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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 viewing. 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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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.

The Systemaster leads our line with a Z80A CPU, 64K of RAM, simultaneous control of 8" and 5.25" floppy disk drives and memory management capabilities. With onboard RS232 SIO drivers, no paddle boards are required. Thus, packaging is efficient and inexpensive. For enhanced system performance, add RAM Drive to your Systemaster. This high-speed, low-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.

Consider the possibilities! A four board set with a Systemaster, an HD/CTC and two SBC II's would create a complete four user system with hard disk control and cartridge tape backup. This is the most innovative and cost effective board configuration on the market today.

TELETEK, the leader in quality and innovation, is proud to offer a 36-month warranty on our entire S-100 board line.

In fact, we are so confident that you will find the TELETEK board family to be exactly what you have been looking for, we are willing to offer a 30-day evaluation program with a money-back guarantee. This offer provides you with a unique opportunity to evaluate the TELETEK line at NO FINANCIAL RISK!

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Store Speech and Music on Your System
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

S-100 Product Directory
by Sol Libes
A comprehensive guide to S-100 products from over 150 sources

S-100 Vendor Addresses
A cross-reference guide

Control Your Lab with a Stepper Motor
by Joseph W. Long
The MC100, designed as a development system for projects that use stepper motors, will be of special interest to people working in areas where mechanical motion is a concern

Simplified Command Line
by Joseph Katz
SYNONYM’s ability to condense commands and pass parameters to them makes it a convenient and powerful program

UNIX Front-End Power for CP/M
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

The WATSTAR Network
by John G. Wilson
How a Canadian University—using off-the-shelf 8-bit hardware—created a shared disk system and cured computer congestion

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
Editor’s Page

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

by Mark Rollins

From 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, we 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, 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 system designers.

We expect the multitasking and multifield systems to be dominated by the UNIX operating system. The built-in power of UNIX primitives and the relative 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 One Park Avenue New York, NY 10016 or call (212) 725-5384 or 725-6856.
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MuSYS CORP
specialists in multi-user business systems
Random rumors and gossip, plus a view of the industry's latest trends

by Sol Libes

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 "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 announced 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® 8-16.

It's 11:00 P.M. Do you know where your files are?

It's great when multiple local and off site users can run any 8- or 16-bit CP/M or MP/M™ program. It's even better when they can share expensive resources like printers, hard disks, and tape drives. Best of all is when they can share your most precious resource — data. Gifford has been delivering systems with all these features for over two years.

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With our Virtual Terminals, each terminal on your system can monitor up to four different programs running concurrently. And at the touch of a key you can switch screens instantly from one program to another.

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And since your Virtual Terminal can run any 8- or 16-bit CP/M or MP/M program, you can choose the best programs for your job from the biggest software library in the world. It's easier than 1, 2, 3!

The Gifford Security Blanket: Total Solutions.

Gifford delivers solutions. This means professional pre-sale consultation, expert system integration with 200 hour system burn-in, complete training, and full after sale support.

For example, our three user CompuPro® based system with a 21-megabyte hard disk costs just $9,990, and can be easily expanded for $500 per user. This includes MP/M 8-16, SuperCalc, and dBASE II.

Other Gifford solutions include systems with hard disks that range from 5 to 300 megabytes, 4 and 9 track tape backup, printers, plotters, and modems. Single- and multiuser 8086, 68000, and Z-80 based systems are available for immediate delivery, with 80286 and 16032 systems on the way.

Two year warranty protection.

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Lock in on Gifford Security today.

If total support, training, on site service, obsolescence-proof upgradeable S-100 bus architecture, and complete system security sound appealing, cut the coupon or give us a call. We'll send you a free brochure that tells the whole story. Once you get it you'll see why Gifford has a lock on multiuser CP/M 8-16.

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CIRCLE 67 ON READER SERVICE CARD

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 hobby shows 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 (56 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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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 windows, 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 stamped self-addressed business-size envelope to: Emma Paqui, 104 W. Wisteria, Arcadia CA 91006.


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., EI 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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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"). Untermminated 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.

Untermminated 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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Uncompromising Additions to your S-100/IEEE-696 BUS
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 system 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 work right, 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 MWRT is produced only by 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 for 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 signals 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 panels (at least the IMSAI) expect that the S-100 Data Out bus exactly duplicates 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 (upper eight address lines A8-A15) 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 panel, 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 were 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 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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CIRCLE 123 ON READER SERVICE CARD
by Hank Kee

The PCjr finally arrives

From the Sidelines

The PCjr is finally the time this column goes to press, PCjr is 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 PCjr 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 outdo 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:

<table>
<thead>
<tr>
<th>Command</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>ED WIDTH80</td>
<td>Invoke ED naming new file WIDTH80</td>
</tr>
<tr>
<td>ABC</td>
<td>ED command to insert any three letters</td>
</tr>
<tr>
<td>[ESC]</td>
<td>[escape] to exit insert mode</td>
</tr>
<tr>
<td>E</td>
<td>exit ED and save file WIDTH80</td>
</tr>
<tr>
<td>DDT86</td>
<td>Invoke DDT86</td>
</tr>
<tr>
<td>RWIDTH80</td>
<td>Read file WIDTH80</td>
</tr>
<tr>
<td>SO</td>
<td>initial location to modify</td>
</tr>
<tr>
<td>18</td>
<td>hex value of &quot;ESC&quot;</td>
</tr>
<tr>
<td>81</td>
<td>hex value of &quot;a&quot;</td>
</tr>
<tr>
<td>33</td>
<td>hex value of &quot;g&quot;</td>
</tr>
<tr>
<td>WWIDTH80</td>
<td>Rewrite file WIDTH80</td>
</tr>
<tr>
<td>/C</td>
<td>control-C to exit DDT86</td>
</tr>
</tbody>
</table>

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SIDELINES

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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 the 64K 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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RECOVER recovers a specific file that cannot be copied or otherwise used because of a defective spot on disk.

RMDIR removes a subdirectory.

TREE 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 176658 1-18-83 2:33p
3 File(s) 0 bytes free
```

We would use the following command to sort the directory on file size and direct it to an external file:

```
DIR A: 123,|SORT/+14>FILES
```

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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CIRCLE 242 ON READER SERVICE CARD
SIDELINES
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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 PC­DOS 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.

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.

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The UNIX File

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

by Ian F. Darwin

By 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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CIRCLE 88 ON READER SERVICE CARD
THE UNIX FILE
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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 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

```
p '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 -I mumble
   do echo $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

```
p 'ls | grep ".c"'
```

where I would have wanted to say

```
p *.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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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 optimising 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.


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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 won-
derful Cobol statements. Phone Cyber-
netics at (714) 848-1922 for more infor-
mation. 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 as-
pects 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, To-
ronto, Ontario, Canada M4Y 2L8. If you
have UNIX mail access to the UUCP
network, you can contact Mr. Darwin at
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This 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 stimulated 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 intermediary 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
Yates Center, KS 66783

Software Tools Users Group
1259 El Camino Real, #242
Menlo Park, CA 94025
by Randy Reitz

CONTINUING 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 GIANTIC FORTH WORD CAN BE WRITTEN TO DECODE THE DPB DATA INTO FOUR USEFUL ITEMS. THE DECODE WORD IS SHOWN IN LISTING 1.


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 NUMBER OF TRACKS IN THE DATA AREA. THE QUOTIENT IS THE NUMBER OF TRACKS IN THE FIRST SCREEN AND IS SAVED IN TRK/DRV; THE TOTAL NUMBER OF TRACKS ALLOWED ON THE DRIVE IS ONE LESS THAN THE NUMBER OF TRACKS IN THE DATA AREA OF THE DISK.


\[
\text{Tracks in data area} = \text{ceiling} \left[ \frac{(\text{BS}+1) \times (\text{DS}+1)}{\text{SPT}} \right]
\]

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 IS 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/BUFF, 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 maxi­
mum 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
    | DSIBS ;

if sector skewing is desired, or as

    : TRANSLATE BIOSPB 4 + ! 0 16
    | DSIBS + ;

if it is not desired. The sleight-of-hand
shown above uses the sector translate
table to determine if the sectors are num­
bered, 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 ori­
gin. No skewing takes place. Other use­
ful 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

Summary
I have shown some important dif­
dferences between CP/M 2.x and CP/M
Plus. These differences are due to the
banked storage required to make effec­
tive use of CP/M Plus features, and the
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 direct 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 DPH 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) 274-1874:
Hayes 212A/PPMI, Cranford, NJ;
(215) 398-1634:
Vadic 212A/PPMI, Allentown, PA.
(Note: Forth words are boldfaced in this article.)
Randy Reitz, 26 Maple St., Chatham Twp., NJ 07928
CompuFone, 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-connector 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...
decoded 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 telephone 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.
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 vector lines V10* through V17* (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 Versa floppy 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 for the bubble disk produces a byte of data using the bubble disk for temporary message storage. Since the bubble disk is available (127K available for data storage), the software moves messages between the bubble disk and the disk 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. A CFDMOI program is the same functionally as CFDEMO with the addition 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 still able to successfully record and playback 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 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 CompuFone to supply such an application, since it would likely require extensive customizing for each particular installation.

A compromise provided by CompuFone 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 a 8080 assembler and is intended to be included in whatever application software for disk buffer. 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 used 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, since I now can supply the CFMODULE code with this origin and loaded the Hex output 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 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 CO00 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 CFMODULE is required. 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). Screen 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  
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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 CFMOD- 

ule 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 timeout, 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 INITCOMPUFONE 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 WAITRNG 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 CFMOD- 

ule 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 : CHKSTR DEPTH \ 0 < NOT ABORT NEED ARG(s) * \ 
2 : NULLTERM DUP COUNT + 0 SWAP C1 DUP C0 1+ SWAP C1 ;
3 \ Create a FILE NAME string
4 : FILENM CREATE BL WORD DUP NULLTERM C@ 2+ ALLOT DOES\ )
5 VARIABLE PPCB 2 ALLOT
6 \ Initialize an FCB variable with a FILENM string
7 : INITPCB 2 CHKSTK \ FCB_addr FILENAM *** ) 1+ PPCB \ PPCB 2 + \ 
8 152 PPCB 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 0 + \ 
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 SYS YCALL DROP

48 Microsystems May 1984
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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 timeout or due to a disk full condition, the SORRY message is PLAYed. Screen 122 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".

---

```forth
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 PSIZE 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 FOOO 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 \ Define NRECS 10 NRECS !
11 12 \ Define location of disk buffers
13 \ Define size of buffers
14 \ Define RAM for CFMODULE argument block
15 12 LOOP CLOSE CLOSE ;
16
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 H B MOV 0 D MVI ARGBLK LHLD
4 D BAD BPUSH 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 CI ; \ Select telephone line
15 \ MIKE 7 MUX CI ; \ Select microphone input
16
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 H B MOV 0 D MVI ENTRY LHLD
5 D BAD 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 PDELETE
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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**THERE'S ONLY ONE**

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CIRCLE 127 ON READER SERVICE CARD
COMPUFONE
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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-Tone 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 FILENM SORRY C:SORRY \ MAX TIME MESSAGE
12 : INITBUF 1 CHKSTK DUP C8 SWAP 1 + BUF1BEG @ ROT CMOVE 
13 : DEFAULT DEPTH 0 = IF TEST THEN INITBUF 
14 : TESTFIL INITBUF FKEXIT DONECODE C0 ;
15 : DELFIL INITBUF FDELETE DONECODE C8 ;
SCR #127
0 ( Calling Words, Record/Playback Words 27JAN84RCR)
1 \ Print the values of the arguments FLAG and DONECODE
2 \ VALUES . "FLAG" FLAG C2 . 9 EMIT
3 \ "DONECODE= " DONECODE C8 . ;
4 \ "PHONE#" must be on stack
5 \ DIALNUM INITBUF DIALER CR . DIALER RETURNS: "VALUES ;
6 \ CALLNUM INITBUF CALLOUT CR . CALLOUT RETURNS: "VALUES ;
7 \ If no "FILENM" is on stack, default name is used
8 \ set FLAG, MUX, MAXTIME and MAXTIME before call
9 \ RECORD DEFAULT 10 FLAG C1 LISTEN
10 CR . LISTEN RETURNS: "VALUES ;
11 \ PLAY DEFAULT SPEAK
12 CR . SPEAK RETURNS: "VALUES ;
13
14
SCR #128
0 ( Load CFMODULE code and Initialize COMPUFONE 17JAN84RCR)
1 \ VARIABLE PCB_CFMODULE 34 ALLOT \ PCB for CFMODULE code
2 FILENM CFMODNM PCBMODULE.IMG \ FILE Name of CFODULE
3 \ INIT COMPUFONE
4 \ FCB_CFMODULE CFMODNM INITFCB \ set up PCB_CFMODULE
5 \ FCB_CFMODULE ENTRY @ LOAD_FILE \ load the code
6 \ CFINIT \ let the CFMODULE code initialize itself
7 \ DBUFF @ BUF1BEG ! \ set up the two buffers
8 \ DBUFF @ NRECS @ 128 * + BUF2BEG !
9 NRECS @ BUPSIZE C1 ;
10
11
SCR #129
0 ( Telephone Ring counter 17JAN84RCR)
1 \ TESTRING DONECODE C0 ?TERMINAL OR ;
2 \ WAIT1SEC 10 FLAG C1 WAIT ;
3 \ Wait for a ring or terminal interrupt
4 \ LONG_WAITRING BEGIN C:RING TESTRING UNTIL ;
5 \ WAITRING \ Wait up to 15-seconds for a ring
6 \ LOOP 15 0 DO WAIT1SEC CHKRING TESTRING IF LEAVE THEN LOOP
7 \ TESTRING ;
8 \ WAITRING \ Wait for 3 consecutive rings
9 \ BEGIN
10 \ LONG_WAITRING \ Returns on first ring
11 \ WAITRING WAITRING AND ? Two more rings within 30-sec
12 \ UNTIL \ Until 3 rings total
13 \ ?TERMINAL ABORT INTERRUPT! ; \ This is way to stop it
14
15
SCR #130
0 ( Message handler 17JAN84RCR)
1 \ FILENM MESSAGE C:MESSAGE.SPH \ FILENM SAVMSG B:MESSAGE1.SPH
2 \ GET address of last character of filename
3 \ ADR CHAR SAVMSG DUP C8 + 5 - ;
4 \ Set SAVMSG filename to n \ \{ n --- \}
5 \ SET MESSAGE 1 CHKSTK 48 + ADDR CHAR C1 ;
6 \ PREMSG \ Find next available save message file name
7 \ 10 1 DO SAVMSG TESTFIL
8 \ IF I SET_MESSAGE ELSE LEAVE THEN LOOP
9 \ SAVMSG TESTFIL ABORT ALL MESSAGE FILES IN USE ;
10
11
52 Microsystems May 1984
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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 two transmit/receive isolation or working on four-wire duplexer with a high degree of isolation would be quite a challenge. I'm not accustomed to the technique details of a board being 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.

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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.

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Why get a Z80 when the world is going 16 bit? ICM gives state-of-the-art features which make it fast and powerful. Reviewers have called the CPZ48000 the 'most hardware advanced,' and a programmers 'Nirvana.' Here's why: Most 16 bit CPUs offer only 1 DMA channel. DMA increases memory transfers by 300%. ICM offers FOUR DMA channels. Memory management unit (MMU) increases address bus to 24 bits, addressing up to 16MB 24 bits of address, 16MB of main memory addressing. Vectored Priority Interrupt. TurboDisk. Memory Mapped slaves at 6MHZ and other features. Write for more details and discount schedule.

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STATISTICS ON JOHN D. OWENS ASSOCIATES:

We have been selling microcomputers since 1975. We were the third oldest continuous advertiser (after Compupro and Cromemco) in BYTE Magazine. Our ads ran continuously from 1977 to August 1983 when we switched over to MICROSYSTEMS in order to better address S-100 users.

JOHN D. OWENS ASSOCIATES
12 SCHUBERT STREET STATEN ISLAND, NEW YORK 10305
(212) 448-6283 (212) 448-6298 (212) 448-2913
We do not have a reader inquiry number. Please call or write for further information. Prices subject to change without notice.
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 curiosity 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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This 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-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. Regrettfully, 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
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**Notes:**
- CPU models: 8080, 8085, 8086, 8088
- Memory sizes: 64K, 128K, 256K, 640K, 1MB
- Other: ROM, disk, printer, etc.
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## S-100 PRODUCT DIRECTORY

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- Includes RT-11 version 5.0 operating system
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"...Microsoft chose Lattice C both because of the quality of code generated and because Lattice C was designed to work with Microsoft's LINK program."
PC MAGAZINE OCT. 1983 D. Clippe

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PERSONAL COMPUTER AGE NOV 1983 F. Wilson

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• Linker and Loader
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• a Zilog Z-8000 Technical Reference Manual
The Translators provide Z-8000 source code from Intel 8080 or Zilog Z-80 source code. This source code expansion is from 2% to 11%. The Translator outputs a worksheet and a Z-8000 source file. The worksheets show each line of 8080 Z-80 code, with notes to help the programmer to optimize performance, and further lower code expansion. It even comments lines it adds! The Z-8000 source code used by these packages are the unique 2500AD syntax using Zilog mnemonics, designed to make the transition from Z-80 code writing to Z-8000 easy.

All 2500 AD Assemblers and Cross Assemblers support the following features:
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Hex File Converter, included—for those who have special requirements, and need to generate object code in this format.
Plain English Error Messages—
System requirements for all programs: Z-80 CP/M 2.2 System with 64K RAM and at least a 96 column printer is recommended. Or 8086/88 96K CP/M or MSDOS (PCDOS).

Cross Assembler Special Features
Z-8—256 User defined registers names, directive to engage UPC, Z-80 style syntax.
8748—fully Intel source code compatible.
8051—256 User defined register names, bit addressable naming allowed.
6800 Family—absolute or relocatable modes, all addressing modes supported, Motorola syntax compatible.
6502—Standard syntax or Z-80 type syntax supported, all addressing modes supported.

8086 and Z-8000 XASM includes Source Code Translators

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Stepper 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 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-
cl, 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 1 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 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.

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

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 Northstar 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-
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 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 software 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 I 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.
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 the 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 application 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

\[
A > BMOTOR \quad \text{(or PMOTOR)}
\]

\[
B > MBASICDEMO \quad \text{(or PDEMO)}
\]

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 BDISPATCH.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. BDISPATCH translates data from the Basic program 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**

Continued from page 83

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 providing a telephone service for users. This is where I got an explanation on the theory of CORE and how it is used. This is where I got an explanation on the theory of CORE and how it is used. This is where I got an explanation on the theory of CORE and how it is used. This is where I got an explanation on the theory of CORE and how it is used. This is where I got an explanation on the theory of CORE and how it is used.

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CIRCLE 52 ON READER SERVICE CARD
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 information 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-

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Snow MC100
Continued from page 86

Continuing 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...

Listing 2

1800 REM
1810 DEF FNF=255: REM THIS POINT BOTH MOTORS SHOULD BE RUNNING. MOTOR A AT
1820 DEF BNF=255: REM THE SPEED OF MOTOR B, THE MOTORS WILL CONTINUE
1830 REM RUNNING EVEN WHEN THE PROGRAM STOPS. BECAUSE OF THE
1840 REM MOTOR CONTROL BYTE VALUE, (AMCO) WHICH DOES NOT STOP THE
1850 REM MOTORS EVEN WHEN THE TERMINAL COUNT IS REACHED.
1860 REM
1870 REM THE MOTOR STATUS CAN BE MONITORED BY READING THE
1880 REM MOTOR STATUS PORT (BADDR). SEE MC100 USER'S MANUAL
1890 REM
1900 REM
1910 REM
1920 REM

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CIRCLE 5 ON READER SERVICE CARD
Simplify your Command Lines

Create CP/M files on the fly with SYNONYM

Among 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 DATA-STAR 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 offered 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 CF=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 do next, 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:

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CIRCLE 64 ON READER SERVICE CARD
CIRCLE 63 ON READER SERVICE CARD
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 Quickeode, 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, CPMEM, 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.

Joseph Katz, 103 South Edisto Ave., Columbia, SC 29205

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

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.

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

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

```
/xdirl/dir2/.../name.oxt
```

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

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 overcome 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 command 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 character | 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 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 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 es.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 es.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 upper 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 input 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
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 com­
mand is used. They are displayed, how­
ever, when the long form, ls -l, is used.

The -v flag in the subshell com­
mand, csh, 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 origined at
100H and the second at 200H.

The result of executing the mkrel
command string shown above is to pro­
duce 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 call­
conventions of the Software
Toolsworks C/80 C compiler. In part,
they replace the library functions al­
ready 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
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 ef­
ectic use of the manual. For those
without such background, an introd­
catory 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 prom­
ised 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 over­
write existing files if desired.

The UNIX link command, ln, is
not implemented in C/NIX and is sore­
ly 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-de­
defined path search capability was avail­
able for all applicable C/NIX com­
mands, rather than the present
inflexible path search provided only
with shell files.

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

<table>
<thead>
<tr>
<th>Command syntax</th>
<th>Command function</th>
</tr>
</thead>
<tbody>
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<td>bye</td>
<td>leave the C/NIX shell (exit)</td>
</tr>
<tr>
<td>cat file file2... &gt; outfile</td>
<td>Concatenate text files</td>
</tr>
<tr>
<td>cat &lt; (....)</td>
<td>Output text in paren</td>
</tr>
<tr>
<td>chdir</td>
<td>Change to top-level directory</td>
</tr>
<tr>
<td>chdir dir</td>
<td>Change to a new directory</td>
</tr>
<tr>
<td>chmod [+w] [w+s] s file1...</td>
<td>Change &quot;mode&quot; of files</td>
</tr>
<tr>
<td>ed dir</td>
<td>Change to top-level directory</td>
</tr>
<tr>
<td>cp file file2... dir</td>
<td>Change to a new directory</td>
</tr>
<tr>
<td>csh -v cmd file param'...</td>
<td>Invoke subshell on command file</td>
</tr>
<tr>
<td>dir [-l] pattern1 pattern2...</td>
<td>List directories</td>
</tr>
<tr>
<td>dir [-l]</td>
<td>List current directory</td>
</tr>
<tr>
<td>echo param file param2...</td>
<td>Echo parameters to console</td>
</tr>
<tr>
<td>era [-f] file file2...</td>
<td>Erase files</td>
</tr>
<tr>
<td>exit</td>
<td>Exit the C/NIX shell</td>
</tr>
<tr>
<td>grep &quot;pattern&quot; file</td>
<td>Search files for a pattern</td>
</tr>
<tr>
<td>grep &quot;pattern&quot;</td>
<td>Search console input for a pattern</td>
</tr>
<tr>
<td>help topic1 topic2...</td>
<td>Display help information</td>
</tr>
<tr>
<td>help</td>
<td>Display list of help topics</td>
</tr>
<tr>
<td>ls [-l] pattern1 pattern</td>
<td>List directories</td>
</tr>
<tr>
<td>ls [-l]</td>
<td>List current directory</td>
</tr>
<tr>
<td>man topic1 topic2 man</td>
<td>Display pages from manual</td>
</tr>
<tr>
<td>mdir dir dir2...</td>
<td>Display list of manual pages</td>
</tr>
<tr>
<td>mkrel file100 file200 file.pre</td>
<td>Make directories</td>
</tr>
<tr>
<td>mv old name new name</td>
<td>Make page-relocatable program</td>
</tr>
<tr>
<td>mv file file2... dir</td>
<td>Move/rename file</td>
</tr>
<tr>
<td>pcmd</td>
<td>Move files to new directory</td>
</tr>
<tr>
<td>ren old name new name</td>
<td>Print pathname of working directory</td>
</tr>
<tr>
<td>rm [-f] file file2...</td>
<td>Rename a file</td>
</tr>
<tr>
<td>rmfile dir dir2...</td>
<td>Remove files</td>
</tr>
<tr>
<td>type file file2...</td>
<td>Remove directories</td>
</tr>
<tr>
<td>Type text files</td>
<td></td>
</tr>
</tbody>
</table>
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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 line printer.

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.

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Network or file server? One implementation provides an answer

The *WATSTAR Network

WATSTAR? 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 upperclassmen 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) 94 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 straightforward, clean design that works well all the time. It proves that a 4 MHz Z80 is not slosh; 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/calendard, 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 token-passing system 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-469 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 VPU's 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 all stations 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 to 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 viewed 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
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 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 booted 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 afficionados 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-

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

Figure 1. **WATSTAR** hardware block diagram.

![Figure 1. WATSTAR hardware block diagram.](image-url)
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. *WATSTAR, using only 64K memory in the central system and no clever bank-switching games, it was possible to realize 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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*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-likes, 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.

John G. Wilson, Faculty of Engineering, University of Waterloo, Waterloo, Ontario, Canada N2L 3G1

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In 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:

<table>
<thead>
<tr>
<th>Acceptable</th>
<th>Unacceptable</th>
</tr>
</thead>
<tbody>
<tr>
<td>@PRINT.1</td>
<td>@WRITE#4 (# is illegal char)</td>
</tr>
<tr>
<td>@EXIT</td>
<td>EXIT.6 (no leading @)</td>
</tr>
<tr>
<td>@age.sr</td>
<td>@POSITION.35 (too long)</td>
</tr>
</tbody>
</table>

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, strcpy, etc., are standard library functions contained in the file stdlib.c that comes with C/SO (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 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.

---

The Basic source program can be written without line numbers.

---

Listing 1
REM Test for MBasic preprocessor
REM 110383
@START PRINT;PRINT;PRINT
PRINT "MBasic arithmetic with A = 2, B = pi."
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 @EDJ
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
@EDJ END

Listing 2
10 A=2:B=3.14159
20 PRINT;PRINT;PRINT
30 PRINT "MBasic arithmetic with A
40 PRINT "B = pi."
50 PRINT "Enter 1 for A*B"
60 PRINT "2 for A/B"
70 PRINT "3 for A+B"
80 PRINT "0 to quit"
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
/* mpre.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
#define MAXLBL 500
char label[9*MAXLBL];
int lineno[MAXLBL];
static int lblcnt = 0;
main (argc, argv)
int argc;
char *argv[];
{ int len;
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.

Price: C/80, $49.95; add $2 shipping for 5½" format, $3 for 8". C/80 Mathpack extension package, $29.95. The Software Toolworks, 15233 Ventura Blvd., Suite 1118, Sherman Oaks, CA 91403; (818) 986-4885.

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LINE NUMBERS
Continued from page 114
```c
#include "stdlib.c"

int eoj(f2)
{
    char *s, *t;

    while((isalpha(*t) || isdigit(*t)) || *t == ';')
    {
        ++i;
        while(isalpha(s[i]) || isdigit(s[i]) || s[i] == ';')
        {
            s = &s[i++];
            t = &t[i++];
        }
    }

    eof(f2);
    int f2;
    {
        int i;
        fclose(f2);
        for (j = 0; j < lblcnt; j++)
            printf("%s on line %d\n", t, n);
        printf("\n");
    }
}
```

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CIRCLE 26 ON READER SERVICE CARD
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 (280) 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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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 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
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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-

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, Addrex-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 Microsystms. 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

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

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</thead>
<tbody>
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<td>Table of contents</td>
</tr>
<tr>
<td></td>
<td>MultiLevel Index</td>
</tr>
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<td></td>
<td>List of Figures</td>
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<td>List of Tables</td>
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CIRCLE 16 ON READER SERVICE CARD 123
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 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 +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.

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.

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 capabiliti-
MicroScript™ $149
Customizable Text Formatter
- generic markup (GML compatible)
- multiline headers, footers, and footnotes
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- scroll by line or window
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- delete by character, word, line, or block
- read external files into current file
- copy, move, and write blocks of text
- insert, overlay, wordwrap, split, or join
- all cursor addressable VTs
- all commands mapped in profile

Postpaid within U.S. & Canada, outside U.S. add $5, CA residents add 61/4%, 8” SS/SD CP/M-86, 8” SS/SD CP/M-68k, 5.25” SS/DD PC-DOS.

CIRCLE 157 ON READER SERVICE CARD

MRS/OS Source Code
THE Z-80 OPERATING SYSTEM
- Runs CP/M 2.2 and CDS-OS applications programs
- Contains 55 OS function calls
- Direct and Standard console I/O
- Standard console I/O includes numerical formatting and I/O steering
- User defined "CTRL 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
- Source code also provided on 8” SSD disk or 5¼” SSD disk (please specify)

ONLY $59.95 COMPLETE
(Fully commented source code included in 250 page manual)

CIRCLE 58 ON READER SERVICE CARD
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 512 x 512 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 1K x 2K. Zoom in and explore a close-up of 32:1, not in the usual quantum leaps of integer zooms, 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 PPMs 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

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).

BD Software
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B: SSSD format, $150
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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 5¼" hard disk drive, a 1 MB 5¼" floppy disk drive, 16 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 microcomputer 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 Malaga St., Chatsworth, CA 91311; (213) 882-9007.

CIRCLE 328 ON READER SERVICE CARD

Floppy disk storage file

The new 5¼" 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 1¼" by 3" and are printed four up in typewriter format. Each file is ½" high, 8½" wide and 8" deep.

Price: less than $40 each.

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

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• DMA compatible with transfer rates to 2 Megabytes/second.
• On board powerfail logic writes 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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**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 standalone 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:** 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:**
Data Management Associates, Inc.
P.O. Box 4340
Wilmington, DE 19807
(302) 655-8986

**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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IEEE 896/9-100 • LOW POWER • FULLY STATIC

LITHIUM BATTERY BACKUP OPTION: Unique POWER-FAIL-SENSE circuit tells processor when bus power is failing, then disables WRITE. Lithium Battery retains memory contents for up to a year. Avoids POWER FAILURE MEMORY CRASHES intelligently.

BG BANK 256s $1,499 Battery Backup $99
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PLUS: 8/16 BIT TRANSFERS • 24-BIT ADDRESSING
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DEALER INQUIRIES INVITED
CIRCLE 14 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

COMING SOON

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.
170 Main Street
East Falmouth, MA 02536
(617) 548-6070

CIRCLE 322 ON READER SERVICE CARD

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The one and only adult Lisp system for CP/M users.

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CIRCLE 10 ON READER SERVICE CARD

CIRCLE 68 ON READER SERVICE CARD

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

COMING SOON

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.
170 Main Street
East Falmouth, MA 02536
(617) 548-6070

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CIRCLE 68 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
Brooklyn, NY 11236
(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.
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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 programs 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.
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THREE NEW PRODUCTS. With the addition of a new 6 MHz Master/SBC, a 128K RAM slave processor board and ARCNET capability through our ARC-100 ARCNET controller board you can build sophisticated S100 bus systems for one to 4000 users.

Intercontinental Micro continues to help State of the Art simple to use.

SYSTEM FLEXIBILITY: With 4 MHz or 6 MHz 8-bit SBC/masters, 4 or 6 MHz 8-bit slave processors with 64K or 128K RAM, TurboDOS™ and PC-DOS™ operating systems, ARCNET links between systems and a complete line of interface and controller boards, Intercontinental Micro System's give you and your customers flexibility—to grow and change.

Imagine, with the introduction of our 16 bit slave in the second quarter, you'll be able to use both 8 and 16 bit processors on the same network—allowing you to keep your 8 bit software library as you grow into the 16 bit world. Soon even IBM PCs will be able to act as slaves in an Intercontinental S-100 bus system.

TurboDOS allows you to construct true multituser systems with CP/M™, MP/M™, CPIM 86 and soon PC-DOS capability. And ARCNET makes local area networks with up to 4000 users possible—and very cost effective. From a simple single user station to large scale ARCNET business system groups, Intercontinental provides flexibility. In fact, our products have been used for a host of functions—from process control and robotics to satellite communications, special movie effects and building demolition.

SPEED AND POWER. Intercontinental Micro pioneered the use of 4 channels of Direct Memory Access (DMA), in the micro world—making our master slave combinations up to 300% faster than the competition. Other state of the art features found in Intercontinental products include: 16 MegaByte Memory Management Unit (MMU) on all SBC/Masters, bank selectable slave memory, vectored priority interrupts, and multiple parallel/serial ports.

Features are great—but they don't mean much unless they help you do your job better and faster.

ANNOUNCING THE FASTEST, MOST POWERFUL, COMPREHENSIVE LINE OF S-100 PRODUCTS EVER AVAILABLE.

Ask for confidential benchmark studies on our product's speed. We think you'll agree we can save you and your customers time.

A COMPLETE PRODUCT LINE. CPZ-4800X—Single Board Computer, 4 or 6 MHz processor (Z80A/B), onboard floppy disk controller, 64K RAM, 4 channel DMA controller, 16 vectored priority interrupts, two parallel I/O channels, two synchronous or asynchronous serial I/O channels, real time clock. 16 bit version available 3rd quarter 1984.

CP/M8X—slave processor, 4 or 6 MHz processors, 64K or 128 RAM basic selectable memory mapped, two serial ports synchronous or asynchronous, two parallel ports, software selectable baud rates. 16 bit version available 2nd quarter 1984.

256KMB—Memory Board, linear addressable to two megabytes, 220 nano second access time—maximum, bank selectable in 16K increments, I/O port address bank selectable in 16K increments, I/O port address bank selection, consists for phantom de-selection, parity error detection. Comox ZPU compatible.

ARC-100—ARCNET controller meets EIA-696/2/01 S-100 spec, coax cable interface, 255 nodes per network segment, 2.5 megabit data rate.

MD-103—Harddisk controller, user selectable sector sizes of 256, 512 or 1024 bytes, implied seek and error recovery, user selectable controller address. Handles up to two drives, 5MB to 140MB.

Personalities—SASI, Centronix, PRIAM, Clock/Calendar, RS232, Modem, RS422, long distance serial communications (up to 4000 ft).

SUPPORT, SUPPORT, SUPPORT. Everyone talks about support. Intercontinental Micro Systems does more. We don't build systems, so you are our most important customer. Ask us for references or call our dedicated support team. You'll find out that support is more than just a word at Intercontinental Micro Systems, it's what we're here for.

SO GET IT ALL. A comprehensive product line loaded with benefits for you and your customers. Flexibility to grow. And support that sets industry standards. Call Intercontinental Micro Systems today—we can help you with your S-100 bus system needs.

CIRCLE 185 ON READER SERVICE CARD
When buying a computer, you can't limit yourself to just satisfying today's needs. The best value in a system comes from its productivity...both for today and tomorrow. CompuPro's System 816™ computer has that value. With all the power and capacity to handle your needs now and down the road.

System 816's longevity stems from top quality components...high storage capacity...the flexibility to handle a large variety of applications...and the speed to get the job done fast. Upgrading is easy, and when it's time to expand from single to multi-user operation, it's as simple as plugging in boards and adding terminals. Your system grows as you grow.

CompuPro also provides a library of the most popular software programs with your system and because it's CP/M® based, you have more than 3,000 other programs to choose from.

Even our warranty is for today and tomorrow. It spans 365 days — and includes the additional security of Xerox Americare™ on-site service nationwide for designated systems.

What's more, CompuPro is one company you can count on to be around tomorrow. For more than ten years we've been setting industry standards, increasing productivity and solving problems.

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