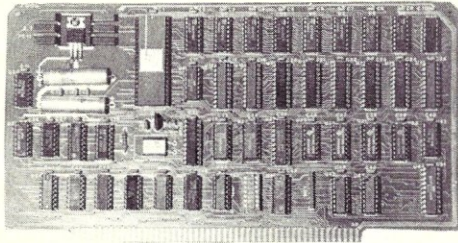
	Complete Systems		Single Board Computers		CPU		Memory		Video (lines x cols.)		Graphics (Pixels)		Local Area Network		Disk Controller		Other		Reader Service Card Numbers				
	8-bit	16-bit	RAM (K)	ROM (K)	I/O	Video (lines x cols.)	Graphics (Pixels)	Local Area Network	Modem	Floppy	Hard	Tape Controller	Analog I/O	EPRoM	Programmer	Clock/Calendar	Speech Synthesizer	Prototyping Extender		Card Cage/ Motherboard	Moniframes	Power Supplies	
Sign Corp.		Z80																				129	
Signum Systems																						In-circuit 8048 emulator card	130
Simpliway Products Co.		Z80				2S+ 2P	24 x 80 25 x 80																131
Ski Electronics				80																			132
Sky Computers Inc.																						Floating point processor cards	133
Snow Micro Systems, Inc.																						Stepper motor controller	134
SPC Technologies, Inc.																						Math processor card	135
SSM		80 Z80		64S	128	8S 2P+ 3S	16 x 64 24 x 80 50 x 80																136
Standard Microsystems Corp.						4S																	137
Stanford Applied Engineering, Inc.																						Backplane	138
Sunny International																							139
Sunol Systems																							140
Suntronics Co.		Z80	Z80	64S	64																		141
Systems Group			Z80	64/ 128D		8S																	142
Tarbell Electronics		Z80	Z80	64S		1P+ 2S																	143
Tecmar, Inc.		86 Z80	Z80	86	64D 16S	4	1P+ 2S															Video digitizer & monitor interface cards	144
Teleram Communications Corp.																						Bubble memory card	145
Teletek		Z80	Z80	64/ 256D	8	2P 2P+ 4S																Intelligent I/O cards	146
Theta Labs, Inc.						4S 2P+ 2S																	147
Thoughtworks																							148
Transend Corp.		80/ Z80		64S	128	2S+ 2P 8S	16 x 64 24 x 80 50 x 80																149
Two Bits Computer Products				256D 256S																			150
U.S. Micro Sales		Z80	Z80	64S																			151
U.S. Robotics Inc.																							152
Vector Electronics Co.				64S		2S/ 3P+ 1S																	153
VLSI Networks, Inc.																							154
Wameco, Inc.		Z80		16S																			155



## S-100 PRODUCT DIRECTORY

	Complete Systems		Single Board Computers		CPU		Memory		Video (lines x cols.)	Graphics (Pixels)	Local Area Network	IEEE-488	Modem	Floppy	Hard	Tape Controller	Analog I/O	EPROM Programmer	Clock Calendar	Speech Synthesizer	Prototyping Extender	Card Copier/Motherboard	Monitors	Power Supplies	Other	Reader Service Card Numbers
	8-bit	16-bit	RAM (K)	ROM (K)	I/O																					
Xitex							16x24																		156	
Yang Electronic Systems, Inc.				32S																					157	
Zenith Data Systems	85/88			256D	4S+1P				Arc-ner																158	
Zobex	Z80	Z80		64D	4S																				159	
X COMP																									160	
Bytewrite																								Barcode reader/printer	161	
Commercial Dynamics, Inc.		780 256K			8K	2S																			165	
Peak Electronics		68008		128K																					164	
PSCE Inc.		68000																							162	
HDL Research Lab Inc.																									166	
Mesa Power Systems																									167	

### PC11 Gives You DEC RT-11 on S-100

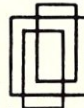


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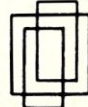
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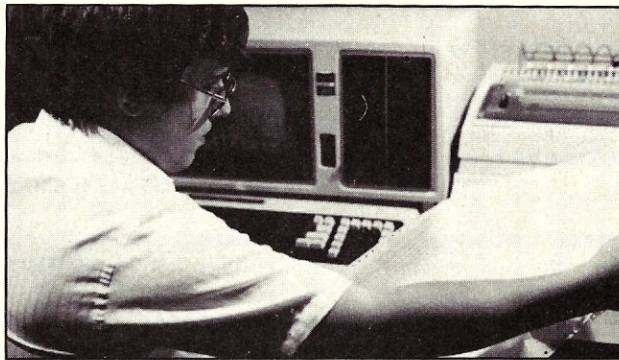
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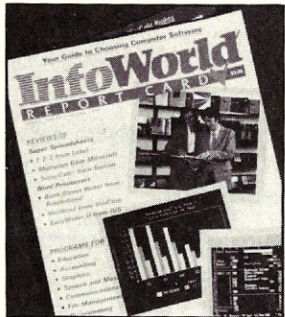


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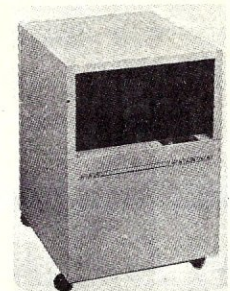
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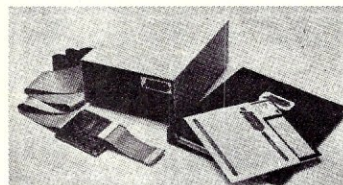
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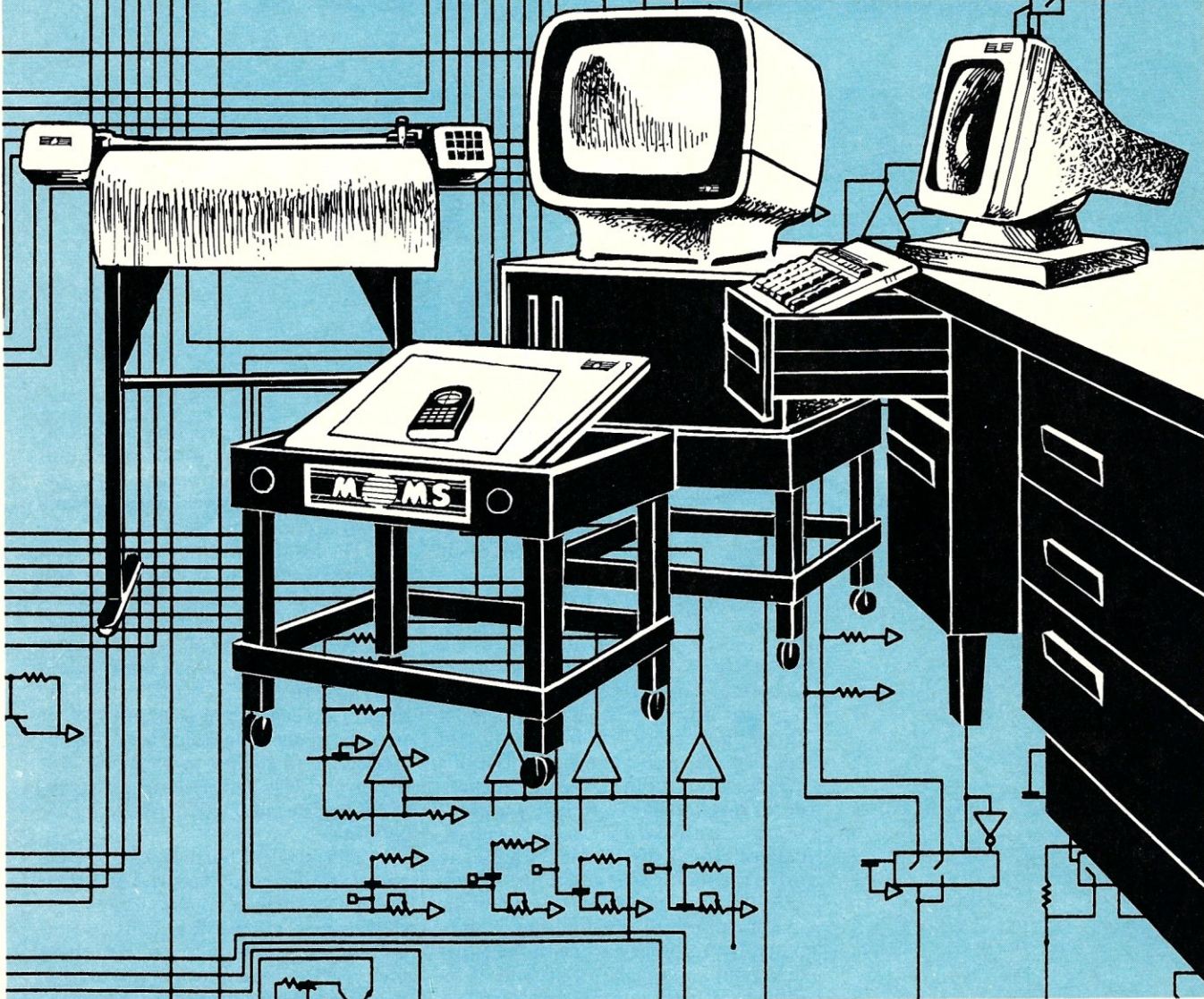
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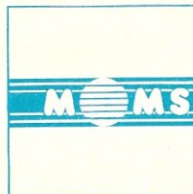


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# Control your Lab with a Stepper Motor

## The Snow S-100 stepper motor control

by Joseph Long

---

**S**tepper motors are found everywhere these days, as they are a simple, easily controlled way of producing mechanical motion. Most printers use stepper motors, as do many robotic devices.

Laboratory chart recorders are another application. In years past, variable-speed chart recorders invariably had complex, expensive gear trains. Use of a stepper motor in this application eliminates mechanical complexity and replaces it with a simple variable-rate oscillator circuit that produces pulses to drive the motor. An additional advantage of stepper motors here is that if the motor pulses are generated by a computer, the recorder may be run in either direction, at variable speeds and, if required, in very complex patterns. A chart recorder of this sort is just one step from being a digital plotter, another device that derives its power and utility from the linkage of computers with stepper motors.

The MC100 hardware/software package is designed to be used as an inexpensive development system for projects that use stepper motors. It is targeted to developers who use systems

that are very expensive, from such companies as Compumotor Corporation. The MC100 will perform most of the functions of larger development systems and do so at a much lower cost.

The MC100 will also be of interest to people working with automation, and in other fields where mechanical motion is of concern. My interest in such hardware stems from use of stepper motors to drive small peristaltic pumps which are used to automatically transfer chemical reagents in a laboratory. It was this application which led to my introduction to stepper motors, and ultimately to Chris Terry asking me whether I would be interested in reviewing the MC100.

The MC100 hardware/software package is designed to control up to two four-phase stepper motors. (Four-phase stepper motors have four coils and require a four-phase pulse train to drive them.) The set-up on which this evaluation is based consisted of the MC100 S-100 stepper motor controller board, an optional manual control panel and optional software package, and two manuals, one for the MC100 board and the other for the software.

The MC100 board will function without the software package, but most users would probably want it because the software is powerful, easy to use, and very inexpensive. The control pan-



el, used to operate the stepper motors independently of the computer, is also a very worthwhile unit.

Four-phase stepper motors can be driven directly from a parallel output port, using four output port bits to turn four power transistors on or off; the four coils in the stepper motor being connected in series with the power transistors. A four-phase pulse train output through the port will then turn the stepper motor. A simple improvement to this circuit consists of a couple of flip-flops connected between the output port and the driver transistors that will produce the four-phase signal from a pulse series using only one bit of the output port. Figure 1 shows such an interface, driving the peristaltic pump I mentioned earlier. This interface is very simple, and using it to drive a stepper motor requires only a few lines of code.

There are several problems with this approach. The motor speed is limited by the speed of the language used. Use of Basic can result in quite low maximum motor speeds. In addition, while the motor is being run, the CPU is busy; it cannot do anything but drive the stepper. If you wish to have a stepper motor follow a complex pattern, the software can quickly get out of hand.

The MC100 board (represented by the block diagram in Figure 2) solves both of these problems. The board contains Intel 8253 counter/timer chips (one for each stepper motor) which are programmed to function as frequency dividers. The S-100 clock signal is divided by these chips to produce the pulses which drive the stepper motors. Motor speeds are changed by sending different values to the 8253s. Once a motor has been started, it can run for a long period (32,000 steps) without attention from the CPU.

8253s contain three 16-bit counters. Two are used in cascade as the dividers and the third is used to count the pulses sent to the steppers, in order to keep track of the total number sent to a motor. This count can be taken internally by counting the pulses going to the motor from the MC100, or externally by counting pulses produced by the stepper, using an optical shaft encoder or another device.

The board also contains an 8255 parallel I/O chip, two sections of which function as motor control and status ports. The third section of the 8255 is available to the user for use as an 8-bit I/O port.

Each motor has two limit switches associated with it. These switches would typically be set up so as to limit mechanical travel produced by the stepper motors. The limit switches are connected to gates that disable pulses to the motors

## The MC100 will perform most of the functions of larger development systems.

when the switches are opened.

The software package makes it possible to write very complex stepper motor control routines that are compact and use little CPU time. The software takes full advantage of the capabilities of the MC100 board. All of the MC100 board's features are accessible to and usable by the programmer from Microsoft M80 assembler or Basic 80. Source code is included for all of the software.

### Hardware

The MC100 is a high-quality board that conforms to the IEEE 696/S-100 specification. It is made of green fiberglass/epoxy, solder-masked, and has silk-screened part numbers. All S-100 pins are present, and the parts all appear

to be of excellent quality. I have experienced no electrical or mechanical problems with the board despite running it 24 hours a day for several months in a very hot, completely filled North Star Horizon computer. All the cable connectors terminate at the top of the board, so it doesn't have to be removed to make changes unless jumpers or the board's address are to be changed. The board has a set of four tiny LEDs in a block at the top of the board that monitors the position of the limit switches. This can be handy in detecting damaged or mis-set switches, especially if the external control box is not used.

The control panel is also well built. Its operation is self-evident from the markings on its front panel. The manual includes schematics of the control box, but the theory of its operation is not given. Basically, it contains a 555 chip, configured as an oscillator, which is used to generate pulses to drive the stepper motors. Either motor can be selected, the directions selected (CW or CCW), and the motor speed varied.

Although it's not absolutely necessary to use the control box, most users would want it because it can be very helpful when bringing up the controller for the first time, as well as in development work and in case of any problems with the software, computer, MC100 board, stepper motors, or limit switches. The control box can make it much quicker to isolate a problem. Using the control box, the steppers can be operat-

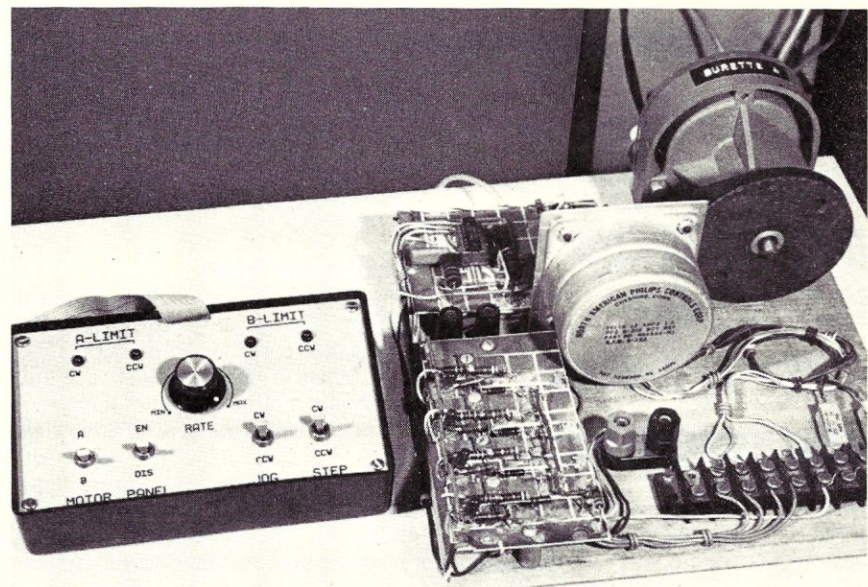


Figure 1. Stepper motor connected to peristaltic pump. The electronics on the board consist of driver transistors connected to the motor windings and flipflops that are connected to a parallel output port. Use of the MC100 eliminates the necessity for these electronics. The device on the left is the MC100 control panel.



# Snow MC100

Continued from page 81

ed independently of software and even independently of the S-100 bus as long as the bus power supply voltages are present.

## Set-up of the board

The board contains only a few jumpers; they configure the board for 8 V, 16 V, or external voltage to operate the stepper motors, internal or external counting of motor pulses, and for interrupt operation of the board. Most of the options are clearly explained (if not self-evident) and should cause no problems. Each motor may be configured independently.

Two items that gave me trouble in the set-up were the board address switches and the interrupt jumpers. When I set the DIP switches per the manual, the board was at the wrong address block. (The board uses a block of 12 addresses and can be set on any multiple of 10H.) The problem turned out to be the switch numbering. The switch itself contains numbers, and there are numbers silk-screened on the board. Naturally, they are different. I have seen many variations on this problem and it should no longer catch me, but it does. There ought to be a warning about this in the manual.

The jumpers for interrupt operation are explained in the manual, but exactly how to set them to work with the MC100 software package was not clearly set forth. I got them by studying the manual very carefully, then doing a bit

**It is easy to do fancy and sophisticated things with stepper motors.**

of trial and error while running a demonstration program included with the software. (I tried several combinations until I found the one that worked.)

The MC100 can be operated in an interrupt-driven or polled mode. The interrupt-driven mode allows somewhat more versatile operation of the board. The only reason for using polled soft-

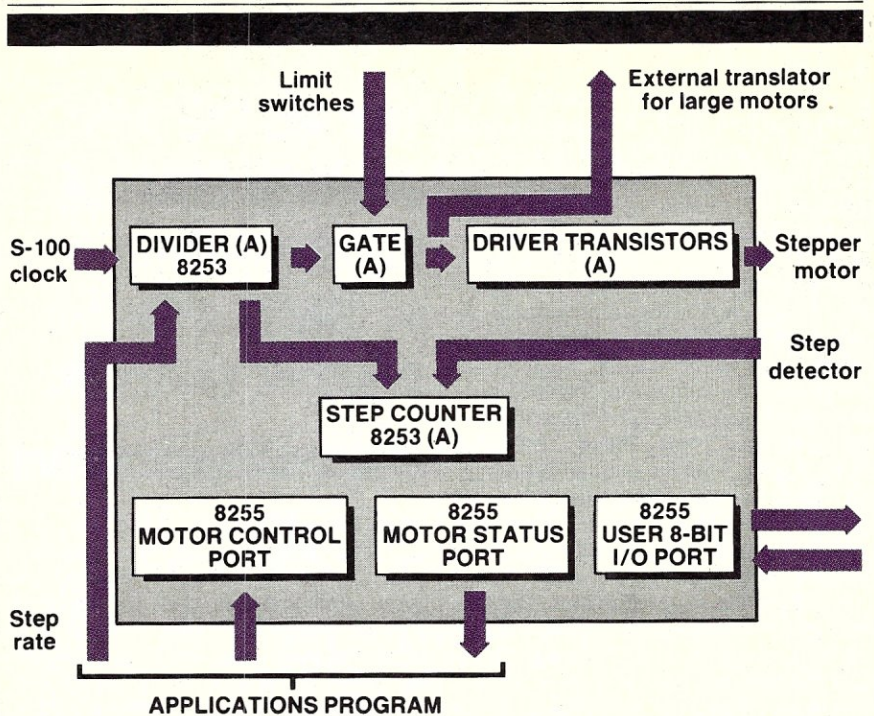


Figure 2. Simplified block diagram of the MC100. The sections marked (A) are duplicated for a second motor.

ware would probably be that your hardware does not support interrupt operation.

The MC100 has provision for driving stepper motors that exceed the power limits imposed by the board. This is done with a 26-pin connector which can be run to an external translator that contains large power transistors and supplies sufficient power to operate large motors. The signals to the external translator presumably are standard and usable with all such devices; I have done no work with high power stepper motors, so external translators are outside my experience.

## Initializing the board

Because at first I could not use the software package (more about why not later), I attempted to write a simple Basic program to initialize the board and operate the motors. I did not quite succeed until I called Snow Micro Systems, where I received assistance from Mr. Ted Rabenko, who wrote a simple Basic program for me that initializes the board and runs the stepper motors. I have since learned that Snow is supplying this program in the MC100 documentation, which means that it should be much easier to bring up the board and test it without making any use of the main MC100 software package. Listing 1 is the program I wrote and fixed with

the help of Snow. Their version is a little more complex and illustrates the use of more MC100 features.

This example program is useful as a way of familiarizing yourself with the board. The relation between values loaded into the counters and motor stepping speeds can be seen by trying different values. The use of the motor control port to enable or disable the motors, change their directions, etc., can be studied. The use of the motor status port can likewise be explored. This is the way I learn best, and a few minutes of playing around with the program was more illuminating than the hours I had spent studying the MC100 hardware manual.

## Manual

The manual furnished with the MC100 is well written. It includes a section on the theory of operation of the board that is quite detailed and easy to follow. It contains extensive sections on programming the 8253s and 8255 for use with the MC100. There are additional sections on configuring the board jumpers, several installation examples and a parts layout drawing, and a set of nicely drawn schematics. Some of the printing on the schematics is very small and a bit hard to read. There is also a list of which S-100 signals are used, which is something all manufacturers really should supply in their documentation.



**Table 1. Parameters passed to driver software from Microsoft Basic.**

1. Total No. of steps (less than 32,768)
2. Starting (minimum) motor step rate
3. Ending (maximum) motor step rate
4. Change in step rate during ramp up/down
5. No. of steps taken at each rate during ramp up/down
6. Motor select
7. Motor direction (cw/ccw)
8. Motor final state (cw/ccw/stop)
9. Enable/disable ramp up
10. Enable/disable ramp down

*There is a 1-to-1 correspondence between these values and those in Listing 2 in the call statement.*

**Table 2. Hardware-dependent configuration switch settings**

Switch	Default value(s)
Board base address	E0
User I/O port	Bits 0-3 in, bits 4-7 out
Interrupt operation	True for interrupt version (BMOTOR) False for polled version (PMOTOR)
External control of interrupts	False: driver enables and disables interrupts as required
Vector interrupt location	V17

The manual is not written with the beginner in mind. I had never actually had to program chips like the 8255 and 8253 used by the MC100, but I was familiar with the basic idea. Still, several hours of studying the manual along with an Intel Data manual and a call to Snow Micro Systems were required to clarify things.

The newly supplied Basic program amounts to a great improvement in the documentation for the first-time user, but still, someone with no assembly language experience would find the manual a challenge. The manual, 32 pages long and printed on good quality paper, includes a table of contents but no index.

### Software package

The purpose of the software package is to provide control of the MC100 from applications programs written using Microsoft Basic 80 or M80 assembler.

The fundamental idea is that in an application you will have a sequence of operations for a stepper motor to perform, such as to start up, run for a while at a particular speed, ramp up to a higher speed, reverse direction if a limit switch opens, etc. The software allows you to carry out such operations in a straightforward, easy way. The applications program passes information to the stepper motor driver software, which

translates the data into values that are loaded into the hardware on the MC100 board. Table 1 shows the parameters passed to the driver.

Once the driver software is installed and working properly, it is easy to do all sorts of fancy, sophisticated things with stepper motors. My previous work with stepper motors involved using them to drive small chemical pumps at various speeds. Just making a motor run at a high speed using the parallel port interface I described previously is impossible in Basic, so the ability to control two motors, making them accelerate, decelerate, reverse direction, etc., all while using very little CPU time is most impressive.

The heart of the software package is a program named CORE. For use with Basic programs, CORE is linked with several other files to produce a program (BMOTOR.COM) which is located at the top of memory, just below CP/M. Parameters are passed through this driver from the Basic program to the MC100 board. BMOTOR.COM is supplied and ready to use unless your hardware conflicts with it. BMOTOR is for interrupt operation. PMOTOR is a polled version of the driver.

For programs written in M80, CORE is used by linking it to the applications program using the Microsoft Linker.

### Installing the software

Table 2 gives the configuration settings supplied by Snow, which may have to be changed before you can use the software. If these settings cause no conflicts, then no installation is required and the software may be used immediately. The command sequence

```
A > BMOTOR      (or PMOTOR)
B > MBASICDEMO (or PDEMO)
```

will install the driver and then run the demonstration program which, if all goes well, will result in a pair of running stepper motors. If only the location of BMOTOR (or PMOTOR) needs to be changed, as was my situation, then a submit file, supplied with the software, can be used to make the new version. You simply run the submit file, specifying the address where BMOTOR is to be placed. The submit file uses ZSID and L80.

This was a point where I got stuck, since I didn't have ZSID. Snow Micro Systems was kind enough to do the relocation of BMOTOR for me. (Snow will supply users of the software with a relocated version of BMOTOR/PMOTOR for a nominal charge.) I have since acquired ZSID and done the relocation myself with no problems.

If other changes in the configuration switch settings are required, then CORE.MAC and BDISPTCH.MAC and possibly HARDWARE.VAR must be modified and reassembled. The source files are well documented, and a user with a modest amount of experience with assembly language programming should be able to change the configuration switches with no problem. BDISPTCH translates data from the Basic program

**The heart of  
the software  
is a program  
called CORE.**

into a form that can be read by CORE, and HARDWARE.VAR sets the base address for the board.

### Documentation

I was unable to get the software running until I had made several calls to Snow Micro Systems. The problem was



# Snow MC100

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that the documentation did not make it very obvious how to get started.

I tried carefully studying the manual, which was not of much help. I tried looking through the listings of all the source files on the disk. I was more confused. A few minutes on the phone with Snow on a couple of occasions got me going.

Partly, I believe, as a result of my phone calls and questions, Snow is now shipping a three-page addendum to the manual that should allow the first-time user to get things going with less trouble than I had. The addendum consists of a list of the files on the disk, with an explanation of what each is for. Information includes how to proceed from the simplest test program I referred to earlier through how to configure and use the Basic driver package.

The manual consists in large part of an explanation on the theory of CORE and how it is used. This is where I got bogged down initially: you don't need to know how CORE works to run the software package and try the demonstration programs.

The last sections of the manual

## Listing 1

```

1000 REM          SIMPLE PROGRAM USED TO ATTEMPT TO RUN MOTORS
1010 REM          USING SNOW MICROSYSTEMS INC. MC100 STEPPER
1020 REM          MOTOR CONTROLLER
1030 REM
1040 REM          AUGUST 1983
1050 REM          J.W. LONG
1060 REM          CHEMISTRY DEPARTMENT
1070 REM          BROOME COMMUNITY COLLEGE
1080 REM          BINGHAMTON, NY 13902
1090 REM
1100 REM
1110 REM-----SETUP BASE ADDRESS OF BOARD-----
1120  BASE=&HE0 : REM SEE MC100 USER'S MANUAL PAGE 5 TABLE 3.1
1130          REM SEE TABLE 3.2 FOR THE OFFSETS TO THE BASE ADDRESS
1140          REM FOR ALL FOR THE PORTS AND REGISTERS USED BY THE MC100
1150          REM SOME OF WHICH ARE USED IN THIS EXAMPLE PROGRAM.
1160 REM-----END ADDRESS SETUP-----
1170 REM
1180 REM
1190 REM-----8255 INITIALIZE-----
1200  OUT BASE+&HB,&H82 : REM SEE MC100 USER'S MANUAL PAGE 14, TABLE 4.4
1210 REM          REM OTHER POSSIBLE VALUES ARE 83H, 8AH AND 8BH.
1220 REM-----END 8255 INITIALIZE-----
1230 REM
1240 REM
1250 REM-----MOTOR CONTROL REGISTER (8255) INITIAL VALUE-----
1260  OUT BASE+&B,&HFF : REM SEE MC100 USER'S MANUAL SECTION 4.2.1
1270          REM CHANGING VALUES HERE WILL ENABLE/DISABLE
1280          REM MOTORS, CHANGE DIRECTIONS, ETC.
1290          REM THE &HFF ENSURES THAT BOTH MOTORS ARE
1300          REM OFF UNTIL APPROPRIATE VALUES ARE LOADED
1310          REM INTO THE COUNTERS.
1320 REM-----END MOTOR CONTROL REGISTER INITIAL VALUE-----
1330 REM
1340 REM
1350 REM-----8253 INITIALIZE-----
1360 REM--INITIALIZE 8253 FOR MOTOR A--
1370  OUT BASE+3,52 : REM SEE MC100 USER'S MANUAL 4.1.1 PAGE 13
1380  OUT BASE+3,116 : REM DECIMAL VALUES USED HERE
    
```

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RM FORTRAN COMING			

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# Snow MC100

Continued from page 84

contain an explanation of the configuration switch settings and two appendices that explain how to use the package with assembly language and Basic. These sections are very brief. The assembly language section explains that to write a new program the sample program (TEST.MAC) and/or the driver (CORE.MAC) may be modified, then reassembled with M80 and linked with L80, which is straightforward. There is no specific advice on writing assembly language programs for the MC100 except for the example program TEST.MAC. I had trouble understanding TEST.MAC, but the problem is perhaps with me: my version of M80 is earlier than the one used by Snow and lacks some features of the newer release. Several of these features are used in TEST.

The Basic section of the manual is chiefly concerned with generating the driver for use with Basic. I found this section of the manual confusing until I made another telephone call to Snow Micro Systems and received an explanation of the fundamental idea behind the installation of the driver. The manual contains no specific information on us-

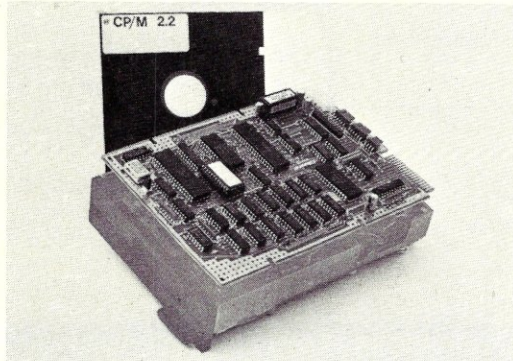
```

1390 OUT BASE+3,176
1400 REM--END 8253/A INITIALIZE--
1410 REM
1420 REM
1430 REM--INITIALIZE 8253 FOR MOTOR B--
1440 OUT BASE+7,&H34 : REM SEE MC100 USER'S MANUAL 4.1.1 PAGE 13
1450 OUT BASE+7,&H74 : REM HEXADECIMAL VALUES USED HERE
1460 OUT BASE+7,&H80
1470 REM--END 8253/B INITIALIZE--
1480 REM-----END 8253 INITIALIZE-----
1490 REM
1500 REM
1510 REM-----LOAD 8253 COUNTERS FOR EACH MOTOR-----
1520 REM--FIRST MOTOR A--
1530 OUT BASE+0,64 : REM RATE GEN 0 MOTOR A, LOW BYTE * 2000000/64=31250 HZ
1540 OUT BASE+0,0 : REM RATE GEN 0 MOTOR A, HI BYTE *
1550 OUT BASE+1,156 : REM RATE GEN 1 MOTOR A, LOW BYTE * 31250/156=200 HZ
1560 OUT BASE+1,0 : REM RATE GEN 1 MOTOR A, HI BYTE * SEE SECTION 4.1.2
1570 OUT BASE+2,10 : REM STEP COUNTER MOTOR A, LOW BYTE
1580 OUT BASE+2,20 : REM STEP COUNTER MOTOR A, HI BYTE
1590 REM--MOTOR A COUNTERS LOADED--
1600 REM
1610 REM
1620 REM--NOW MOTOR B--
1630 OUT BASE+4,64 : REM RATE GEN 0 MOTOR B, LOW BYTE 2000000/64=31250 HZ
1640 OUT BASE+4,0 : REM RATE GEN 0 MOTOR B, HI BYTE
1650 OUT BASE+5,56 : REM RATE GEN 1 MOTOR B, LOW BYTE 56 & 1 BELOW ADD TO
1660 OUT BASE+5,1 : REM RATE GEN 1 MOTOR B, HI BYTE 312. 31250/312 IS 100 HZ
1670 OUT BASE+6,254 : REM STEP COUNTER MOTOR B, LOW BYTE
1680 OUT BASE+6,10 : REM STEP COUNTER MOTOR B, HI BYTE
1690 REM--MOTOR B COUNTERS LOADED--
1700 REM
1710 REM
1720 REM-----TURN ON MOTORS USING MOTOR CONTROL PORT-----
1730 OUT BASE+8,&HCO : REM TURNS ON BOTH MOTORS, BOTH CCW ROTATION. BOTH
1740 REM CONTINUE RUNNING EVEN AFTER REACHING TERMINAL
1750 REM COUNT. SEE MC100 USER'S MANUAL SECTION 4.2.1.
1760 REM TO CHANGE MOTOR DIRECTIONS, ETC CHANGE THE
1770 REM VALUE OUTPUT HERE.
1780 REM-----END MOTOR TURN ON-----
1790 REM

```

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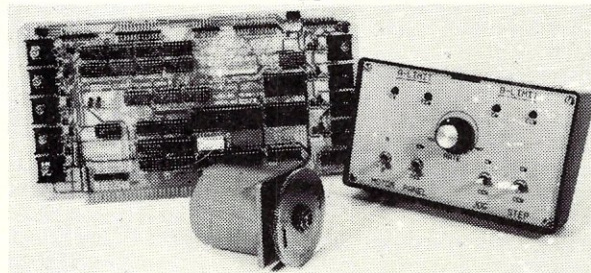
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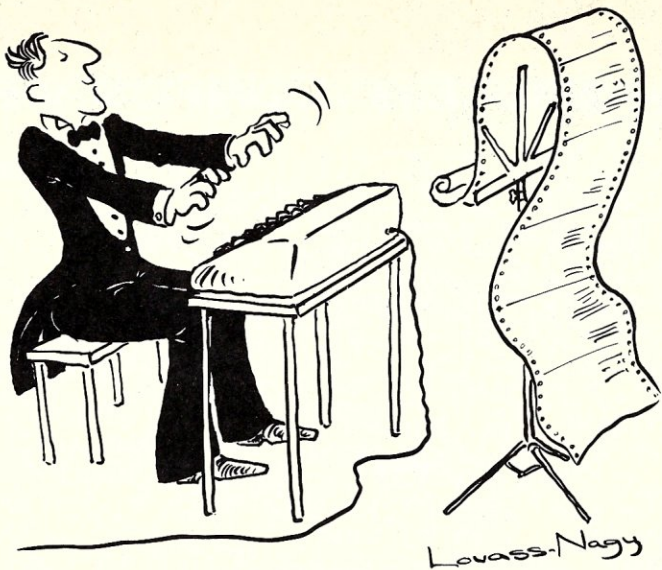
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# Snow MC100

Continued from page 86  
ing the Basic/driver software. The example program (BDEMO or PDEMO) can be used as a reference, along with the manual. I found BDEMO to be somewhat difficult to follow, as it contains numerous GOTOs and its documentation is a bit sparse. I probably spent two hours going back and forth between BDEMO.BAS and the MC100 manual until I had it figured out, which probably is not an unreasonable amount of time, considering the scope of the program.

The manual is 15 pages long. It has a table of contents but no index.

## Other languages

Snow supports only Microsoft Basic 80 and M80 for use with their software. Microsoft Fortran is mentioned in their ads, but no mention is made of it in the documentation. It would seem that both Microsoft Fortran and compiled Basic should work with the MC100, but I have not tried them. It is possible that other Basics would work with the MC100 if they can pass integer (2 byte, ordered low byte, high byte) data to the Basic driver, but it is up to the user to

```
1800 REM
1810 REM -----COMMENTS-----
1820 REM AT THIS POINT BOTH MOTORS SHOULD BE RUNNING, MOTOR A AT
1830 REM TWICE THE SPEED OF MOTOR B. THE MOTORS WILL CONTINUE
1840 REM RUNNING EVEN WHEN THE PROGRAM STOPS. BECAUSE OF THE
1850 REM MOTOR CONTROL BYTE VALUE (&HC0) WHICH DOES NOT STOP THE
1860 REM MOTORS EVEN WHEN THE TERMINAL COUNT IS REACHED.
1870 REM
1880 REM THE MOTOR STATUS CAN BE MONITORED BY READING THE
1890 REM MOTOR STATUS PORT (BASE+8). SEE MC100 USER'S MANUAL
1900 REM TABLE 4.6, PAGE 19.
1910 REM
1920 REM
```

## Listing 2

```
2000 REM ALL VARIABLES BELOW TYPE INTEGER
2010 REM .
2020 REM .
2030 REM .
2035 CALL SYSINIT : REM INITIALIZE MC100 HARDWARE
2040 REM .
2050 REM .
2060 REM .
2070 CALL BUFF (ATOTSTEP,AMINFREQ,AMAXFREQ,DELTAUFREQ,DELTASTEP,
AMOTORSELECT,AMOTORDIR,AFINAL,ARAMPUPDIS,ARAMPDNDIS)
THIS CALL SENDS VALUES FOR MOTOR A TO BUFFER IN DRIVER.
A SIMILAR CALL CAN BE USED FOR MOTOR B
2080 REM
2090 REM
2000 REM .
2010 REM .
2030 REM .
2040 AMOTORSTATE=USR(AMOTORSEL) : REM CHECK STATUS OF MOTOR A
2050 REM .
2060 REM .
2070 REM .
```



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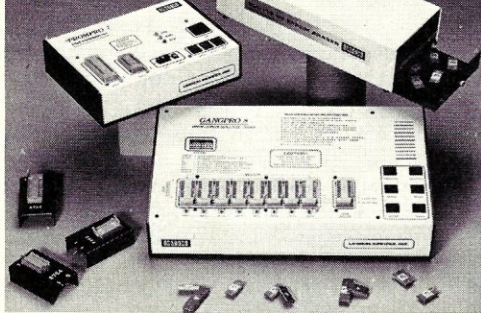
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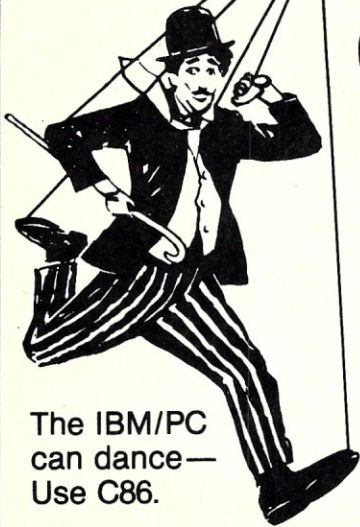
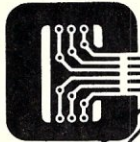
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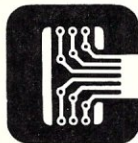
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## Snow MC100

Continued from page 88  
determine whether it is possible and just how it would be done.

### Summary

The MC100 package is very high quality and does exactly what is claimed for it; it is a powerful, sophisticated stepper motor control/development system. The documentation for the product is adequate for programmers with some assembly language experience, but could be improved to make the system easier to install and use for less experienced persons.

Snow Micro Systems has a new revision of the software in preparation that will enhance the utility of the MC100 package. It will be ROMable, usable with both Z80 and 8080 processors, and allow higher step rates and contain numerous enhancements and improvements, as well as improved documentation. The new revision will probably be available by the time this is published.

### References

Bober, R.E.: "Taking the First Step," *Byte* (February 1978), pp. 35-112.

Guilder, J.: "Focus on Stepping Motors," *Electronic Design* (October 25, 1977), p. 48.

Joseph W. Long, Department of Chemistry and Chemical Engineering Technology, Broome Community College, Binghamton, NY 13902

### VENDOR INFORMATION

#### Products:

MC100 Dual Stepper	
Controller	\$350
Manual Control Panel	\$135
Software (8" CP/M)	\$ 35

#### Hardware requirements

IEEE 696/S-100 system  
Block of 12 I/O ports

#### Software requirements

32K CP/M  
Z80 processor  
ZSID (possibly required for installation)  
Microsoft Basic 80 and/or M80 assembler, version 3.0

#### Manufacturer

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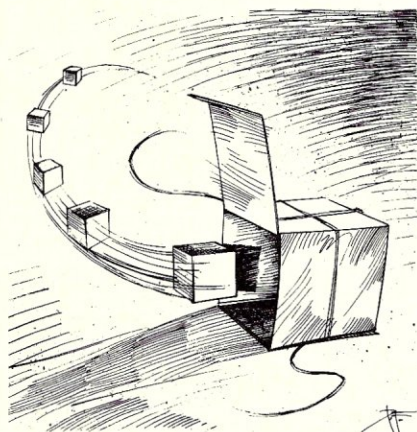
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---

# Simplify your Command Lines

**Create CP/M  
files on the  
fly with  
SYNONYM**



by Joseph Katz

---

**A**mong the handiest programs to have on a CP/M system is SYNONYM, a public domain program written by Bill Allen and modified by him and Roy Lipscomb to version 3.0.

SYNONYM builds CP/M commands. It does not create new programs, but it does allow you to use existing programs more efficiently by creating new commands that may be executed on the command line from the CP/M prompt (A>, B>, etc.).

That may sound silly, but if you think about it for a few moments, it should suggest itself as a downright useful capability.

Say you want to run a program written in Microsoft Basic, and it needs to reserve two files and the first 36K of memory. Issuing the command to do all that requires entering the command

```
MBASIC FILENAME/F:2/M:&H9000
```

and if you think that is a simple matter, especially if you have to do it over and over again, you should have little interest in SYNONYM. What SYNONYM

can do is let you create a new CP/M command that will save you from having to type that nonsense time after time. Just typing a single letter and ENTER can supply the entire command line, once it is installed with SYNONYM.

Or suppose you are, like I am, a mite casual about labeling disks as you work with them. You know, you tell yourself you'll remember that the one with the thumbprint on the upper right-hand corner has your spreadsheet template for I.R.S. Form 1040. Sure you will. So tax time comes around and you have to hunt among several disks, all with thumbprints on them. The old way to do it is to put one disk after another into Drive B and type DIR B: until the right one unveils itself. The new way, with SYNONYM, is to create a command like B.COM that merely requires you to type B and press ENTER to process those unlabeled disks on a mass-production basis.

Or perhaps you use business software that requires complicated commands and is finicky about how they are entered. I use dBASE II from Ashton-Tate, and DataStar and SuperSort from MicroPro International. The most efficient way to invoke these programs is to follow them on the CP/M command line with instructions about the routine they should follow. For instance, you



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# SYNONYM

Continued from page 92

know that in dBASE II the easiest way to get to work with the date demonstration file is to issue the command as DBASE DATER, and the best way to work on the demonstration invoicing file with DataStar is the enter DATASTAR ORDERS. SYNONYM allows you to write each command line into a separate file. Type DATE, for example, and you get dBASE II doing its stuff automatically; type ORDERS and DataStar goes into action.

SYNONYM is at its best in really complicated situations such as those of-

ferred by a program like SuperSort. SuperSort will sort almost any file in almost any way, but remembering how to use its commands is difficult for anyone who does not use the program frequently. Here is one set of commands needed to sort a file called SAMPLE.DAT:

```
A> SORT
INPUT = 62, CR-DEL
SORT-FILE = SAMPLE.DAT
OUTPUT-FILE = OUTPUT.DAT
KEY = #4, 6, DESCEND
GO
```

That is not as easy to remember as DOIT.

Fortunately, SuperSort allows you

to use your word processor (in nondocument mode, of course) to write that sequence into a command file with the extension .CMD. Then all you have to do is issue something like the following command:

```
A> SORT CFIL=DOIT.CMD
```

If you cannot remember that, you can look up the command sequence in the manual. Or use SYNONYM to create DOIT.COM, then type DOIT and press ENTER. That way is simpler, because you can use SYNONYM to build a command "on the fly." To use SYNONYM, follow this model and type

```
SYNONYM NEWNAME OLDNAME PARAMETER
```

What results is the new command.

Let us take that step by step. SYNONYM invokes the program, of course. But you cannot simply do that and wait for prompts about what to do next: the new command name and everything you want it to do must be entered when you invoke SYNONYM.

So NEWNAME is the name of your new command, the one you are creating to save you work. In my example it would be DOIT (you do not type DOIT.COM because SYNONYM adds the extension).

Next comes OLDNAME (again without the extension .COM because SYNONYM knows that whatever follows NEWNAME is a command file).

Then come the parameters to be passed to OLDNAME—whatever you want it to do. The SuperSort example has all parameters included in the file DOIT.CMD, so no parameters are included in DOIT.COM. Now take the command to read the directory of Drive B, for example. If that is all you want—to read the entire directory—there would be no parameters and you would simply use SYNONYM to create B.COM containing the command DIRB:. But if you wanted to find a particular file, you would need the filename as a parameter. You can install it as part of B.COM or can issue it as a runtime parameter by entering the command B FILENAME and pressing enter.

Suppose you wanted to search a stack of unlabeled disks inserted one after another into Drive B for a spreadsheet template called 1040.CAL. That filename would be the parameter, and the command you would need would be DIRB:1040.CAL.

Now all you need to find it, with SYNONYM and some elbow grease, is to create that command by issuing the following command:

```
SYNONYM B DIR B:1040.CAL
```

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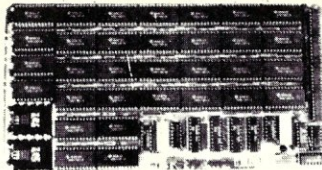


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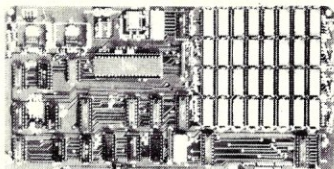
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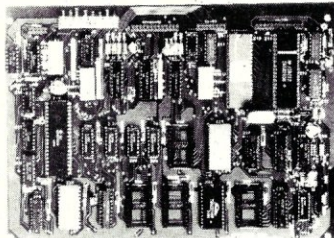
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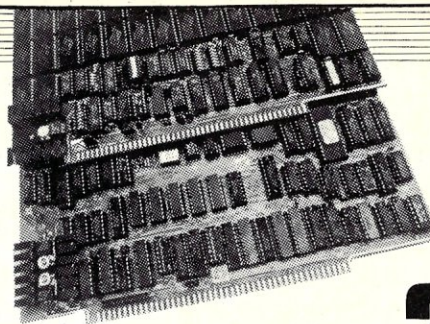
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# SYNONYM

Continued from page 94

After a second there is a new file on your disk: B.COM. Type B and press ENTER and the search begins on Drive B for the file 1040.CAL.

When you find it, you are in business. You can begin getting information together for your tax return or, depending on the command you had SYNONYM create to you, anything else.


What do you do with the command SYNONYM has created when you are through with it? Erase it if you like. For a trivial operation like the directory scan, that probably is what you ought to do to avoid cluttering the disk and its directory with needless files. But if the new command has a continuing use, keep it. Do not worry about forgetting what B.COM does: if ever you want to see its contents, use the CP/M resident command TYPE and TYPE B.COM.

Bill Allen and Roy Lipscomb deserve a great deal of credit for creating SYNONYM, version 3.0, and giving it free to the community of CP/M users. I am additionally grateful to Bill Allen for reading the manuscript of this article and for his permission to include the source code here. The object code,

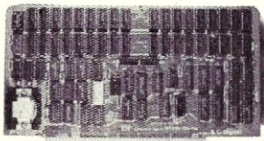
## SYNONYM lets you use existing programs more efficiently by creating new commands that are executable from the CP/M prompt

SYNONYM3.COM, is available on many remote CP/M systems for the price of some time and a telephone call. (A similar program is included with Fox & Geller's Quickcode, a dBASE II utility program.) But the source code is

a little more difficult to come by. Because it can be customized to make SYNONYM even more useful than it already is—for example, by making SYNONYM set the NEWNAME.COM to \$ SYS so that it is invisible to the directory—it is well worth having.

I have tidied the source code a little and tested SYNONYM thoroughly on Pickles & Trout CP/M 2.2 and Radio Shack's Model II microcomputer. It should work as is on any standard CP/M. Owners of Radio Shack's Model I and of early Heath equipment, and anyone else with a nonstandard CP/M, will have to change the ORG equate to reflect the beginning of the TPA (Transient Program Area) and may have to change the equates at the following labels: CURDRIV, CPMEP, DISPLC. The equate at DISPLC is used in computing the address of the CCP (Console Command Processor) and assumes that it starts 0800H bytes below FBASE. I have used "+++" to mark the beginnings of the areas that may have to be changed. SYNONYM.ASM can be assembled using the Digital Research, Inc., assembler ASM.COM. 

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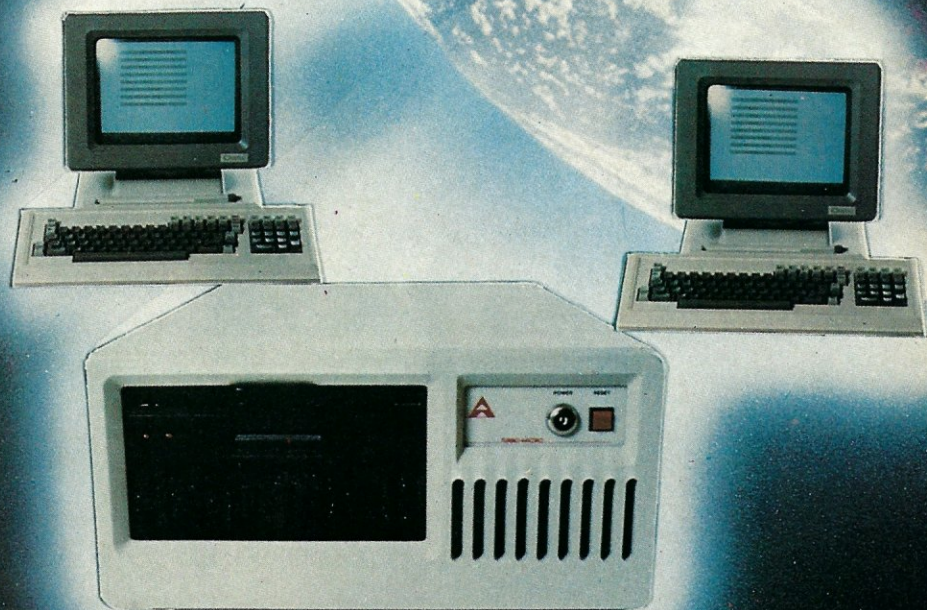


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---

# UNIX Front-End Power for CP/M

**Add UNIX  
directory  
structure and  
command-line  
processing  
with C/NIX**

by Robert A. Langevin

---

**S**canning the contents pages of some of the current microcomputer journals gives the impression that UNIX is taking over the world. If, like me, you have an 8-bit system with CP/M-80, you have probably been envious of 16-bit owners for whom hierarchical directories, pipes, and I/O redirection are everyday words. Fortunately, inexpensive help is at hand in the form of C/NIX-80, a new product from C/Craft.

C/NIX, written in C, runs in conjunction with CP/M and provides an impressive array of features. These include:

- Hierarchical directories
- Input/output redirection
- Pipes
- Nestable shell files
- UNIX-like commands and programs
- On-line help files

Together, this collection of features provides a real taste of UNIX and, in my opinion, is superior in some respects to the earlier efforts represented by Microshell and Unica.

---

## Program summary

As supplied, C/NIX-80 consists of three basic programs: **cnix.com**, a 25K program that implements most of the C/NIX features; **cnixhigh.sys**, a 1.4K program that is loaded immediately below the CCP when C/NIX is first started and remains resident until C/NIX exits; and **cnixutil.pre**, an 11K program that loads above C/NIX when needed and implements the commands **chmod**, **mkdir**, and **rmdir**.

Numerous additional programs are included in the package, including **grep.pre**, a 10.4K program that implements a UNIX-style generalized regular expression parser; **mkrel.com**, a 9.5K program that permits you to create relocatable versions of machine language programs that will load immediately above C/NIX; 84K of help files that provide on-line access to the entire C/NIX manual; and 56K of C source code for a variety of useful functions. All in all, at its current \$65 price, C/NIX-80 provides more capability than you would believe possible.

## C/NIX features

**Hierarchical directories.** Hierarchical directories are implemented in C/NIX by using the user feature of CP/M to provide subdirectories. User numbers 6 through 31 are used for this



purpose, so that 26 subdirectories can be defined on a single physical or logical disk drive. The C/NIX implementation permits subdirectories to be nested four deep, enough for most practical purposes. The root directory on an individual disk is identified by /x, where x is a drive letter. The path name to specify a particular file is then of the form

```
/x/dir1/dir2/.../name.ext
```

where dir1, dir2, etc., are subdirectories along the path to **name.ext**.

C/NIX maintains a record of the current (last used) directory for each disk, and these current directories can be referenced by the short form **x:**, where (as before) x is a drive letter. This is of considerable importance, since normal CP/M programs are unable to parse a path name—a limitation that can be partially obviated by incorporating the programs in shell files. It is noteworthy, by the way, that neither of the competing products, Microshell nor Unica, implement hierarchical directories—one of the most appealing features of UNIX.

Unfortunately, except for shell files, as discussed below, C/NIX does not offer a path search capability. As a result, a file not in the current directory of a logged disk must be accessed by using its full path name. In practice, this is not a serious deficiency.

**Input/output redirection.** Input/output redirection is implemented in C/NIX in a fairly extensive way, going somewhat beyond the capability afforded by UNIX. Four operators are available for redirecting console output: **>**, **>>**, **>+**, and **>&**. These are used with the syntax “command operator outfile”. The first operator, **>**, is used if the outfile does not exist. An outfile is created, and the output of command is written to it. If the outfile exists, the use of **>** will abort the operation (with no error message). The second operator, **>>**, will append the output of command to the end of outfile. The third operator, **>+**, displays the output of command on the console as it is written to outfile. The last form of the operator, **>&**, writes both normal console output and error output to outfile. Error output is defined in C/NIX as output produced using the BDOS direct console output function.

C/NIX supports console input redirection with three operators, **<**, **<+**, and **<** (text). The syntax of the first two operators is “command operator infile”. Of these, the first uses infile instead of the keyboard as the source of input to command. The second causes infile to be echoed to the console as it is read. The last form, **<** (text), is used primarily in shell files and supplies text to com-

mand when console input is requested. Text can contain control characters.

Finally, a number of combined forms is also supported: **>>+**, **>>&**, **>+&**, and **>>+&**, where, as before, **+** means input display, **&** means error redirection, and **>>** means appending. Together, the C/NIX redirection operators provide more flexibility than you are ever likely to use.

**Pipes.** Since CP/M doesn't support concurrent processing, C/NIX implements pipes by using temporary files that hold the interprocess results. These are created on the disk from which C/NIX is loaded, although a patching procedure (using DDT) is provided in the manual for designating a different disk for these temporary files. As you would expect, they are deleted after use. The pipe operator is the familiar UNIX **|** and is used with the same syntax as in UNIX, **command1 | command2 | command3 | . . .**. Thus the output of **command1** is supplied as input to **command2**; its output, in turn, is supplied as input to **command3**, and so forth.

While this implementation of pipes is relatively slow as a consequence of creating, writing, reading, and deleting the temporary files that implement the pipe operator, there is no real alternative in the absence of a concurrent processing capability. However, if you need

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## C/NIX, with an impressive array of features, provides a real taste of UNIX.

---

to use pipes frequently and have implemented a RAM disk on your machine, you can significantly improve the speed of pipe operations by patching C/NIX, using the instructions provided in the manual, so that pipes are created on the RAM disk instead of on a floppy.

**Shell files.** Shell files, which are called command files in the C/NIX manual, provide all of the capability of CP/M's **submit** and **xsub** constructions and more. A shell file always has a name of the form **name.sub** and may reside in any directory in your system. The contents of the file consist of a list of one or more CP/M or C/NIX commands. The

list is terminated by control-Z. Unlike CP/M **submit**, shell files can contain control characters and can be nested.

A shell file is invoked simply by supplying its name without the sub extension. Thus, for example, if **cs.sub** is a shell file to clear the screen on the console, typing “cs RETURN” will invoke a subshell of C/NIX, execute the shell file **cs.sub**, and return to the directory from which the subshell was invoked.

As C/NIX is presently implemented (version 1.01), shell files are the only files for which a simple path search capability is implemented. This works as follows: If a shell file is invoked, C/NIX first looks for the file in the current directory. If the file is not found there, C/NIX looks for the file in the top-level directory of the disk from which C/NIX was loaded. If the file is still not found, C/NIX finally looks for it in the top-level directory of the disk in drive A. If the file is not found there, C/NIX aborts the operation with a message that the file was not found.

**Wildcards.** C/NIX supports the use of wildcards in filenames, and these are fully expanded by the command interpreter. As with CP/M, the character **?** will match any character in a filename. Likewise, the character **\*** will match any character string in a filename, but unlike its use in CP/M, if **\*** is used at the end of the name or extension part of a filename, it is equivalent to a string of **?**s.

### C/NIX commands

The available C/NIX commands are shown in Table 1. In the command statements, optional flags are shown in square brackets, alternatives are separated by vertical bars, and ellipses (. . .) are used to represent lists of files or parameters.

While the function of most of these commands is either self-evident or is the same as that of the corresponding UNIX command, there are a few differences from UNIX usage that are worthy of note.

The **cat** command, when used alone, asks for user input from the console. The input is terminated by entering control-Z. When used to concatenate files, the hyphen, **-**, stands for console input. Thus the following construction is possible:

```
cat file1 - file2 > outfile.
```

This command string will create outfile and write file1 to it. Then the command processor will append whatever is input from the console to outfile until a control-Z is encountered, after which it will append file2 to outfile and terminate.

The **chmod** command is used to set





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# C/NIX-80

Continued from page 99

a file or files to read-only status, **-w**, or read/write status, **+w**. In addition it permits you to mark a file as system, **+s**, or nonsystem, **-s**. Files marked as system files are not displayed when the short form, **ls**, of the directory command is used. They are displayed, however, when the long form, **ls -l**, is used.

The **-v** flag in the subshell command, **cs**, causes each command from the invoked command file to be echoed to the console before it is executed.

When using the **era** command to erase files, the **-f** flag generates a query on the console before each file is erased.

Finally, the **mkrel** command is unique to C/NIX. Its syntax is

```
mkrel file100 file200 file.pre.
```

The parameters, **file100** and **file200**, are identical machine language files except for the fact that the first is originated at 100H and the second at 200H.

The result of executing the **mkrel** command string shown above is to produce a relocatable version, **file.pre**, of

the program in **file100** that will load and execute immediately above **cnix.com**. As a result, when **file.pre** has finished executing, **cnix.com** does not have to be reloaded.

## Additional features

In addition to the basic C/NIX as described above, the distribution disk contains the source code, written in C, for a number of library functions that will be useful to C programmers. These include the following:

- bdos** — a C interface to BDOS
- getc** — buffered character input
- fopen** — buffered file open and close
- main** — hidden main to interface to C/NIX
- malloc** — dynamic memory allocate and release
- putc** — buffered character output
- strutils** — standard string utilities

All of these functions use the calling conventions of the Software Toolworks C/80 C compiler. In part, they replace the library functions already supplied with it by alternative versions that interface more readily with C/NIX.

## Documentation

The documentation supplied with C/NIX-80 consists of a 41-page, 8½ by 11" offset manual best described as terse but adequate. The manual is organized (without an index) in the same format as UNIX manual pages, so that for each C/NIX command you find the usual name, synopsis, description, notes, see-also, and bugs sections.

Actually, all the information that

# C/NIX supports the use of wildcards in filenames.

you need to know about C/NIX is in the manual, but it can be devilishly difficult to dig out. Worse, some knowledge of the UNIX command language and structure is almost essential to make effective use of the manual. For those without such background, an introductory UNIX reference text such as *A User Guide to the UNIX System* by Thomas and Yates (Osborne/McGraw-Hill), is essential.

## Problems

C/NIX-80 operates precisely as described in the manual, and support and nominally priced updates are promised by C/Craft for six months after the package is purchased. The bugs sections of the manual pages are quite honest about limitations of the present version of C/NIX.

Most of the limitations are not very serious, but a few are inconvenient. One of the most bothersome is the fact that the copy and move commands, **cp** and **mv**, fail if a file of the same name exists in the target directory. It would be very helpful if you had the option to overwrite existing files if desired.

The UNIX link command, **ln**, is not implemented in C/NIX and is sorely missed, since it affords the capability to maintain a single copy of a file and reference it from several directories, thereby conserving disk space.

It would also be helpful if a user-defined path search capability was available for all applicable C/NIX commands, rather than the present inflexible path search provided only with shell files.

Strangely, and unlike most UNIX implementations, the line printer is not

Table 1. Summary of C/NIX commands

Command syntax	Command function
<b>bye</b>	— leave the C/NIX shell (exit)
<b>cat file1 file2... &gt; outfile</b>	— Concatenate text files
<b>cat &lt; (...)</b>	— Output text in parens
<b>chdir</b>	— Change to top-level directory
<b>chdir dir</b>	— Change to a new directory
<b>chmod [+wl-wl+sl-s] file1...</b>	— Change "mode" of files
<b>cd</b>	— Change to top-level directory
<b>cd dir</b>	— Change to a new directory
<b>cp filefrom fileto</b>	— Copy a file
<b>cp file1 file2... dir</b>	— Copy files to new directory
<b>cs [ -v ] cmdndfile param'...</b>	— Invoke subshell on command file
<b>dir [-l] pattern1 pattern2...</b>	— List directories
<b>dir [-l]</b>	— List current directory
<b>echo param1 param2...</b>	— Echo parameters to console
<b>era [-f] file1 file2...</b>	— Erase files
<b>exit</b>	— Exit the C/NIX shell
<b>grep "pattern" file1</b>	— Search files for a pattern
<b>grep "pattern"</b>	— Search console input for a pattern
<b>help topic1 topic2...</b>	— Display help information
<b>help</b>	— Display list of help topics
<b>ls [-l] pattern1 pattern</b>	— List directories
<b>ls [-l]</b>	— List current directory
<b>man topic1 topic2</b>	— Display pages from manual
<b>man</b>	— Display list of manual pages
<b>mkdir dir1 dir2...</b>	— Make directories
<b>mkrel file100 file200 file.pre</b>	— Make page-relocatable program
<b>mv oldname newname</b>	— Move/rename file
<b>mv file1 file2... dir</b>	— Move files to new directory
<b>pwd</b>	— Print pathname of working directory
<b>ren oldname newname</b>	— Rename a file
<b>rm [-f] file1 file2...</b>	— Remove files
<b>rmdir dir1 dir2...</b>	— Remove directories
<b>type file file2...</b>	— Type text files



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## C/NIX-80

Continued from page 101

known to C/NIX so that, for example, you can't use a command like `cat file > lst`, where `lst` is the line printer. However, control-P works as in CP/M to echo the console screen to the printer so that you can work around the absence of a `lst` device.

### Summary

C/NIX-80 provides many UNIX-like capabilities for 8-bit systems with CP/M-80. It works as represented, takes up little space in RAM, and contributes new capabilities to the CP/M environment. In addition, C/NIX has an educational value in providing a useful introduction to many of the more common features of UNIX. At its present price, it is an outstanding value.

**Prices:** C/NIX-80, \$65; manual only, \$20.

**Available from:**

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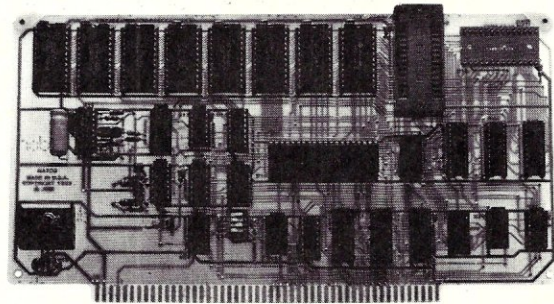
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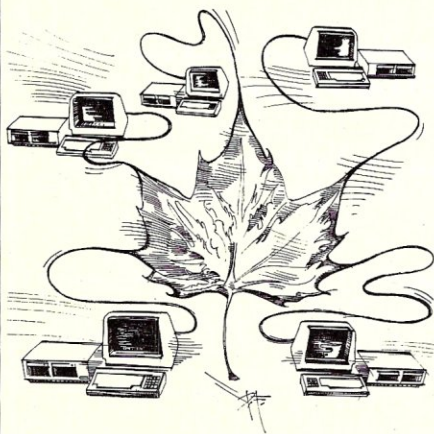
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# The \*WATSTAR Network

**Network or file server? One implementation provides an answer**



by John G. Wilson

---

**W**ATSTAR? Low technology? Aren't there enough networks around already? Yes, all those questions and more can well be raised. "Network" has now become the umbrella buzzword under which systems companies can sell substantial amounts of hardware, and the suggestion that networking is close to motherhood and apple pie is undoubtedly part of the selling pressure. However, for the end user, the real question is, "What facilities does the network give me?" As always, the design of the system is the critical item. The hardware—that profitable hardware—is only the vehicle; the basic design decides what user facilities are available, and the software, which implements the design, makes it fly.

What, then, makes \*WATSTAR different? \*WATSTAR is a system designed at a university and is not currently on the marketplace, although that may come to pass. It's a network that provides suitable facilities for teaching support in a way that is not available anywhere on the microcomputer market. A low-technology system that

keeps its costs down by using off-the-shelf 8-bit hardware, \*WATSTAR has gone out of its way to keep its design straightforward. It concentrates on the prime directive of providing a shared disk system, and has no superfluous "gold plating." Finally, \*WATSTAR continues to astound our visitors with its performance: it has been running 24 hours a day, seven days a week for more than six consecutive academic terms.

So let's open up the package and see what we have. \*WATSTAR's name and logo are derived from its place of origin, the University of Waterloo, Canada, and the fact that it is a star network. The need that led to its conception was a shortage of adequate computing resources for first-year classes. This may be hard to believe on a campus where the central facility consists of four IBM 4341s. However, in every new class, some 1800 freshmen enter programming courses that require the completion of 10 computing assignments in 12 weeks. This amounts to a time allocation of 108,000 student terminal hours—without even considering the needs of upper classmen and the graduate and research community. The central facility is overworked, and the available resources have never kept up with the demand. This has created an environment receptive to the development of any alternate system that can



pick up some of the load imposed by computing assignments.

\*WATSTAR was designed and developed by the Faculty of Engineering, whose earliest microcomputer experience was acquired on SOL20s. The \*WATSTAR objective was to use network technology to create a shared disk system. The software resources were to be off-the-shelf CP/M packages. Two years later the results, and the experience of six consecutive academic terms, have exceeded all our expectations. The original \*WATSTAR installation now contains 30 stations available to users—25 of which have XCEL graphics boards—and is currently supporting over 200 user accounts. During the term all stations are normally in use for hours on end with a typical work pattern of edit, compile and link. The worst-case performance with all stations working still seems to be at least three times better than a floppy disk.

Why did we have to design our own system when networks were available on the market? Quite simply because none of them, then or now, provides facilities for each of many users to have private space on the central disk. This is not an unusual requirement for a system in which many people need access through a limited number of gateways. All the big mainframe systems and many of the minicomputers have this capability in at least one of their available operating systems. However, nowhere in the world of micros does it appear to exist! And yet without it, educational networks are awkward and tend to assume that the user carries a private floppy disk around. When multiple users have private space on disk, a network suddenly becomes a versatile general-purpose public facility—one whose usefulness is not restricted to the educational environment.

The remaining parameters are capacity and performance. The first is provided by the current central host, a Memorex 214 (Fujitsu 2312) 84 MB SMD disk. The original development work was done on a CDC 9448. The Memorex unit is an 8" Winchester hard disk with a 20 msec access time, and represents the leading edge of current off-the-shelf technology. The second parameter is provided by the use of COMPUSTAR network protocol and stations. This permits a 200 K/sec packet transfer rate on the network bus. Finally, the central operating system, or file server, manages a neat and compact cache system that reduces the disk accesses by a factor of four.

What makes our network achieve such a satisfactory performance using normal components from the low-technology 8-bit world? It is a straight-

**With \*WATSTAR  
any station may  
generate a re-  
quest to become  
temporary bus  
master for one  
round of packet  
communications.**

forward, clean design that works well all the time. It proves that a 4 MHz Z80 is no slouch; far from being superseded by 16-bit CPUs, the Z80 and CP/M seem destined to become the PDP-8 of this technological generation.

The physical \*WATSTAR system consists of the packaged disk subsystem, usually a 5" x 19" rack-mounted box, and five boards in an S-100 mainframe. These boards are uncomplicated. They comprise an AMD SuperQuad single-board computer, a KONAN SMC100 disk controller, a clock/calendar board, and our own S-100 network controller board, which supplies the network bus protocol and RS422 drivers. These are all hosted in a CCS2200 mainframe, one of the nicest examples of bent metal engineering around.

The network protocol is unchanged from COMPUSTAR, which is a token-passing polling system. However, the token is an implicit one, being passed either by timeout or by release on task completion. The system should not be thought of as having a full network capability, since it is not possible for the central system to initiate communication to any station. It is best thought of as a shared disk system where any station may generate a request to become temporary bus master for one round of packet communications. The advantage of a token-passing system compared to a collision detection or avoidance system (CSMA/CD) is that network response time depends only on the average disk access load. In any CSMA/CD environment, especially where an indefinite number of retries is permitted, this process adds an indeterminate amount of time to the delay due to disk access.

The central network controller board is a neat and effective design

which provides for IEEE-696 signals on one side and for the data and control lines and the drivers required in a COMPUSTAR network on the other. COMPUSTAR is a multiconductor, full duplex, byte parallel, RS422 network. The controller has a 1K on-board buffer, whose address is jumper selectable, and a control port. The board generates PHANTOM whenever the buffer is addressed, which enables it to be treated as a normal part of the host memory from the S-100 side.

The stations are standard Intertec VPUs and the station interface is the standard chaining adapter board which comes with a VPU. These make the network look like two parallel ports to the station network drivers. Each station is encoded on the board and no two stations may have the same code. The central polling loop goes to each station in sequence, putting an encoded query on the bus. If the station does not acknowledge, the query times out and the polling moves on to the next station. If a station does have a software request pending, this bit completes the technical protocol which then makes the station temporary bus master.

The station now makes a block transfer of one packet to the output port. Because the station is bus master, this transfer moves the byte stream directly into the central controller's buffer from the network side. When this is complete, the central software examines the packet header, which is now in its own address space, and dispatches whatever task is called for. The results are sent back to the station by the same procedures in reverse. The station then releases the bus, and the polling loop picks up again.

The software design is best reviewed from the station end first. The key to any user being able to access the appropriate logical disk area is to get the correct disk parameter blocks into the station BIOS. This is all done by the sign-on utility, which the user talks to after power up or reset. Once the user ID and password have been validated, the DPBs are obtained from the system record area and linked in, at which point CP/M initialization is completed and the user sees a normal prompt. A standard CP/M system with four disks is then available to the user, with these four logical disks being partitions on the central host.

All disk space is allocated to groups of users who may number one or more in size. A major system utility permits group, user, or station space to be allocated, modified or withdrawn dynamically at any time. Each user has access to four primary logical disks: A, which is private; B, which is group common



# \*WATSTAR

Continued from page 105

and is read only to all except the master account of the group; C, which is scratch space for the duration of the logon period only; and D, which is the public common space and is read only to all except the system master account. A and C are the only disks with write permission. D normally contains the system library of resource software. Any group may have up to 99 users, and this is the normal basis for allocating space to a section of an academic course or to any smaller group of users.

Part of the disk is set aside as the system record area, and the overall system configuration and structure is contained in this hierarchy of records, which do not, themselves, occupy more than 400K. The current system configuration at any time can thus be saved on a floppy disk and contained in a few files. Record blocks are kept for each user, each group, and each station.

Other records contain system parameters, space allocation records, and a group directory. The remaining system space contains the central operating system, the various station operating systems for different types of machine, and the boot, sign-on and copy programs. All disk operations are controlled through access codes. This helps to prevent casual reads or writes in the system record area, which is normally

only accessed at sign-on or logoff time. Once the required parameters have been obtained, the station operating system has all the information it needs to access the user's disk space directly using the normal CP/M functions.

The central operating system can be described as a file server, but a more

**\*WATSTAR is a straightforward, clean design: it works well and proves the 4 MHz Z80 is no slouch.**

accurate description is that of a function dispatch mechanism. It is a stand-alone system and does not need the presence of any general-purpose system such as CP/M. The primitive nucleus resides in EPROM. As soon as a central reset or power up takes place, the EPROM program relocates itself to RAM and reconfigures the board to all RAM. This

nucleus contains the disk drivers, the network drivers and the station polling mechanism. In this configuration, any write operation, such as formatting, can take place; however, whenever the first read demand is made from the network, the full central operating system is boot off the disk and commences execution in the central CPU. The system now contains the print spool mechanism and the caching system, and permits the full range of function operations.

A special disk area is set aside as the print spool space. Whenever any material is sent to the CP/M list device from any station, it is stored in this print spool space. When the user is ready for actual hard copy, a system utility called PRINT is run. This causes all the material stored for the station to be sent to the printer. The output buffer is serviced by interrupts but not on a character-by-character basis, which would be an excessive overhead. The printer is a parallel device run from a Zilog PIO. Each time the handler is entered, the next buffer is literally stuffed down the line until a control character is encountered which will cause mechanical action in the printer. At this point, the control character is sent, interrupts are re-enabled, and the handler exited.

DEC aficionados will recognize the mechanism, but it is not as simple as it sounds in the Zilog world, since the PIO does not seem to have been de-

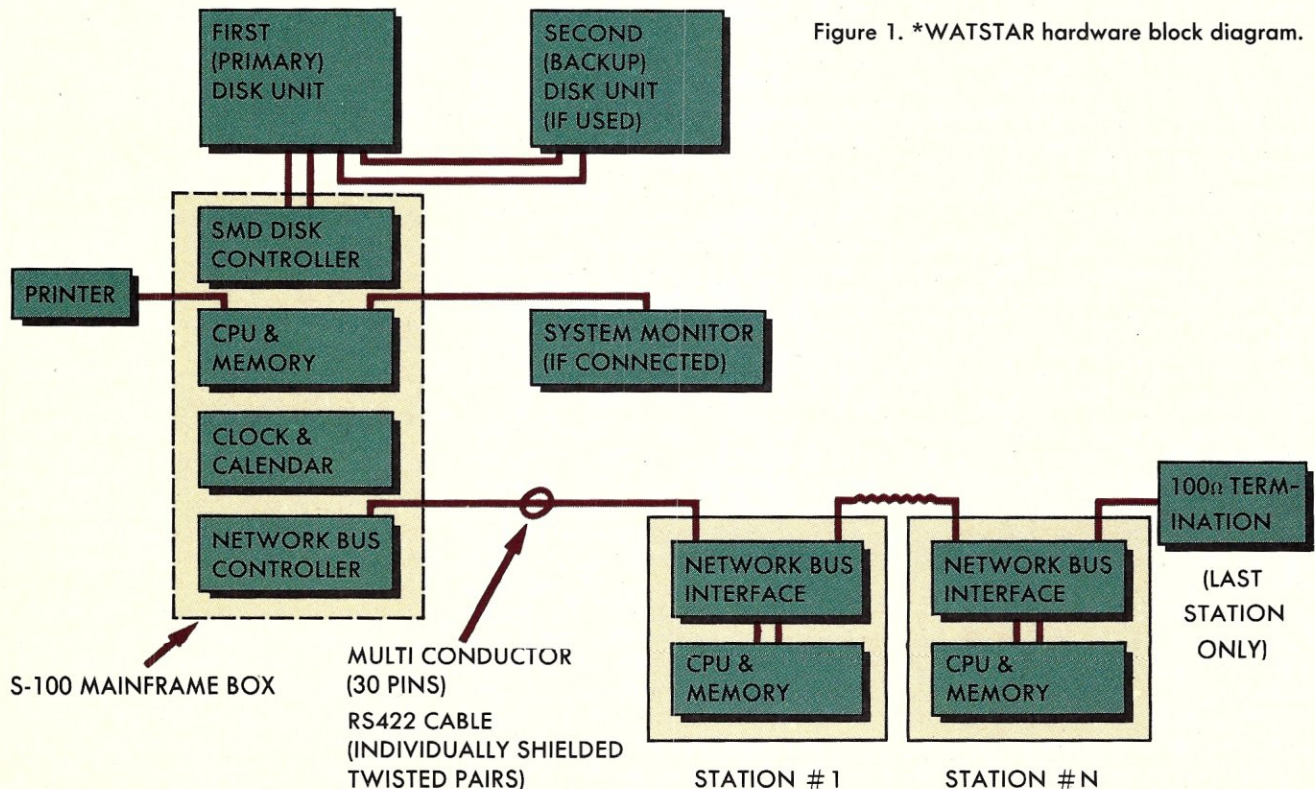


Figure 1. \*WATSTAR hardware block diagram.



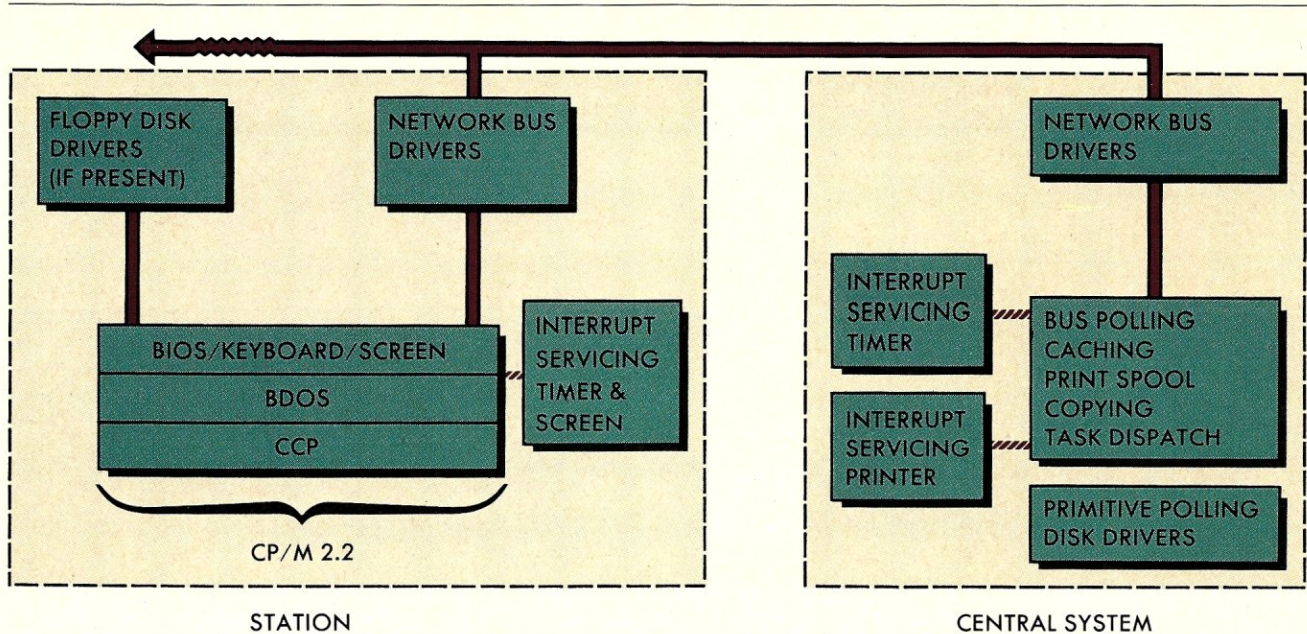


Figure 2. \*WATSTAR system block diagram.

signed with this in mind! However, it does work and is the key to permitting disk operations to interleave efficiently with print output in the central system. The alternative would be the additional cost of a dedicated print output station. The printer in the current system is a Printronix 300; a machine of this quality is necessary for such heavy-duty usage (close to 3000 pages per day). Our only regret is that it is not a model 600.

The cache system has proved to be the most significant contribution to system throughput. Network descriptions often give great emphasis to the packet transfer rates in a given system. Our experience is that it is meaningless to compare these numbers if the packet transfer time is small compared with the key limiting factor—the disk access time. \*WATSTAR, for example, has a 200 K/sec transfer rate on the network and a 20 msec disk access time, almost a 1:10 ratio. In simple terms, if the network drivers are sitting around waiting most of the time, there is no point in the network going any faster, and it will not degrade the performance if it goes slower.

Caching, on the other hand, positively reduces the number of disk accesses. The principle is quite straightforward: whenever a demand is made for disk access, the cached records are searched first. If the sector is in cache, which is an organized set of buffers in memory, then the demand is met from memory without any disk access. If not, then once the required sector has been accessed, as many contiguous sectors as possible are read in at the same time.

This number depends on the

amount of memory available and the number of stations. It makes sense to try to bring in a complete allocating block, since CP/M space organization makes sectors contiguous within allocation blocks. However, the fundamental purpose is to read as much as possible without a fresh seek. When this is done, the additional sectors are stored in the cache area in anticipation and the requested sector is sent out.

## Available networks did not provide private space for many users on the central disk.

Once again, this is not as simple as it sounds, but the basic principle is clear and achievable. The benefit is that any reduction in the number of accesses is a corresponding improvement in throughput. This, to the user, is the system's perceived performance. In \*WATSTAR, using only 64K memory in the central system and no clever bank-switching games, it was possible to

realise a four-time improvement in throughput. This made it possible to support 25 stations in heavy usage with a satisfactory response time.

To summarize, \*WATSTAR is a network system that can be used as a plug-in replacement for the central component of a COMPUSTAR system, or as a fresh system where the network stations and cabling are standard COMPUSTAR. Its central operating system provides a multiple-account, multiuser, password-protected environment where each station sees a single-user CP/M 2.2 system. The disk and directory sizes for all accounts are selected dynamically at set-up time and are only subject to the limitations of CP/M. The central system permits additional disk units to be added to extend the primary capacity and/or to provide low-cost on-line archiving. Many more stations can be added, theoretically up to 255; performance does not depend upon this factor and is only degraded by the concurrent network I/O demand. This is probably true of most networks.

Installation is a friendly and proven procedure using stand-alone, automatic utilities to take the supervisor of the new system up to the stage of having one account and one station on line. At this point, the normal space management utility is used to set up whatever further accounts and stations are planned. The system permits any CP/M packages to be loaded through a floppy disk gateway. Any package configured for a SuperBrain will run in a VPU, and installation changes are only needed to reflect the logical disks available.



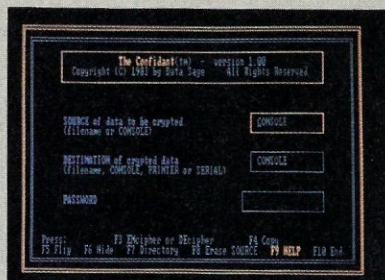




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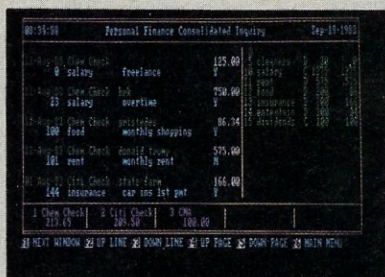


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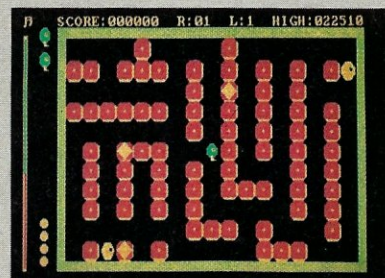
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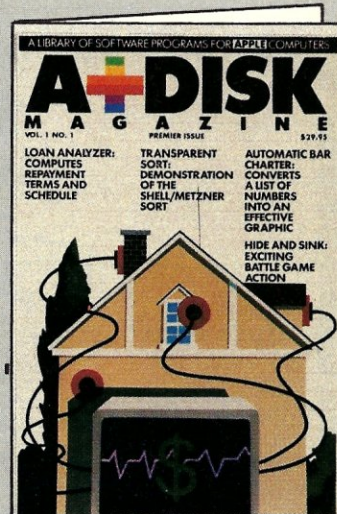
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## \*WATSTAR

Continued from page 107


Since this is a university, the work goes on, and we have plans for exploring several new avenues. Some of these are:

- Integrating alien (non-CP/M) stations into the network, starting with the IBM PC.

- Setting up a network that serves only PCs or PC look-alikes, but that offers the alternate operating systems as a user-switchable facility.

- Reworking the central operating system to use extended memory through the extended addressing capability of the AMD board. This would permit more extensive caching and greater throughput and allow us to add more stations without unacceptable degradation.

- Reworking the central operating system around one of the 16-bit CPU chips, probably the 10 MHz 80186.

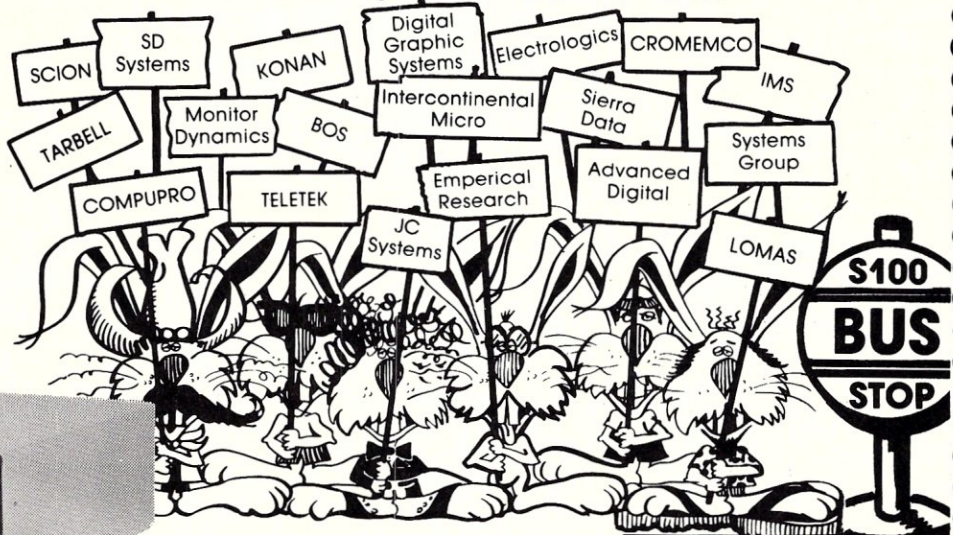
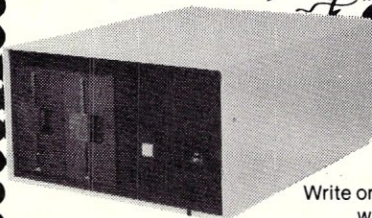
- Discontinuing the use of the expensive RS422 cable and employing 75 ohm coax, which will demand the redesign of the bottom layer of the network and the interface. 

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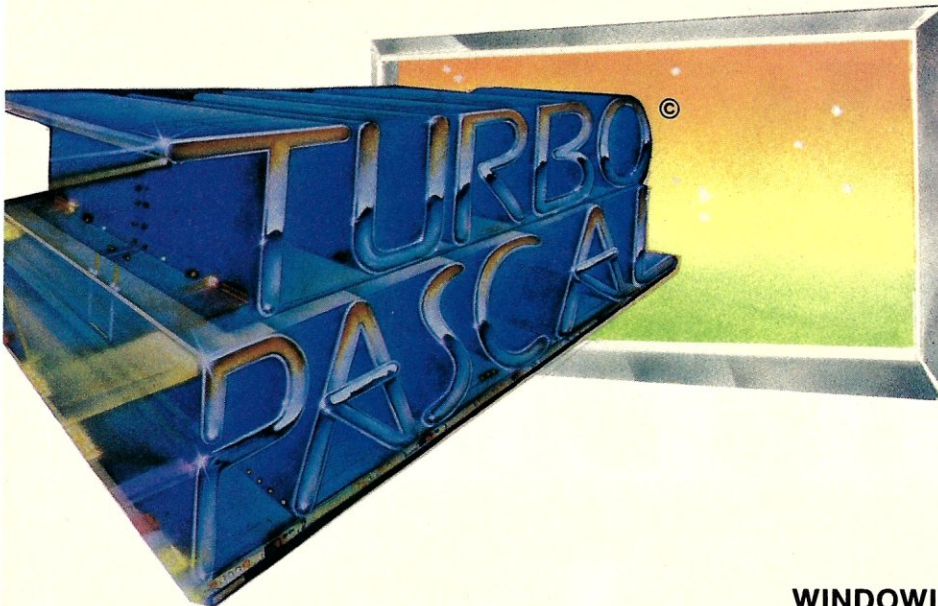
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# Down with Line Numbers

## A C preprocessor for Basic

by James L. Shearer

---

**I**n their well-known benchmark article, "Eratosthenes Revisited," (*Byte*, January 1983, page 283), Jim and Gary Gilbreath observed that programming in C is like driving a small car: "It gets the job done quickly, briefly; it feels zippy and maneuverable." After getting a copy of C/80 (my candidate for the best software buy in America) from The Software Toolworks a few months ago, I've come to appreciate and endorse that opinion. This article presents a C program which illustrates how useful the C language is.

Many of us still program in Basic; probably more than will admit it. But Basic programs are hard to maintain because of the inherently poor structure, the GOTOs and GOSUBs, and the remarks and white space that slow performance and use up memory. Moreover, the incessant line numbers clutter up the code and are a pain to type.

The preprocessor shown in Listing 3 overcomes most of these shortcomings. The Basic source program can be written without line numbers, using your favorite text editor. Alphanumeric labels are used for GOTO, GOSUB, and

other branching statements. Listing 1 shows a simple program written in this fashion. The preprocessor strips away REM statements and unnecessary white space, then inserts the line numbers, substituting the appropriate ones for labels, and produces compact, interpreter-readable code (see Listing 2).

The syntactical requirements for this preprocessor are few. The Basic code (MBasic in this case) must have correct syntax according to the requirements of the language; the preprocessor in the simplified form presented here does no syntax checking. Line numbers may *not* be used. Where GOTO, GOSUB and other branching statements indicate the need for a line number, replace it with a label named in a manner to help clarify your code. The labels are eight-character strings whose first character must be the at-sign, @, and whose subsequent characters may be letters, numerals, or periods. Examples:

Acceptable	Unacceptable
@PRINT.1	@WRITE#4 (# is illegal char)
@EXIT	EXIT.6 (no leading @)
@age.sr	@POSITION.35 (too long)

Actually, labels longer than eight characters are allowed; but only the first



eight characters are recognized. If that imposes any serious hardship, the dimensions of the label array and the other eight-character limitations can easily be changed.

Looking at the main program in Listing 3, you will see that the preprocessor passes the source program file twice. On the first pass, it counts lines (by 10), skipping any REM or blank lines, searches for labels at the start of the line storing those labels in the array `label[]`, and stores the associated line numbers in array `lineno[]`.

On the second pass, the lines are read, REM lines and blank lines are skipped, line numbers are written to the output file, labels are replaced by the appropriate line numbers, and the text of the line is then written to the output file. The workhorse of this pass is the function `writeln`.

The functions `isalpha`, `isdigit`, `strepy`, etc., are standard library functions contained in the file `stdlib.c` that comes with C/80 (version 3). Those functions are probably included with most C compilers. In any event, they are simple functions that can be written as part of the preprocessor program.

So how is the preprocessor used? Write the MBasic "source" program as described above, being sure *not* to use

## The Basic source program can be written without line numbers.

line numbers. Use plenty of white space and remarks. They won't slow your program. Save your program using an extension such as `.SRC` or `.PRE` (anything but `.BAS`). Suppose your program is named `SAMPLE.PRE`. Run the preprocessor by typing

```
MBPRE SAMPLE.PRE SAMPLE.BAS
```

when the `>` prompt appears. Your source file `SAMPLE.PRE` will be read, the labels will be converted, REM and spaces eliminated, and the resulting MBasic program will be written to `SAMPLE.BAS`. The program file `SAMPLE.BAS` can now be run like any other MBasic program.

Listing 1

```
REM Test for MBASIC preprocessor
REM 110383

A=2:B=3.14159
@START PRINT:PRINT:PRINT
PRINT "MBASIC arithmetic with A = 2, B = pi."
PRINT
PRINT "Enter 1 for A*B"
PRINT " 2 for A/B"
PRINT " 3 for A+B"
PRINT " 0 to quit"
INPUT "Your choice";C
IF C=0 THEN @EOJ

ON C GOSUB @MULT, @DIV.2, @ADD
GOTO @START

@MULT PRINT A*B
RETURN

@DIV.2 PRINT A/B
RETURN

@ADD PRINT A+B
RETURN

@EOJ END
```

Listing 2

```
10 A=2:B=3.14159
20 PRINT:PRINT:PRINT
30 PRINT "MBASIC arithmetic with A = 2, B = pi."
40 PRINT
50 PRINT "Enter 1 for A*B"
60 PRINT " 2 for A/B"
70 PRINT " 3 for A+B"
80 PRINT " 0 to quit"
90 INPUT "Your choice";C
100 IF C=0 THEN 190
110 ON C GOSUB 130, 150, 170
120 GOTO 20
130 PRINT A*B
140 RETURN
150 PRINT A/B
160 RETURN
170 PRINT A+B
180 RETURN
190 END
```

Listing 3

```
/* mbpre.c
** MBASIC pre-processor
** James L. Shearer
** 210 West Maumee St. - Suite 2
** Angola, IN 46703
** (219) 665-7673
**
#include "printf.c"
#define NULL 0
#define EOF -1
#define MAXLEN 255 /* Max line len */
#define MAXLBL 500 /* Room for 500 labels */

char label[9*MAXLBL]; /* arrays for labels */
int lineno[MAXLBL]; /* and their line nmbrs */
static int lblcnt = 0;

main (argc, argv)
int argc;
char *argv[];
{
    int len;
```



## LINE NUMBERS

Continued from page 113

The preprocessor shown in Listing 3 is a stripped-down model. You can add to it to your heart's content. If you are using a Basic other than MBasic, you may need to modify this program. My preference is baZic, a North Star look-alike from Micro Mike's, Inc., of Amarillo, Texas. Numbers are coded in BCD so that round-off errors are eliminated, multiline functions are implemented, and the interpreter is coded in Z80 rather than 8080. However, baZic suffers from the shortcomings of North Star Basic—notably, the inability to use long variable names. To overcome that, I have modified the preprocessor shown here to convert long variable names into the letter-digit format required by that interpreter.

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```
static int f1, f2;
char line[MAXLEN];
char word[MAXLEN];
static int lineno = 0;

if (argc != 3)
{
    printf("Usage: mbpre d:srcfile.ext d:outfile.ext \n");
    exit();
}
f1 = file(argv[1]);

/*****
 * First pass. Assign line nos, build label table, drop REM lines *
 *****/

while((len = getin(line, MAXLEN, f1)) > 0)
{
    getwrd(word, line);
    if (len > 1 && strcmp(word, "REM"))
    {
        lineno = lineno + 10;
        if (*line == '@')
            bldlabel(line, lineno);
    }
}

fclose(f1);
f1 = file(argv[1]);
if ((f2 = fopen(argv[2], "w")) == 0)
    printf("Can't open: %s\n", argv[2]);

lineno = 0;

/*****
 * Second pass. Replace labels with line nos, squeeze out unnecc- *
 *****/
```

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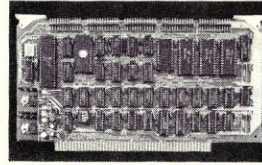
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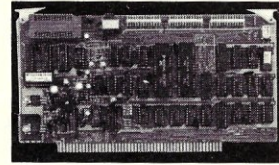
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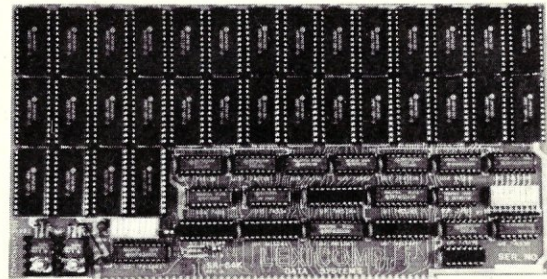
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**CIRCLE 78 ON READER SERVICE CARD**  
116 Microsystems May 1984

## LINE NUMBERS

Continued from page 114

```

* essary white space, write statement lines with nos to outfile *
*****

while((len = getln(line, MAXLEN, f1)) > 0)
{
    getwrd(word,line);
    if (len > 1 && strcmp(word,"REM"))
    {
        lineno = lineno + 10;
        writeln(line,lineno,f2);
    }
}
eoj(f2);
}

file(fname) /* Open file fname for binary read. Return file */
char *fname; /* number. Print error message if no file */
{
    int i;
    i = fopen(fname,"r");
    if (i > 0)
        return i;
    else
    {
        printf("Can't open: %s\n",fname);
        exit();
    }
}

getln(s, lim, f1) /* Reads line from file f1 to s */
int lim, f1; /* Returns line len (0 if EOF) */
char s[];
{
    int c, i;

    i = 0;
    do (c=getc(f1)); /* pass white space */
        while(isspace(c));
    if (c != EOF && c != '\n')
    {
        s[i++] = c;
        while(--lim > 0 && (c=getc(f1)) != EOF && c != '\n')
            s[i++] = c;
    }
    if (c == '\n')
        s[i++] = c;
    s[i] = '\0';
    return(i);
}

bldlabel(s,n) /* Put label from line s and line */
char *s; /* number n into arrays. */
int n;
{
    if (lblcnt <= MAXLBL);
    {
        wrdcpy(label+9*lblcnt,s);
        label[9*lblcnt+8] = '\0'; /* limit label to 8 char */
        labelno[lblcnt] = n;
        lblcnt = lblcnt + 1;
    }
}

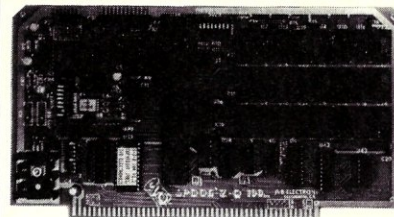
writeln(s,n,f2) /* Write line s to outfile f2 inserting line */
int f2, n; /* number n. Also replace internal labels */
char s[]; /* with appropriate line numbers. */
{
    int i, j;
    char t[MAXLEN];

    i = 0;
    if (s[i] == '@') /* label if 1st char @ */
    {
        while(s[i++] != '?') /* pass it */

```



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```

    while(isspace(s[i]))          /* and white space */
        ++i;
}
fprintf(f2,"%d ",n);           /* write line number */
while(s[i] != '\n')
{
    if (s[i] == '"')            /* check for quotes */
    {
       putc(s[i],f2);           /* write first " */
        while(s[++i] != '"')    /* and all in between */
            putc(s[i],f2);
        putc(s[i++],f2);        /* then ending " */
    }
    else if (s[i] == '@')       /* check for label */
    {
        getwrd(t,&s[i]);         /* get label into t */
        i = i + strlen(t);      /* move ptr past label */
        t[8] = '\0';           /* only 8 char signif */
        for (j = 0; j <= lblcnt; j++)
            if (strcmp(t,label+9*j) == 0)
            {
                fprintf(f2,"%d ",labelno[j]);
                break;
            }
        if (j > lblcnt)         /* no match */
        {
            printf("\n##### No match for label ");
            printf("%s on line %d\n",t,n);
            fprintf(f2,"%s?",t);
        }
    }
    else
        putc(s[i++],f2);        /* 'regular' character */
}
putc(s[i],f2);                 /* end-of-line char(s) */
}

getwrd(t,s)                    /* Get next word from s, put it in t. */
char s[],t[];                  /* For our purposes, words start with @ */
{
    int i, j;                   /* or alpha and then alpha, digits, embed */
                                /* ".," and optional final type char. */

    i = 0;
    if (s[i] == '@' || isalpha(s[i]))
    {
        ++i;
        while(isalpha(s[i]) || isdigit(s[i]) || s[i] == '.,')
            i++;
        if (s[i]=='%' || s[i]=='!' || s[i]=='#' || s[i]=='$')
            i++;
    }
    for (j = 0; j <= i; j++)
        t[j] = s[j];
    t[i] = '\0';
}

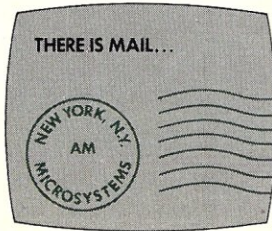
wrncpy(s,t)                    /* copy next word (see getwrd) from t to s */
char *s, *t;
{
    while (isalpha(*t) || isdigit(*t) || *t == '@' || *t == '.,')
    {
        *s = *t;
        s++;
        t++;
    }
}

eoj(f2)
int f2;
{
    int j;
    fclose(f2);
    for (j = 0; j <= lblcnt; ++j)
        printf("\n%4d %10s",labelno[j],label+9*j);
    printf("\n");
    exit();
}

#include "stdlib.c"

```





# Letters to the Editor

**This month...  
A SAL/80  
rebuttal, more  
on file transfer  
systems, and  
a note from  
paraGraphics**

Dear Mr. Terry,

I'd like a chance to respond to Mike Barker's review of our SAL/80 package (March 1984). First, I should say that we *have* changed the license contract to state *explicitly* that no royalties are required on programs written with the SAL/80 compiler package. We had assumed that such a statement would be redundant, *since there is no runtime package to charge royalties on!* But the fact that the question has arisen shows that assumption to have been in error.

I really do not want to write one of those endless line-by-line rebuttals of all those points upon which I take issue with the reviewer. On the other hand, since more than 800 readers of *Microsystems* have requested information about SAL/80 either by letter, phone or bingo card, here is some more information about the package.

"SAL/80 is a package of macros that claims to be a compiler implementing a new language of the same name." A more accurate description would be that it converts the DRI macro assemblers into *structured* macro assemblers. It is sometimes convenient to refer to this combination as a compiler.

What distinguishes SAL/80 from other structured assemblers is the size and scope of the package. Where other structured assemblers are content to provide an IF-ELSE and one or two LOOP constructs, SAL/80 also provides a SELECT/CASE, five flavors of LOOP, a fairly complete set of console I/O primitives, and OPTIMIZES the test/branch code emitted by the control-statements. This optimization means a saving of two (Z80) or three (8085) bytes in about a third of the branches generated.

The manual is large (235 pages), and considerable effort has been expended to make the contents accessible as a reference. In addition to the 3-page table of contents there is a 5½-page subject index. The compiler source (which is given in Appendix A) has its own table of contents and index.

Chapter 1 (45 pages) covers the syntax and semantics of the various constructs of the "language," with flowcharts and hints on how to use each directive. There are cross-references to other sections of the manual and to the DRI MAC/RMAC manual.

Chapter 2 (31 pages) is a tutorial on SAL/80 in the design and coding of well-structured modular programs. A "worked" example is given in the form of an elaborate memory-test program, with "snapshots" of portions of the code at various stages of completion.

Chapter 3 (50 pages) consists of the complete listing of the "worked" example in its final form. There are about 1,150 lines of SAL/80 code set off by enough white space and comments to expand it to about 2,000 lines in all. The code is very readable, and anyone undertaking to learn SAL/80 would be well advised to spend some time with this chapter.

Chapter 4 is seven pages of tips on how not to get mugged by the various snares and pitfalls of the SAL/80 package and/or the DRI macro assemblers.

Appendix A is the compiler source (70 pages), and, quite aside from the actual utility value of the program it represents, is an interesting example of what can be done with the macro facility of MAC and RMAC.

Appendix B covers the error messages (generated by SAL/80) by showing what will actually appear on the screen and explaining its significance.

Appendix C is a summary of the SAL/80 commands, with the formal syntax and cross-references to both the pertinent text in Chapter 1 as well as to the implementing source code in Appendix A.

Programs in SAL/80 are written by starting with a template that outlines the "generic" shape of the program and may be altered to suit the taste of the individual. This consists largely of commented-out predeclarations and MACLIB statements. Almost all data structuring and manipulation is done as one is accustomed to do in ordinary assembly-level programming, but all of the CONTROL structuring (test/branch code) is accomplished by using the SAL/80 control statements.

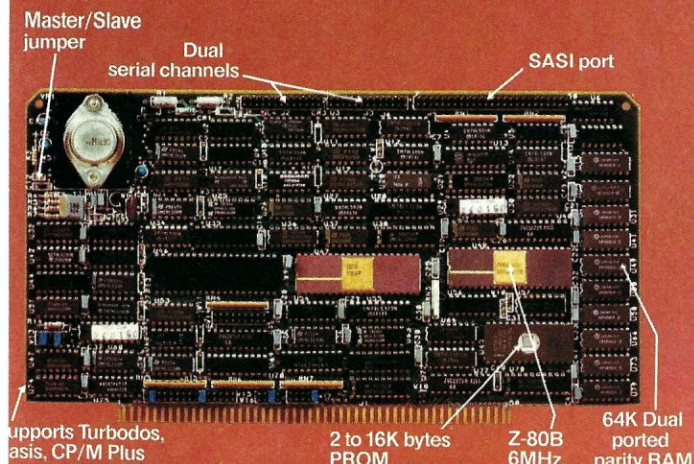
These control statements work almost precisely as do the corresponding statements in Pascal or C, with IF-ENDIF, IF-ELSE-ENDELSE and SELECT-CASE-ENDSELECT providing most of the forward branching and the several loop statements generating the backward branches. The loop structures include the NON-indexed loops WHILE-ENDWHILE (test/exit at the top), REPEAT-ENDREPEAT (test/exit at the bottom) and LOOP-UNTIL-ENDLOOP (test/exit in the middle) as well as the INDEXED loops FOR-UNTIL-STEP-ENDFOR (test/exit anywhere) and DO-ENDDO (test/exit at the bottom).

The "utility" macros are primarily concerned with console I/O although there are some string operations (search and compare) and some 8- by 16-bit multiply and divide routines. The console I/O primitives reduce by an order of magnitude the number of keystrokes required as compared with that of "naked" assembler.

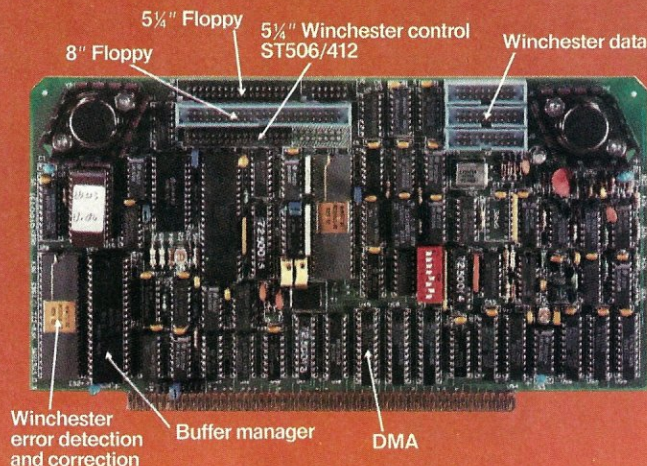


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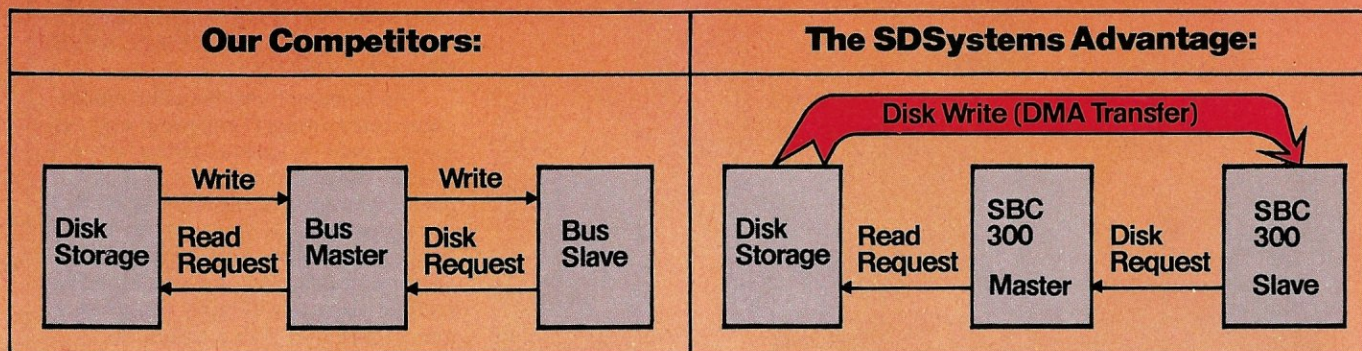
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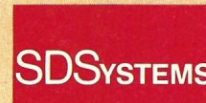
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## LETTERS

*Continued from page 119*

A program of 100 lines (exclusive of comments or white space) will compile in about one minute on a 6 MHz machine using 8" disks. Although this is rather slow, programmers experienced in the use of the package have found that the overall reduction in development time is great enough to make this acceptable.

We at PROTOOLS expect that the next version (3.0) will be a separate, native code preprocessor compatible with other assemblers, will support Zilog as well as Intel mnemonics, and should

## SAL/80 struc- tures your code with macros.

run two to four times faster. In the meantime, the price of \$59 (which includes a free update to version 3.0 when available, later this year) is intended to compensate for the slowness of compilation. A SAL/86 for the IBM PC will be offered for \$99 at the same time.

As to ease of use, the point can be argued either way: If you program in assembler only on rare occasions, say, one 80-line device driver a year, then it's probably not worth the effort to learn to use the package. If you program in assembler on a continuing basis or write large programs, then any structured assembler you use will repay the effort many times over. For a review of SAL/80 written by a user, see the February issue of *Dr. Dobb's Journal*.

Steve Newberry  
PROTOOLS

24225 Summerhill Avenue  
Los Altos, CA 94022

Dear Mr. Libes,

*Re: Moving from one OS to another*  
You asked for readers to let you know of file transfer systems other than those listed by you. Here are two more, both of which require soft-sectored IBM 3740 compatible disks.

1) FILESTAR, a CP/M based system that reads and writes TEXT files, and that displays and initializes directories on disks intended for, or received from, any of the following four operating systems: a) IBM Basic Exchange; b) DEC RT/11; c) Motorola MDOS and



*Mike's*

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d) Intel ISIS. I've only used it so far with DEC RT/11. It costs about £130 retail (about \$195 in March 1984; send foreign money order) and is by:

**MicroSec**  
49b Market Parade, Havant  
Hampshire PO9 1PY England  
phone: international  
+ 44 705 450055  
(speak to Mr. Hindmarsh or to Mr. Russell)

I gather they developed this particular program as a tool to help them in their main occupation of writing custom software for solving engineering problems.

2) A small French office equipment consultant is working on transfers from WordStar texts to XEROX 860/850 texts. I watched his Xerox 860 (just the kind of word processor that my larger customers buy for their typing pools) make a fairly successful attempt at transferring a SpellBinder file to Xerox 850 format. The only real problem lies in SpellBinder's not using the type of control codes the consultant expects from WordStar, which simply means I should have filtered them out.

Again, this system relies on "standard" 8" diskettes, and again it is an in-

house tool. At the moment this system is still experimental and isn't on sale. I'm still hawking the one file he has done for me round my customers' typing pools to see if their typists can cope.

**Monsieur Jean-Pierre Cros**  
Association Française de  
Bureautique  
33 bis, Avenue Edouard Vaillant  
92100 Boulogne, France  
phone: international  
+ 33 1 620 1477

My main interest in file transfer arises because I earn my living as a translator, often by typing directly into SpellBinder using various CP/M format disks. I also dictate work, which is then typed by various free-lance typists who have their own word processors (all different brands).

I would like to be able to use my machine to make corrections to their work. Likewise, my customers would like to make corrections (or changes) on their own machines, or, alternatively, their correspondants in the USA, UK, Australia, South Africa, etc., want to change things.

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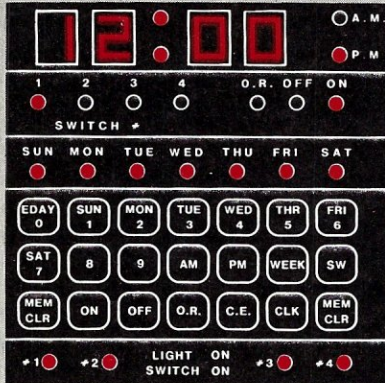
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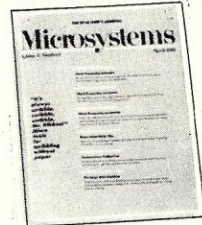
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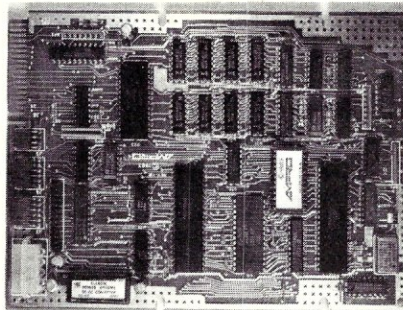
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## LETTERS

Continued from page 121

now, and at least in France, typists just don't have modems, and I can't afford to buy one for each of them, let alone pay the telephone bills to Australia for 20 pages at 300 baud. So I'm interested in any hard information you might be able to let me have on the subject of passing files between unrelated machines and by means of disks.

The most informative book I've read on the subject is *Machine Language Disk I/O & Other Mysteries* by Michael J. Wagner, published by IJG, Inc., ostensibly for the TRS-80, but in practice applicable to any Z80 plus Western 1771 or 179x controller chip.

An extremely lightweight article, "Out on a 5" Limb," by Roger L. Modeen appeared in the Nov/Dec 1983 *CP/M Review*, but at least it does include DPBs and skew tables for some 16 different 5" CP/M formats. One of the "details" overlooked is the business of how many 128-byte CP/M sectors there may be per sector on the disk. This in-

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**Most typists—at least in France—don't have modems, and I can't afford to buy one for each of them.**

---

formation can be deduced from skew tables which are actually skewed, but otherwise it isn't there. Perhaps other BIOSes recognize the sector length on the disk and act accordingly—mine does not; it needs telling explicitly (twice over, and in two different ways, but that is another story!).

Other annoyances include hard-sector systems, and at least Apple, CBM/PET, & Sirius/Victor doing their own soft-sector things. I'd like to ignore them all, but the three word processing systems used by my typists and customers are hard sectored: Philips P5000, Address-plus (=Lannier), and Wang.

Right now, the upshot is that I can probably communicate with someone interested in computers even without

using a modem, but disk communication with typists is still very limited—in spite of the fact that IBM invented the floppy disk as a means of communication between separate machines.

Andrew S. Marland  
35 Avenue Chevreul  
92270 Bois Colombes  
France

Dear Mr. Libes,

We wish to thank Mr. Beser for his comments and suggestions on our product, "The Game Board," as reviewed in the January 1984 issue of *Microsystems*. There are a few inaccuracies in his article which we would like to comment on. First, "The Game Board" partially emulates the Heath H19/Z19 and the DEC VT100/VT52. The ANSI mode of "The Game Board" is compatible with the VT100, not the VT52, as stated in Mr.

Beser's article. Second, we also offer "The Game Board" fully assembled and tested for \$595.

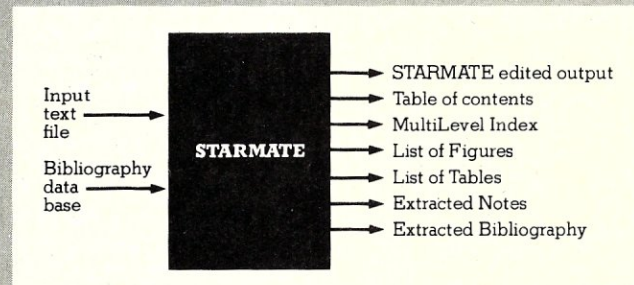
In reference to his "wish list," all of his suggestions have been implemented except the grey scale. We have adopted Digital Research's GSX graphics extension as our design specification for a new version of firmware. It includes commands to draw points, lines, arcs, pie slices, circles, filled areas, cell arrays, graphics text, etc. Grey tones may be simulated by the use of area fill with a user-supplied pattern to provide texture. This firmware is available now with our regular products and as an update to previous purchasers.

John Murphy  
Technical Director  
paraGraphics  
58 Needham St.  
Norfolk, MA 02056

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# New Products

**What's new:  
a quick roundup  
of recent  
innovations and  
improvements**

## Vector S-100 interface

A multipurpose interface for IEEE-696/S-100 bus systems provides three full-duplex parallel I/O channels, an RS232C serial port, and a selectable-rate interrupt timer on a single board. Designated the 8800GF2 by Vector Electronic Company, the board is ideal for data-acquisition systems, machine-tool interfaces, process control, printers, or other I/O-oriented systems.

Each of the three parallel data channels incorporates eight TTL latched input lines and eight tri-state output lines with 24 mA drivers. Additional lines provide strobe, enable, or attention signals with selectable polarity. Data transfer rates up to 10 MHz are supported.

A switch-selectable interrupt timer gives fixed interrupt rates from 50 interrupts/sec to 19,200 interrupts/sec. The basic rates may be reduced further by factors of 2, 4, or 8 with appropriate jumper placement. Each parallel connector provides power for peripheral devices. The total power available for all three connectors is +5 volts @ 200 mA and +12 volts @ 50 mA.

The model 8800GF2 serial port provides RS232C  $\pm 12V$  signals or optically-isolated 20 mA signals with an internal or external current source. In RS232C, the board functions either in the data terminal equipment (DTE) mode or data communication equipment (DCE) mode.

Character frames can be 7 bits or 8 bits long with odd, even, or no parity and one- or two-stop bits. The data transmission rate is switch selectable from 50 bits per second to 19,200 bps, including a 134.5 bps rate for Selectric typewriters.

Fabricated of epoxy-glass material, the 10" by 5.3" circuit board is solder masked on both sides and has gold-plated card-edge connectors for superior contact and long wear.

Power requirements for the 8800GF2 interface are +8V at 400 mA typical, 800 mA maximum; +16V at 50 mA typical, 200 mA maximum; and -16V at 50 mA typical, 200 mA maximum.

Available in two versions, the 8800GF2CB is qualified as a Certified System Component (CSC) with a 200-hour burn-in, two-year limited warranty and direct exchange in case of malfunction. The 8800GF2B is an assembled and tested (A&T) version with a 20-hour burn-in and has a one-year limited warranty.

**Prices:** CSC, \$399 each; A&T, \$325 each.

Vector Electronic Co., 12460 Gladstone Ave., Sylmar, Ca 91342; (213) 365-9661.

CIRCLE 326 ON READER SERVICE CARD

## SuperCord II interface transforms typewriter into printer

A new interface accessory that enables an ordinary electronic typewriter to become a printer for computers has been announced by Cord Ltd.

The SuperCord II is an update of the original SuperCord, which received the first U.S. patent for its ability to link electronic typewriters and computers.

The SuperCord II contains a 4K memory buffer. This enables the electronic typewriter to print out data from the computer at the typewriter's rate of speed, usually 110 baud, even if data arrives at a much faster baud. The SuperCord 4096 memory buffer stores information until the typewriter is ready to accept and print it.

Use of SuperCord II enables every popular brand of computer to have letter-quality printout at the low cost of an electronic typewriter. Of course, when the SuperCord II computer interface is turned off, the electronic typewriter functions as an ordinary typewriter.

Nearly every popular brand of computer can be used with the SuperCord II for connection to a typewriter. This includes the IBM PC, Apple, Atari 800, Commodore 8032 Pet, TRS-80, Eagle PC, and others. The list of electronic typewriters able to use the SuperCord includes Adler, Brother, Royal, Smith-Corona, Silver-Reed, etc.

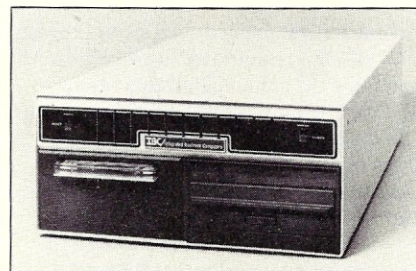
**Prices:** Model 1, \$295; Model 2, \$365.

Cord Ltd., 2815 Junipero Ave., Bldg. 102, Signal Hill, CA 90806; (213) 595-4446.

CIRCLE 327 ON READER SERVICE CARD

## Super Cadet business computer

IBC has announced its largest 8-bit



business computer, the Super Cadet. IBC's other models include the Middi Cadet in both high-performance and low-cost versions, and the 16-bit Ensign.

The Super Cadet allows up to 16 users per system; it has up to 640K of RAM, a high-speed 8 MHz Z80H CPU, and fast memory management capabilities.



## MicroScript™ \$149

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\* CP/M-86, CP/M-68K, are trademarks of Digital Research, PC-DOS is a trademark of IBM Corporation.

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For Hayes Smartmodem†, modem 7 and xmodem.
- B-trees & Virtual Memory Management Library** ... \$149  
List handling features.
- Advanced Building Blocks** ..... \$ 99  
Julian dates, dBaseII access, data compression, text windows.

All Building Blocks use 'IBM PC Building Blocks'.  
Source included. Credit Cards Accepted. Single User License.  
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(TM) IBM\*

(TM) Hayes Microcomputer Products†

(TM) Ashton-Tate\*

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- Standard console I/O includes numerical formatting and I/O steering
- User defined "CNTRL C" function
- Sequential and Random disk file access
- Provides Standard file management functions plus Direct Disk Access
- 12 system utility functions include PATCH AND BATCH
- Requires 32K Z-80 computer with editor and assembler

- Directory utility provides directory error checking, statistics, and alphanumeric ordering
- "HELP" menus throughout

**FULLY COMMENTED SOURCE CODE** included in 250 page manual

- Source code also provided on 8" SSSD disk 8"SSDD disk or 5 1/4" SSDD disk (please specify)

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DESKTOP COMPUTERS	PRICE	MSDOS
	Includes	Lotus 1-2-3
ZF-110-22 Z-100 Low Profile, 8088/8085 CPU, 128K RAM 2 5 1/4" Floppy Disks 320K each, 8 Color Graphics	\$2,799	
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### NEW Z-150 & Z-160

Zenith's newest line of computer systems  
\* allow you to run most IBM Personal Computer software with no alterations! \*

150 128K RAM detachable keyboard 2 RS232 Serial Ports 1 Centronics Parallel Port	1-320K Drive \$2,389	2-320K Drives \$2,570
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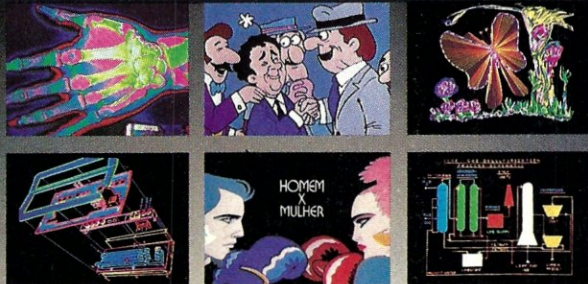
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# The Image Solution

The CAT 1600 Series  
lets you take full  
advantage of your color  
graphics potential.



Plug this powerful color video graphic system into your IEEE-696 bus and watch your computer open its eyes. Exercise your creativity developing new ways to study your world and discovering the flexibility of video imaging. Our real time frame grabber gives you instant availability of the image to be processed. The CAT 1600 is the creative link between machine, man and the world.

Resolution is the name of the game, and we've got it. Physically you're looking at 512x512 pixels up to 24 bits deep. And that's real color. Now, center on a pixel, any pixel, and roam the screen through an image space as large as 1Kx2K. Zoom in and explore a close-up of 32:1, not in the usual quantum leaps of integer steps, but in smooth logarithmic steps of 1.1%. A smooth zoom... that's human engineering.

At the heart of the matter is a dedicated 8086 image processor. It blazes a 16 bit wide path through the various memories, lookup tables and image parameters as it executes high level commands from your host processor. Up to 48K of static

RAM makes the image processor useful for downloading custom programs from the host.

When it came to adequate memory, we didn't forget. 768KB of dynamic memory gives you plenty of image. Our PROMs have a library of 64K organized into over 130 sophisticated graphics commands such as continuous live digitization, character and shape generation, global image manipulation and animation effects, to relieve the host computer from low level primitives.

At your disposal is a palette of 16.7 million colors and 256 shades of gray. Quantized lines or free-hand sketching completes the picture. Use a variety of pen widths, brush strokes, even airbrush! Now imagine what you can do with a superb quality image captured in real time from a color video camera. Contact us for an eye opening demonstration: 935 Industrial Avenue, Palo Alto, CA 94303. 415/856-2500



What you see is what you get.

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## WRITE

The Writer's Really Incredible Text Editor lives up to its name! It's designed for creative and report writing and carefully protects your text. Includes many features missing from WordStar, such as sorted directory listings, fast scrolling, and trial printing to the screen. All editing commands are single-letter and easily changed. Detailed manual included. WRITE is \$239.00.

## BDS's C Compiler

This is the compiler you need for learning the C language and for writing utilities and programs of all sizes and complexity. We offer version 1.5a, which comes with a symbolic debugger and example programs. Our price is \$130.00.

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# BDS C

The fastest CP/M-80 C  
compiler available today

Version 1.5 contains some nifty improvements:

The unscrambled, *comprehensive* new User's Guide comes complete with tutorials, hints, error message explanations and an index.

The CDB symbolic debugger is a valuable new tool, written in C and included in *source form*. Debug with it, and *learn* from it.

Hard disk users: You can finally organize your file directories sensibly. During compilation, take advantage of the new path searching ability for all compiler/linker system files. And at run-time, the enhanced file I/O mechanism recognizes user numbers as part of simple filenames, so you can manipulate files located *anywhere* on your system.

BDS C's powerful original features include dynamic overlays, full library and run-time package source code (to allow customized run-time environments, such as for execution in ROM), plenty of both utilitarian and recreational sample programs, *and speed*. BDS C takes less time to compile and link programs than any other C compiler around. And the execution speed of that compiled code is typically lightning fast, as the Sieve of Eratosthenes benchmark illustrates. (See the January 1983 BYTE, pg. 303).

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CIRCLE 202 ON READER SERVICE CARD



## NEW PRODUCTS

Continued from page 124

ty. The system is compatible with the OASIS and MP/M II operating systems, thus providing the user with an abundant supply of sophisticated application packages.

**Price:** The Super Cadet, with 8 MHz operation, 256K 120 ns memory, single 1 MB floppy disk drive, 85 MB 8" hard disk, 8 serial I/O ports, Centronics port, and 30" desktop cabinet: \$15,095.

The Middi Cadet is a low-cost, physically smaller version of the Super Cadet. Housed in a 12" x 16" x 17" cabinet, it includes a 6 MHz Z80B CPU, with 256K of RAM, a 20 MB 5 1/4" hard disk drive, a 1 MB 5 1/4" floppy disk drive, 10 serial ports and a Centronics port. The Middi Cadet can switch-select between operating systems such as MP/M and OASIS. Optionally available are a 512K memory, a cartridge tape, and a bisynchronous port for communications.

**Price:** \$7,495.

The high-performance Middi Cadet includes all of the standard Middi Cadet features, plus 10-user support, 40 MB hard disk storage, 512K of RAM,

and a high-speed 8 MHz Z80H CPU. The HP Middi offers performance beyond any of the 8-bit systems on the market and exceeds that of some 16-bit systems

**Price:** \$10,995.

IBC predicts that 8-bit computer sales will remain high because these machines provide an alternative to operating systems requiring large, high-performance hardware capability not currently available in low-priced systems. However, they have also developed the 16-bit Ensign for the UNIX-based business systems market.

The Ensign is a 16-bit, multi-processing/multiuser business micro-computer based on a MC68000 and four slave CPUs capable of running the UNIX operating system. The system operates at 8 MHz with no wait states, using proprietary memory management and ECC circuitry. The Ensign is designed to handle I/O for up to 32 concurrent users. The system is available in either a desktop or rack-mounted cabinet, and supports up to 8 MB of main memory (up to 512K per user), a capacity of over 1000 MB of SMD disk memory, and cartridge or 9-track reel-to-reel magnetic tape units.

**Price:** \$25,000; includes a 16-port system with 512K of memory, 85 MB disk storage, 1 MB of floppy disk storage, and a centronics port.

**IBC/Integrated Business Computers, 21592 Marilla St., Chatsworth, CA 91311; (213) 882-9007.**

**CIRCLE 328 ON READER SERVICE CARD**

### Floppy disk storage file

The new 5 1/4" Flexible Disk File holds floppy disks and protects them from becoming warped, scratched, touched or damaged in any way. It is made of tough plastic that has a built-in antistatic material which helps prevent damaging static electricity from reaching flexible disks.

Forty-eight labels and 168 tabs are supplied with each filing case, which come as 12 labels and 42 perforated tabs in each of four colors: red, yellow, green and blue. Permanent pressure-sensitive disk labels measure 1 1/4" by 3" and are printed four up in typewriter format. Each file is 1/4" high, 8 1/8" wide and 8" deep.

**Price:** less than \$40 each.

**Eddie Goodwin Co., P.O. Box 470331, Miami, FL 33147.**

**CIRCLE 340 ON READER SERVICE CARD**

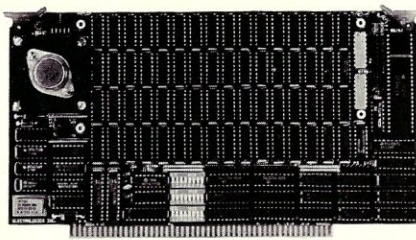
# WAIT NOT, WANT NOT!

**If you've been waiting for a disk emulator that can increase your system's throughput by as much as 50 times, the wait is over. QUASI-DISK is here!**

**QUASI-DISK** is a high capacity, I/O mapped RAM board which acts like an additional disk drive on any S-100 system.

**Here's what makes QUASI-DISK a better buy than the others:**

- Fully S-100/696 compatible.
- **QUASI-DISK** offers 2 modes of expansion:
  - a) Chip capacity may be doubled with the addition of an add-on module.
  - b) Storage capacity may be increased to 4 Megabytes by replacing 64K RAMs with 256K devices.
- DMA compatible with transfer rates to 2 Megabytes/second.
- On board powerfail logic write protects disk during power failures.
- Optional battery back-up provides 2 hours of powerfail protection.
- External wall mount power supply allows system power to be switched off while data is retained indefinitely.
- Six layer printed circuit board improves performance and reliability.



### GUARANTEE

Unique design guarantees that **QUASI-DISK** will perform as advertised, in standard as well as non-standard S-100 systems.  
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**CIRCLE 57 ON READER SERVICE CARD**

- Requires only 6 I/O addresses to access entire board.
- Supports extended I/O addressing when enabled.
- On board 22 bit address generator may be programmed for auto increment or decrement if desired.
- Any sector size may be implemented.
  - Onboard LED's indicate "drive active" and "powerfail status".
  - Price includes installation software on 8" SS/SD diskette with all source code supplied.
  - Sample CP/M\* Bios routines are included for integration into any CP/M\* system.
  - **QUASI-DISK** is covered by a 1 year warranty and an extended warranty option is also available.

**QUASI-DISK (512K) — \$895.00**

**Expansion Module**

**(additional 512K) — \$695.00**

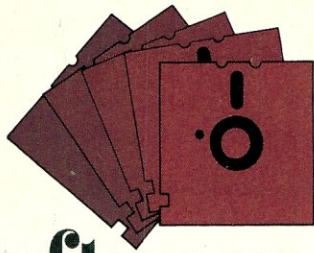
**Back-up Battery (including wall mounting supply) —**

**\$195.00**

\*CP/M is a registered trademark of Digital Research.

**TIME SAVED IS MONEY WELL SPENT**





# Software Directory

**New programming aids that shorten development time and increase productivity**

**Program name:** APPGEN (Applications Systems Generator)

**Requirements:** Any microcomputer running PICK, UNIX or having a standard C Compiler

**Minimum memory:** 128K

**Language:** C or Databasic

**Description:** APPGEN provides all the tools necessary for the development of complete, fully documented commercial applications in a fraction of the time and cost required by traditional programming methods. The APPGEN development and runtime environments are easily portable among all the machines and operating systems supported by The Software Express, Inc. In addition to the applications generator, numerous fully integrated accounting packages are available for use as stand-alone applications as well as for modification or enhancement under the generator. These packages can also be included as parts of comprehensive vertical packages developed under APPGEN.

**Price:** \$12,000

**Included with price:** documentation, video demonstration, training

**Available from:**

**The Software Express, Inc.**  
10103 Fondren, #220  
Houston, TX 77096  
(713) 270-5218

CIRCLE 320 ON READER SERVICE CARD

**Program name:** FileDriver

**Requirements:** any microcomputer running CP/M, MP/M, or TurboDOS

**Minimum memory:** 51K

**Language:** C

**Description:** FileDriver is a comprehensive, integrated collection of utilities that allows the creation of hundreds of application-specific, customized utilities.

FileDriver's unique CUSTOM feature lets you create your own, user-named .COM files specifying all the functions and options you wish, as well as an entire command line consisting of one or more file IDs. Directions to read file IDs from a text file previously created by the user are included. Thus complex, but powerful utilities can be invoked with a minimum of keystrokes. FileDriver utilities may be accessed in one of three ways: from individual .COM files, from an all-in-one .COM file, or from a menu interface. FileDriver does not modify the operating system (is not a CCP replacement) and will run in conjunction with other utilities and other menu interfaces leaving sufficient TPA. Other features include multiple wild cards on a command line, wildcard user areas and disk drives, exclude list of files from a

wild-card designation, write to/read from text files, act across user-area boundaries, copy/archive to sequential floppy drives, support attribute flags and group numbers.

**Price:** \$85 (8"); \$90 (5 1/4")

**Included with price:** disk (8" or 5 1/4") and documentation

**Available from:**

**Dunbar-Ridge Group**  
102 Sterling Court  
Syosset, NY 11791  
(516) 4964431

CIRCLE 321 ON READER SERVICE CARD

**Program name:** MAGIC/MPS

**Requirements:** A Z80 microcomputer running any version of CP/M or MS-DOS

**Minimum memory:** 64K

**Description:** MAGIC/MPS is a medium level, portable language that maintains traditional language philosophies to create application programs without the need of a runtime package. The instruction set, through the MAGIC compiler, permits the creation and maintenance of machine-executable programs. It is multiuser and has file I/O capabilities with random, sequential and ISAM file types. Other features include: internal data areas that are completely variable with buffers that are dynamically allocated for both hardware and software efficiency; fast BCD arithmetic with up to 35 digits; simplified screen formatting and data editing; handwritten assembly language can be mixed anywhere in the source code; total string manipulation capability; convenient control over peripherals and conditional compilation of source code.

**Price:** MPS/80: \$795 (for CP/M-80)  
MPS/86: \$995 (for CP/M-86 and MS-DOS)

**Included with price:** disk containing assembler, linker and compiler, plus full documentation

**Available from:**

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CIRCLE 322 ON READER SERVICE CARD

**Program name:** Lattice 8086 C Compiler (with 8087 support) Version 2.1

**Requirements:** PC-DOS or MS-DOS

**Minimum memory:** 128K

**Description:** This updated version enables C programs to access the complete 1 MB program and data space that can be addressed by 8086 and 8088 microprocessors. Four distinct memory models are supported, allowing the C programmer to choose the best combination of efficiency and addressability. The S and P models produce compact



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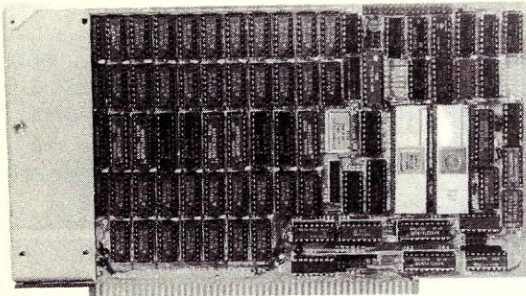


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CIRCLE 68 ON READER SERVICE CARD

## SOFTWARE

*Continued from page 128*

code that can address up to 64K of data, while the D and L models allow access to as much as 1 MB of data. Program size is limited to 64K in the S and D models, but can be as large as 1 MB in the P and L models. The Lattice C function library has been extensively improved to handle the new MS-DOS multilevel file directories and to be more compatible with the latest versions of UNIX. Users of the current Lattice compiler may obtain the updated version by contacting the dealer from whom they purchased it.

**Price:** C compiler: \$500

Library source code: \$500 (reduced from \$1,500)

**Available from:**

**Lattice, Inc.**  
P.O. Box 3072  
Glen Ellyn, IL 60138  
(910) 858-7950

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**Program name:** JETIII

**Requirements:** CP/M, CCP/M, MP/M, PC-DOS, or MS-DOS

**Minimum memory:** 3 MB

**Language:** CBasic

**Description:** JETIII is an integrated, computer-aided applications software development system and multiuser database. A menu-driven program generator enables programmers to write remarked and structured software code in a fraction of the time it normally takes to develop applications software, automatically generating code for many standard functions, such as file maintenance, transaction processing, and reporting. JETIII can also accommodate relational, hierarchical, and network database structures, as well as integrate applications software with the company's BizWiz modules (general ledger, payroll, accounts payable and accounts receivable). All Jetsoft programs and packages developed with JETIII are operating system-independent and transportable to most microcomputers. A menu-driven report-writer program is also included which is designed to generate a variety of reports and delimited files from the database. Other functions provided by JETIII include menu/forms creation capabilities and system security.

**Price:** \$40,000

**Included with price:** manuals and "hotline" telephone support

**Available from:**

**Jetsoft, Inc.**  
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(617) 548-6670

CIRCLE 324 ON READER SERVICE CARD



## SOFTWARE

Continued from page 130

**Program name:** ANSI Standard MUMPS

**Requirements:** CP/M and North Star Horizon or comparable hardware

**Minimum memory:** 56K

**Language:** machine language

**Description:** ANSI Standard MUMPS is a high level applications development language with a built-in DBMS. All software created with ANSI MUMPS is transportable to any hardware environment adhering to the ANSI Standard. It has statements similar to those of Basic, i.e.: subscript by alphanumeric string, collating sequence function, examine variable contents, restart after break point, GOTO named alphabetic or numeric entry points, pattern matching, etc.

**Price:** \$40

**Included with price:** User's Guide

**Available from:**

HSC Computer Services, Ltd.  
P.O. Box 43  
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(212) 642-6912

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**Program name:** DESIGNER SCREENS

**Requirements:** Z80, 8080 or 8085 running CP/M 2.2 with ASCII terminal, 80 x 24 or larger

**Minimum memory:** 48K

**Language:** 8080 assembler and C

**Description:** DESIGNER SCREENS is a full-screen editor and runtime support package for terminal screen designs intended for use by serious programmers. Using DESIGN, a programmer can type displays directly onto the terminal screen. Elements of the design, called "objects," can be rearranged on the screen with simple cursor commands. Five visual attributes and line drawing are supported. Designs are transportable between installed terminals.

A linking program, LINK, is provided to link up to six screen designs to a user program. During the linking process, a customized, self-relocating, 8080 machine language program is generated to support the linked designs at runtime. The package makes it easy to implement on-screen forms, menus, help screens, boilerplate notices, and even simple animation. Runtime support for input includes: data-type control, decimal alignment, a type-ahead buffer, end-user edit commands, and everybody's favorite, "Fred's Magic Window," which can display field-by-field input instructions automatically, as needed.

**Price:** \$195

**Included with price:** Design program, LINK program, Install program, type-set manual and demo programs.

**Available from:**

Austin E. Bryant Consulting  
P.O. Box 1382  
Lafayette, CA 94549  
(415) 945-7911

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**Program name:** BASXREF

**Requirements:** any 8080, 8085 or Z80 microcomputer

**Minimum memory:** 32K

**Description:** BASXREF is a program that facilitates the understanding, debugging and maintenance of Basic pro-

grams by generating an alphabetized cross-reference of the variables used in a program, along with their corresponding line numbers. This list can be written to console, disk or printer output. BASXREF can also suppress certain parameters, as well as adapt itself to various dialects of Basic.

**Price:** \$39

**Included with price:** detailed documentation

**Available from:**

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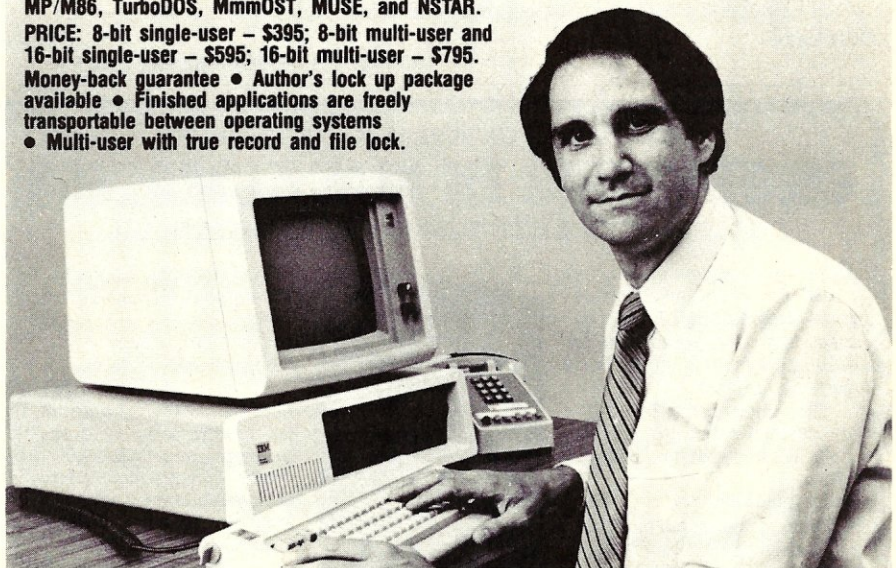
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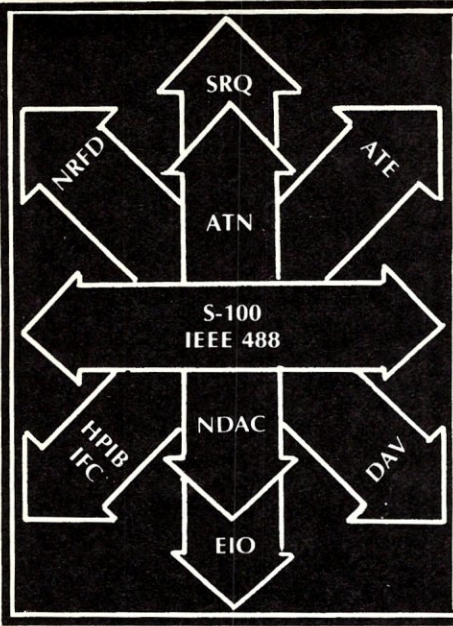
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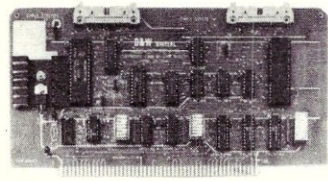
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# THE 488+3

IEEE-488



S-100

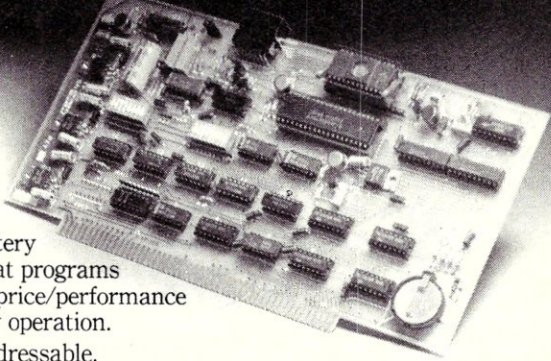
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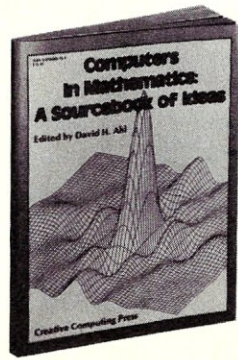
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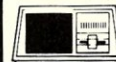
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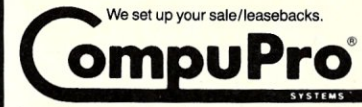
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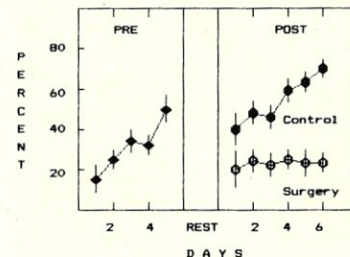
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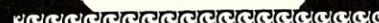
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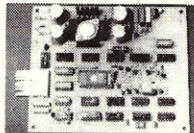
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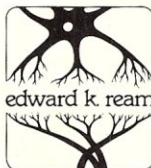
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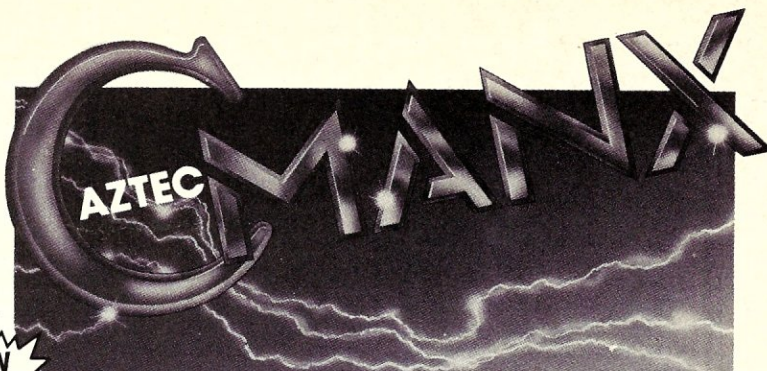
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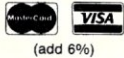
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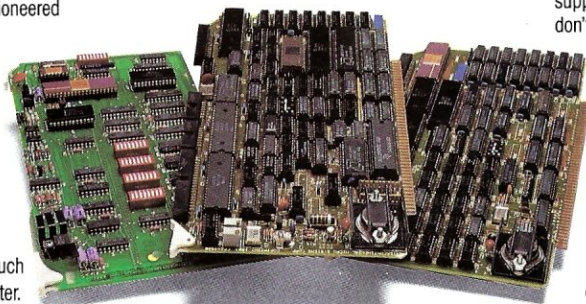
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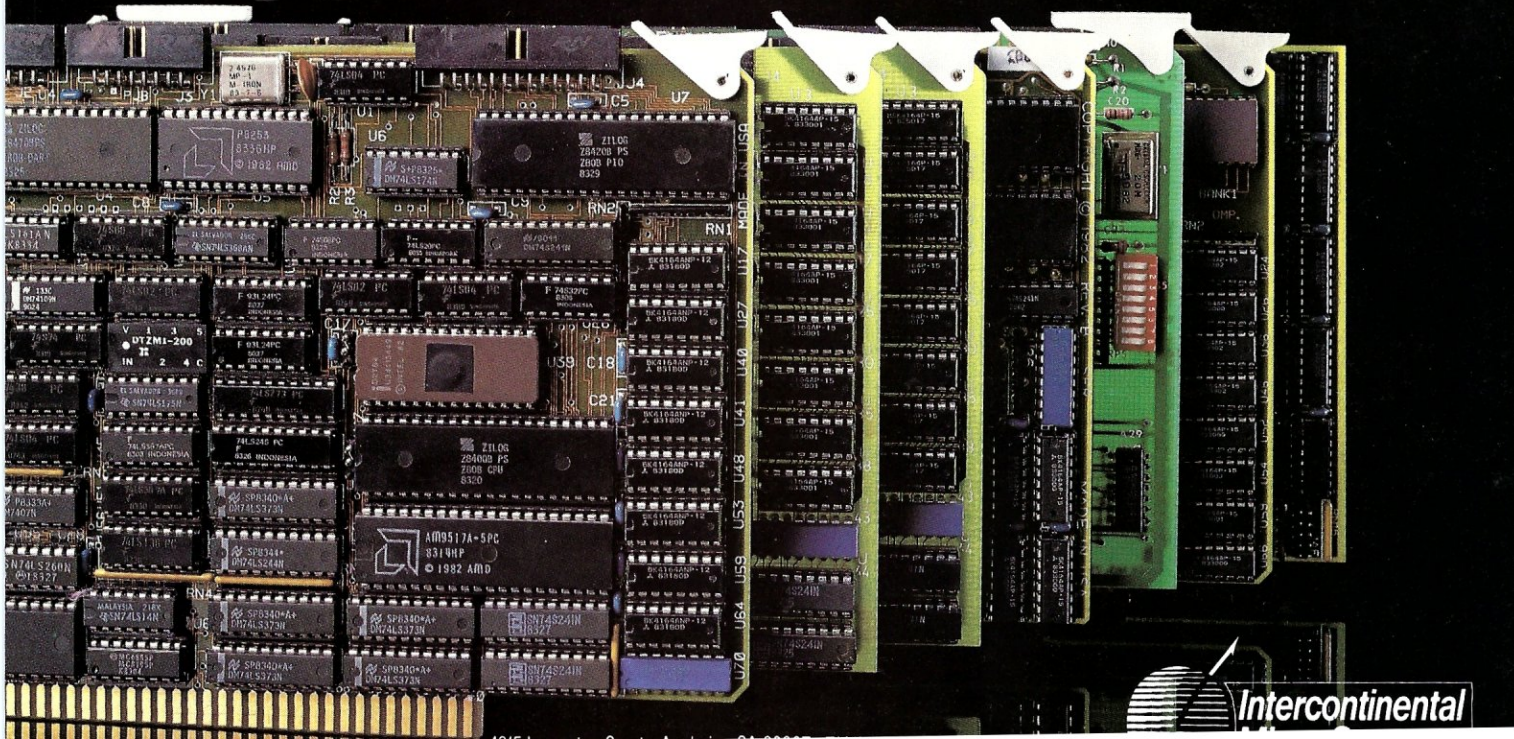
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