C Interpreters & Debuggers
/* see pages 22-34 */

Also in this Issue

Public Domain MS-DOS & CP/M Software .................. 12
Implementing PC-DOS on Non-IBM Compatible Systems - Part II .......................... 38
MS-DOS Device Drivers ................................... 52
Rolling Your Own PC/XT/AT Clone ..................... 66
Converting from CP/M to MS-DOS on the PC ............. 80

Complete Table of Contents on Page 3

March/April 1986 Vol. 2/No. 2 $4.50 U.S.A.
MACROTECH—STILL THE S-100 PERFORMANCE PACESETTER

MI-286. Our 80286/Z80H Dual CPU Board is at least twice as fast as Compupro’s 8085/88 and it’s a direct replacement. The MI-286 has already become the standard by which other 80286 based systems are measured. Ask us for a complimentary Benchmark Report.

ADIT. There’s nothing else like it on the market. It’s an Intelligent I/O Board with its own real time firmware that lets you control up to 16 different terminals, modems or printers all from a single slot. ADIT is the performance standard in environments such as Alpha Micro where I/O speed is critical.

V-RAM. High performance Static CMOS system memory/virtual disk in either quarter or half megabyte configurations. With its on-board battery and power-fail logic, the V-RAM sets a new performance standard at conventional static memory prices. When accessed through I/O port channels, the half megabyte V-RAM becomes M Drive compatible with true non-volatile solid-state disk capability.

MSR. High performance and reliability in a memory so fast you won’t believe it’s a dynamic ram product. Compatible with all popular S-100 environments, the MSR’s low power consumption and 120 nanosecond ram devices set a new standard for dynamic memory products. The MSR is available in quarter, half, one and two megabyte configurations at the lowest prices in the industry.

Dealers:
Gifford Computer Systems (415) 895-0798
Custom Computer Technology (800) 222-8666
S-100 (800) 423-5922
John D. Owens & Associates (212) 423-5922
In England: Fulcrum (Europe) Ltd. (0621) 828763

Macrotech dealers also include most Compupro Systems Centers, Heathkit Electronic Centers and Alpha Micro Dealers.
Intelligent Computer Designs XL series S-100 products offer the latest in state-of-the-art designs.

Our slave products, the 8-bit XL-DL80 and the 16-bit XL-DL88, feature two slaves on one card, enabling system integrators double the number of users previously possible.

The XL-M180, a high-performance system master for single or multi-user applications, complete with hard disk, streaming tape and floppy capabilities introduces something new. An onboard Local Area Network with up to 5Mbps transfer speed. With it, interfacing other XL-M180's or even IBM-PC's is a snap!

If you think ICD has solutions for your systems' needs, write or give us a call.

XL-DL80
- 2 completely independent slaves
- 8mhz 70108 processor
- 128k to 512k memory expansion
- 4 serial communication channels
- DMA transfers to/from system master
- CP/M 86, MS-DOS, PC-DOS, TurboDOS compatible

High performance
- HD64180 uPD
- 512k memory with burst refresh
- 5Mbps local area network
- 4 bi-directional parallel ports
- 2 serial ports
- 1 clocked serial port
- Pipelined architecture
- 2 SYSTEMS O/S available

XL-M180
- Hard disk controller/Streaming tape option
- All digital floppy disk controller
- Extended instruction set
- Programmable interrupt structure
- 20 level interrupt structure
- Over 80 I/O ports
- Software programmable baud rates

XL-DL88
- 2 280H 8mhz processors
- ½ megabyte memory
- 2 190k local drives
- 4 serial ports
- Draws only 700 milliamps
- No wait states
- CP/M, MS-DOS, TurboDOS compatible

All ICD products have a one-year part/labor warranty.

XL-SERIES is a trademark of Intelligent Computer Designs Corp.
CP/M is a trademark of Digital Research Corp.
MS-DOS is a trademark of IBM Corp.
TurboDOS is a trademark of Software 500, Inc.
SYSTEMS is a trademark of Micron Inc.
Since 1968 Teletek has been a leader in the design and manufacture of single board computers, controllers, memory boards and interface boards. Teletek offers five different single board computer (SBC) models, each with its own unique features to meet the varied needs of the system integrator. Based on the 8086 16-bit and 8087 8-bit microprocessors, Teletek's SBCs will run high performance micros capable of handling large amounts of onboard, dynamic RAM. The SBC-86/87 also offers an optional 8087 math coprocessor for numeric intensive applications.

Teletek's Systemaster II provides two RS232C serial ports and two Centronics-compatible parallel ports or may be optionally configured to provide a SCSI interface or an IEEE-488 interface to support many laboratory testing and measuring instruments. Teletek also offers a dual controller board, the HD/CTC, which will control any two ST506-compatible hard disk drives and any QIC-02/QIC-24-compatible cartridge tape drive. This unique design saves hardware cost as well as space in the mainframe.

Teletek's IEEE 696/5-100 boards run under the multi-user, multi-processing operating system TurboDOS by Software 2000, supporting up to 16 users and capable of running PC-DOS application programs. For single-user systems, Teletek is supported by the CP/M operating system.

In Europe:
Kode Limited
Station Road
Caine, Wiltshire
SN11 0JR England
tel: 0249-813771
telex: 449335

In Brazil:
DANVIC S.A.
R. Conselheiro Nebias, 1409
01203 Sao Paulo, Brazil
tel: 221-6033 (PABX)
telex: 1123888 CICP BR

Teletek provides a 30 day evaluation program to qualified customers. For more information, call our Sales Department at 916-920-4600 or write for our information package.
STAFF

Publishers
Sol & Lennie Libes

Editors
Sol & Don Libes

Associate Editor
Susan Libes

Contributing Editors
A.G.W. Cameron
David Carroll
Ian Darwin
Nelson T. Dinerstein
Dave Hardy
Ken Jackson
Henry Kee
Steve Leon
William Wong

Editorial Assistant
Lenore Melillo

Advertising
Lennie Libes

Circulation/Administration
Lennie Libes

SUBSCRIPTION RATES

1 Yr. 2 Yrs.
U.S. $20 $35
Canada & Mexico $28 $52
Europe & So. America $35 $64
Asia, Africa, Australia & Near East $39 $70

ADVERTISING RATES: Available on request. Call (201) 522-9347 or write to: M/SJ, Box 1192, Mountainside, NJ 07092.

CHANGE OF ADDRESS: Please send old label and new address to: Micro/Systems Journal, Box 1192, Mountainside, NJ 07092.

CORRESPONDENCE: Address all letters to: M/SJ, Box 1192, Mountainside, NJ 07092. The editor may also be contacted via MCI Mail (SLIBES).

Micro/Systems Journal (ISSN #8750-9482) is published bimonthly by Libes Inc., 995 Chimney Ridge, Springfield NJ 07081. Second Class postage is paid at Springfield, NJ and at additional offices. POSTMASTER: send address changes to MICRO/SYSTEMS JOURNAL, PO Box 1192, Mountainside, NJ 07092.

Copyright © Micro/Systems Journal, a subsidiary of Libes Inc. All rights reserved, reproduction prohibited without permission.

Micro/Systems Journal is a trademark of Libes Inc.

IN THIS ISSUE

FEATURE ARTICLES

Implementing PC-DOS on Non-IBM Compatible Systems - Part II .......................... 38
Christopher Cochran & Kristofer Sweger

Program Interfacing to MS-DOS - Part VI ......................................................... 50
William G. Wong

Rolling Your Own PC/XT/AT Clone ................................................................. 66
Sol Libes

Converting From CP/M to MS-DOS on the PC ................................................. 80
Robert J. Stek, Ph.D.

PRODUCT REVIEWS

C Interpreters .......................................................... 22
Don Libes & Graham Morris

C Source-Level Debuggers ................................................. 28
Jonathan Sachs

Lomas Data Products' S100-PC ..................................................... 58
Dave Hardy and Ken Jackson

CompuPro S-100 PC Video Board ................................................. 60
Alex K. H. Soya

DEPARTMENTS

Publishers' Page ...................................................... 4
Lennie & Sol Libes

News, Views & Gossip .............................................. 6
Sol Libes

The SIG/M Public Domain ............................................. 10
Steve Leon

The PC/Blue Report .................................................. 14
Hank Kee

The C Forum .......................................................... 16
Don Libes

The CP/M Bus .......................................................... 70
Bob Blum

The UNIX File .......................................................... 72
Ian F. Darwin

The Data Base Forum ................................................ 74
Nelson T. Dinerstein

The Scientific Computer User .............................................. 78
A. G. W. Cameron

Software Directory .................................................... 86

New Products .......................................................... 89

AUTHORS: Micro/Systems Journal is always seeking good articles. Please write or call first to see if we are interested in the subject. Please do not send the article unless we ask for it.

If you are interested in reviewing hardware or software, please write telling us your interests, your background and include a sample of your writings.

Send a stamped self-addressed business size envelope for a copy of our Author's Guide.

TRADEMARK ACKNOWLEDGEMENTS

Macintosh
UNIX
GEM, CP/M
Concurrent DOS
8088, 80386, 80286
IBM PC, PC/XT, AT
MS-DOS, UNIX
GW Basic
64000, 64010, 64020
Publishers’ Report To The Reader

by Lennie & Sol Libes

We have completed our first full year of publishing M/SJ and it is therefore an appropriate time to take stock of our efforts.

EDITORIAL

Most new magazines take several issues before they come up to speed editorially. Usually their first few issues are weak on content as they attempt to obtain worthwhile articles.

As we look back on our first year we are pleased with the high standard of editorial content we have achieved. Feedback from readers has proven this over and over.

We have addressed topics that other magazines would not touch out of fear or greed. For example, our two part series on the NEC V20 and V30 chips gave information that was totally ignored by other publications out of fear of suit from Intel.

And, virtually every other newstand computer publication ignores S-100 and CP/M out of fear that they will alienate their PC-based advertisers. And, we were the first to discuss building PC, XT and AT clones from generic components…a topic still avoided by most publications fearful of losing IBM’s lucrative advertising.

We have published articles directed to the advanced microcomputer user recognizing that we will never attract the vast majority of not-so-sophisticated users, and hence will always have a small circulation compared to publications edited for the widest appeal.

CIRCULATION

This issue will be mailed out to over 11,000 paid subscribers. Approximately another 1,200 will go out to newstand dealers, book stores and computer stores. We also expect to sell more than 1,200 back issue copies in the next year.

Thus, the total reader circulation, of this issue, is over 13,000.

We actually print about 15,000 copies, using the balance for promotion.

FINANCIAL

On the financial end we can report that the magazine is profitable and we are able to minimally compensate ourselves for our efforts and the financial investment we made. However, M/SJ is more a “labor of love” since we could no doubt earn much more in other endeavors.

There is no doubt in our minds that M/SJ could be built up into a large and very successful business operation. We have done a little to promote the magazine to potential subscribers, advertisers, dealers, etc. However, we have decided that the size of the current operation is all we can handle and have therefore decided to keep our promotional efforts at a level necessary to maintain the current size and circulation of the magazine.

The truth is that we like editing M/SJ and tolerate the publishing part only as a means to getting M/SJ out. We would love to have someone else publish it, while we just do the editing.

Also, we have lost some commercial software advertisers because we refused to drop our columns on public domain PC and CP/M software.

READER STUDY

We have been conducting two reader studies in conjunction with subscriber renewals. The first study generated over 2,000 responses to a questionnaire which asked readers what systems and languages they used and what their interests were. The second study, still in progress, questioned readers about the content of the first 5 issues of M/SJ.

### SYSTEMS USED BY M/SJ READERS

<table>
<thead>
<tr>
<th>PC/PC-Compatible Systems</th>
<th>S-100 Systems</th>
<th>UNIX Systems</th>
<th>VAX</th>
<th>PDP-11</th>
<th>Alton</th>
<th>Sun</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM-PC</td>
<td>103</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>60</td>
</tr>
<tr>
<td>IBM-XT</td>
<td>78</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>28</td>
</tr>
<tr>
<td>Zenith 150/160</td>
<td>60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>IBM-AT</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Compaq</td>
<td>33</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>Cloned</td>
<td>33</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>Sanyo</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>ASCII-6300</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>Leading Edge</td>
<td>8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Tandy</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Other</td>
<td>17</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>Total</td>
<td>405 (61%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>115 (23%)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other Systems</th>
<th>TSS-80</th>
<th>Apple II</th>
<th>KayPro</th>
<th>Heath 289</th>
<th>Osborne</th>
<th>Morrow MD</th>
<th>Big Board</th>
<th>Xerox 820</th>
<th>Televideo</th>
<th>Ampro</th>
<th>Commodore</th>
<th>Macintosh</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>63</td>
<td>60</td>
<td>55</td>
<td>28</td>
<td>18</td>
<td>18</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>13</td>
<td>10</td>
<td>242</td>
<td>565 (113%)</td>
</tr>
</tbody>
</table>

Total number of systems used by 500 M/SJ readers = 1,413.
It takes an inordinate amount of time and effort to compile the data from these questionnaires. We were forced to limit ourselves to only tabulating the data from the first 500 responses to the first questionnaire. The following are the results of tabulating just the first question on the first questionnaire... What systems do our readers use? The table in this column is a breakdown on the systems our readers use.

The average M/SJ readers uses more than one system... the average is 2.9 systems. It is apparent that the IBM-PC/XT/AT and compatibles are the most used by M/SJ readers (81%). S-100 systems rank second, being used by 65%.

The third most popular type system among M/SJ readers are the UNIX-based systems (23%). These are mostly timesharing systems (typically a VAX) being used by engineering, scientific and educational users.

Ranking fourth and fifth, much further lower in percentages are Apple (12%) and KayPro (11%) systems running CP/M.

Note that the “other systems” comes to 113% because many readers used more than one system in this category. In all, we counted 120 different system manufacturers of systems used by M/SJ readers.

In a future issue we will report on other reader data we have collected.
Rumors & Gossip

Digital Research has dropped all support for its language products. Customers who seek help from DRI with these products will be given a list of clubs and told to seek help from them.

Rumors are flying fast and furious on Apple's plans to upgrade the Macintosh. Latest rumors are that Apple will introduce a Midimac powered by a 68020 with some VME bus slots and SCSI interfaces as well as plug-in cards to provide color graphics and attachment of a hard disk, expanded memory, etc. An Upscale Mac 68K-based system with 15 or 17 inch screen to compete with the Sun and Apollo workstations is also rumored.

IBM is reported developing a 20Mbyte 3.25-inch winnie at one of its Japan facilities. It is rumored that this is intended for its XT replacement due out shortly. IBM is currently using a 3.25" drive from Matsushita in its Japanese version of the PCjr. There are also rumors that IBM will shortly release a version of the AT with an 8MHz clock.

The EGA (Extended Graphics Adapter) video controller for the PC/AT appears to finally be gaining acceptance in the marketplace. Several companies have released software for it and two other manufacturers (AST and Vega) have released EGA compatible cards that cost less and have more features. Several other companies are expected to shortly introduce EGA cards, EGA compatible monitors and software. When the Far East board makers start shipping EGA cards we should really see the price drop and EGA popularity gain.

NEC is sampling the V40 and V50 chips, which are upward compatible with the V20, V30, 8088 and 8086 microprocessors. The chips integrate several functions previously performed by peripheral chips. These include: DRAM refresh, four channel DMA, serial I/O channel, interrupt control, bus and wait control, clock generator and timer/counters. The chips also have a power-down feature. There is a rumor that NEC plans to also introduce versions of the V20 and V30 that execute the Z80 instruction set. But what has really got Intel scared is NEC's 70291, a substitute for the 80287 math coprocessor. When used with a V20/30 it provides even better performance and has even more math functions.

And, there are rumors that NEC is working on a V60, an 80286 substitute and a V70 look-a-like. Both are rumored to integrate the math coprocessor into the one package.

The Microprocessor Standards Committee of the IEEE has formed a subcommittee to develop a 32-bit version standard for the S-100 bus. The committee is being chaired by Mark Garetz of Viasyn (CompuPro). People who wish to have input or participate in the development of this standard should contact Mark directly at Viasyn, 26538 Danti Court, Hayward CA 94545, (415)786-0909.

MS-DOS & CONCURRENT-DOS RUMORS

The release of MS-DOS Version 4.0 is rumored imminent. The features of the new release have been discussed in this column previously. It is expected that IBM will not upgrade to this new version, rather they are expected to adopt versions 5 of MS-DOS.

MS-DOS Version 5 is expected to be released later this year. It is rumored to be designed to exploit the full potential of the AT and run exclusively in the powerful protected mode of the 80286. Further, Version 5 should allow AT users to address up to 16Mbytes of physical memory and 1 gigabyte of virtual memory. IBM is expected to adopt Version 5 and add a few features of their own to support graphics and communications to mainframes.

MS-DOS Version 6 is not expected to be released until next year and is rumored to be designed for 80386-based systems. It is expected that Version 6 will allow the creation of "virtual machines" on the 386 so that users can run several PC-DOS sessions or even DOS and XENIX at the same time. Expect Compaq to beat IBM to market with a 386-based machine, to be released before year-end and running Version 6 of MS-DOS. The big hold up appears to be that Intel is still working bugs out of the 80386. Although they have been sampling for some time actual production appears to still be a few months off.

Digital Research recently demoted a preliminary version of its Concurrent PC operating system which addresses 8Mbytes of memory on 8088-based machines using AST RAMcards. Concurrent uses a memory pool manager that bankswitches program code from conventional memory to high memory in a manner similar to that used in CPM 3.0. DRI also reports that it has begun shipping copies of Concurrent DOS-286 that emulates PC-DOS while in the 286's protected mode.

DRI may have finally scored a coup over Microsoft. IBM has adopted Concurrent PC DOS as the operating system for a POS (Point of Sale) system it is selling based on the AT. Using Concurrent, one or two AT's control as many as 128 terminals. When not used as the system controller the AT(s) can be used to run standard PC software under Concurrent.

Concurrent was selected because it is multi-tasking and multi-user. DRI customized a version of Concurrent for IBM that is different from the version found on dealer shelves. IBM is charging $1,250 for the operating system, $2,500 for a version of Basic and some other programs and $900 for a general sales application that must be customized to the retailer's needs.

It would appear that IBM thought Concurrent was better than Xenix (Microsoft's multi-user, multi-tasking OS for the AT) and could not wait for Microsoft to release a multi-tasking version of MS-DOS. The question now is: will IBM sell Concurrent through its dealer network and will DRI be able to capitalize on this to compete against Xenix? Considering that the Xenix implementation for the AT has not been selling well, it may indicate that the market for a multi-user multi-tasking AT based systems is quite limited. Of course what is a limited market for Microsoft may be a terrific market for DRI.

UNIX FOR $99

This may be the year that the UNIX operating system finally makes an impact as two companies have introduced versions at really affordable prices.

Wendin, Box 266, Cherry WA 99004, (509)235-8088, has introduced a $99 version of UNIX called PCUNIX that they claim brings the power and flexibility of UNIX to the PC and compatibles. PCUNIX is multitasking and multuser. But even more startling is their claim that PCUNIX allows users to run MS-DOS programs without modification. It includes 30 utility programs. Wendin also sells PCVMs, a $99 version of VAX/VMS for the PC.

Microport Systems, 10096 Sequel Dr, Aptos CA 95003, (408)686-0286, has introduced a $139 version of Unix System V, called V/AT, for use on 80286-based systems. Microport also expects to introduce, later this year, an enhanced version that will run Xenix V applications.

According to Datamation magazine, Microsoft has sold between 10-15,000 copies of Xenix for the AT. This means that less than 3% of all AT's are running Xenix. When we take in the entire personal computer marketplace the percentage is probably between 1-2%. With Microsoft...
DUAL GPIB-488 INTERFACE BOARD
A Stand-Alone, Independently Controlled Dual Channel IEEE-488 I/O Processor. Interface Activity Modes for Controller-in-Charge, Controller Assigned or Terminal Bus Slave, and all Interface Functions are handled transparent to Host System CPU through an on-board CPU and DMA controller. User Friendly operation.
A&T, P/N 52748-900-102

RGB COLOR GRAPHICS BOARD
Programmable resolution up to 512 x 512 pixels with 4 local video planes and on-board graphics processor. Color mapper allows 16 colors from a palette of 4036. Light pen input. Plus more...
A&T, P/N 52748-300-101

12-BIT A-D/A CONVERTER BOARD
8 Channel A-D: 12 microsec Conversion, 50KHz Sample Rate, Programmable Gains, Offset and Diff./Single Modes.
8 Channel D-A: 2 microsec. Setting, Bipolar V or Unipolar I Output, Programmable Reference levels, Dual-Ported Channel Refresh RAM, 16/8-Bit Data Transfers via I/O or Memory Mapped
A&T, P/N 52748-900-101

PERIPHERAL SUPPORT BOARD
Two Serial SYNC/ASYNC Ports with RS-232, TTL or Current Loop Outputs, three B-Bit Parallel Ports, three Timers, Real Time Clock/Calendar and Responser Programmable Interrupt Controller. Small Proto Area with +5 and ±12v.
A&T, P/N 52748-150-101

BAR CODE PROCESSOR BOARD
The BarTender is a stand-alone I/O Processor that reads and prints most common Bar Codes. Includes b-directional reading, wand interface, clock/calendar with battery, Extensive documentation and software.
A&T, 52748-500-101 Without Wand
A&T, 52748-500-201 With Wand

MULTI-PURPOSE PROTOTYPING KIT
Industrial Quality with Plated-Thru holes for Wire-Wrap or Solder projects. Complete with +5, ±12v Regulators, Bus Bar, Filter Capacitors, and Manuals.
P/N 52748-450
expected to introduce a multi-processing version of MS-DOS later this year even at this low cost Unix may never achieve a significant share of the market.

Many readers have purchased the book Operating System Design, The XINU Approach (see Book Mart, Page 92). If you had not notice before XINU is UNIX spelled backwards and the book contains a good part of the source code for an operating system. Now comes word that Roger B. Frank, 59738 West Nova Ave., Littleton, CO 80127 has ported XINU to a homebrew Motorola 68010 system.

And, Richard Stallman (author of the original EMACS editor) and some friends are working on the GNU project (UNIX by the people, for the people, for little or nothing). He is at 166 Prospect St., Cambridge MA 02139.

JAPAN'S THIRD WAVE IS COMING

In 1981-82 the Japanese made their first attempt at invading the U.S. computer market with 8-bit CP/M-based machines. This first wave of machines flopped. In '83-'84 the second wave hit with MS-DOS based machines that lacked IBM-PC compatibility. That also failed.

In '85 the Japanese took a year off to study the situation more carefully. Thus, this year, Japan's third attempt is being made with low-cost, IBM-compatible machines. Epson, Panasonic, Sharp, Toshiba, and NEC are all introducing such machines with a strong commitment to making them better and cheaper than the likes of the IBM and Compaq machines. The Japanese are expected to capitalize on their wide distribution channels. Thus we can expect to see stereo stores selling these systems in the $1,000 range.

It is interesting to note that mainland China is also trying to establish a foothold in the U.S. market. The Great Wall Computer Company is trying to set up distribution for a PC-compatible.

AMIGA & ST BATTLE

Commodore and Atari are fighting it out at the low end. The consumer market picked up a little this past Christmas with the Atari ST and Commodore Amiga selling well, but not as well as they had predicted. However both were still ramping up production and therefore dealers were able to sell all they could get; peripherals were particularly in short supply.

Atari, who started shipping in July, produced about 100,000 ST's by year-end with 70% going to the European market; they had actually gone on sale in Europe 2 months earlier than in the U.S. as Atari worked on meeting FCC regulations. Jack Tramiel, Atari President, had predicted they would ship 1,000,000 by year-end...oh well, try again in '86. Commodore is rumored to have shipped about 30,000 systems.

The consumer market went into the doldrums after Christmas. Atari thus started selling the ST to mass merchandisers and introduced a more powerful ST with 1Mbyte RAM for their computer store dealers. Mass merchandisers are expected to sell the unit without monitor for well under $500. With many TV sets today having direct video inputs this appears a good prospect.

Both Atari and Commodore are trying to push their systems into the business market. However, this is proving a tough sell as both still lack business applications software. Further, color and superior graphics does not appear that important to business users.

Both Atari and Commodore are trying to push their systems into the business market. However, this is proving to be a tough sell as both still lack business applications software. Further, color and superior graphics do not appear to be that important to business users. Ashton-Tate, etc. undertook development of software for these systems.

The likelihood is that the market for the ST and Amiga will soon reach saturation. Atari may have already reached it with its turning to mass merchandisers for distribution. Commodore may be forced to do the same. Both units, although in short supply during the Christmas season, were being discounted by some dealers to as low as $700 for the ST and $1,100 for the Amiga.

Atari has disclosed that it has built prototype entry-level Unix workstations using the Motorola 68010/68020, AT&T WE32100 and National 32000 microprocessors. The units have several mgs of RAM, provide true multi-tasking and high resolution graphics.

ATARI VS APPLE

When Apple went after Digital Research for using the same icons on its GEM software it was not IBM they were worried about, it was Atari. After all Microsoft's Windows also looks remarkably like the Macintosh display and Apple did not bother them.

What really has Apple worried is Atari. When running GEM it looks exactly like the Mac, and in color, and at half the price. But Microsoft's windows is aimed at running on the expensive IBM AT class machines, selling in the same, or more, price range of the Mac. Apple has every right to be worried. Everything Atari is doing appears to be aimed at undercutting the Mac. For example, one week before Apple announced its new 1Mbyte Mac, Atari announced its 1MByte ST. Not only that, Atari started shipping units on the day Apple was announcing the new Mac.

Further, Apple has disclosed that it is working on a 68020-based version of the Mac, a true 32-bit machine, with an open hardware architecture and capable of running UNIX. And, you guessed it, Atari has disclosed that it is working on a 68020-based machine to run UNIX, to be announced this spring.

Now, if I were Apple, I would be really worried about Atari.

RANDOM BITS

Toshiba is shipping a CMOS version of the Z80 which dissipates only 60 milliwatts at 4 MHz as compared to over a watt for the standard Z80.....QMS Inc. is the first company to announce an under $2,000 list price laser printer.....Kodak has announced that it will start shipping 12M and 6.6Mbyte floppy disk drives later this spring......Compupix Technology Inc., Boca Raton FL, has introduced a parallel-processor board for the PC using the NCR Corp's Geometric Arithmetic Parallel Processor chip, which houses an array of 72 processors. Versions are available with one-to-four chips offering 72, 144, 216, or 288 parallel processors. Prices range from under $5K to $6K. It uses a single-instruction multiple-data path architecture, operates at 10MHz and performs up to 20.8 billion floating-point operations/sec.

COMPUTER FLEA MARKET CALENDAR

I buy most of my components and supplies at computer flea markets where I usually find the lowest prices. I plan therefore to publish, in each issue of M/SJ, a calendar of flea markets. Clubs or companies running computer flea markets should notify us, as early as possible, to be listed in this calendar.

March 15th: New Carrollton MD; Sheraton Motor Hotel. Run by Ken Gordon Productions, (201)297-2526, (800)631-0062 outside NJ.

April 6th: Baltimore MD; Maryland State Fairgrounds Exhibition Complex at Timonium MD. Run by the Baltimore Amateur Radio Club, (301)561-1282.

April 12th: Long Island NY, Colonie Hill Hauppauge NY. Run by Ken Gordon Productions, (201)297-2526, (800)631-0062 outside NJ.

April 19-20: The Trenton Computer Festival, Trenton State College, Trenton NJ. Run jointly by five computer clubs (609)771-2487.

TCF is the grand-daddy of personal computer events, now in its 11th year. The flea market covers many acres and there is also a commercial exhibit area with 600 booth spaces. There are also talks and user group sessions. Sol Libes, Rich Conn, Steve Leon, Henry Kee, Don Libes, Steve Ciarcia, and other well-known personalities will be in attendance and speaking (see the ad in this issue).
THE TOOLS YOU NEED BUT NEVER HAD THE TIME TO WRITE

**CompuMagic's new UTILITY PACKAGE**

FOR ALL CP/M COMPUTERS

ALL OF THIS FOR ONLY $45 with a 30-day money-back guarantee

CMCOPY, COMPARE, DoubleSpace, ERASE, RENAME, SORT, WordCount
Seven tools with a common command interface: command line and prompt modes; multiple commands on a line; what-if, query & overwrite modes; renaming of new files with wildcards; input redirections; changing source and destination user areas; concatenation; I/O to files and devices; etc.

A.COM
Corrects typos! Converts A:MBASIC to A:MBASIC, etc.

MINIERA
Does wild-card erases from within WordStar and takes only 1k of disk space.

MDIR & MDIRS, DISKDF, DIRSPACE & UDIR, DIRBAK
Directory programs that tell you what you need to know: directory listings with or without size; multiple file specifications, output redirection; sort files by name or type. What's on one disk that's not on another? How much space is left in a disk directory? What files are in ALL user areas? List all *.BAK files.

R/O & R/W
Who needs 6k of STAT for R/O & R/W status changing? These are 1k each.

SCREEN (SCREEN ECHO TO A FILE)
For program developers and the curious, captures everything going to the screen, even through BIOS, and writes a copy to a file. (Works with MBASIC too). Better than ^P — you can't edit a printout or merge it into documentation.

TYPIT
Turn your $3000 computer into a $200 typewriter. Great for envelopes & forms. Allows I/O redirection; use it to create short .SUB files.

The CP/M version of the package contains all 20 programs (plus installation programs) on a 8” SSSD or 5” Osborn Disk (Others available, ask) plus complete documentation for only $45. At just $2.25/program, you can't afford to do it yourself!

30 DAY MONEY-BACK GUARANTEE: If these programs don't make your computer easier to use, return the package to us with your comments for a full refund.

NEVER COPY-PROTECTED: CompuMagic programs are never copy-protected, and our license allows you to use them on all computers you own for which they're suitable.

Also available: Osborne 1 & EXEC Special Versions with the legendary MANYKEY for only $65.

TO ORDER: Send Check or MO or call with your VISA/MC or COD order. No charge for UPS ground shipping. Add $2 for UPS COD; $5 for foreign shipping/handling. (MD res. 5% tax too, please)

**CompuMagic, Inc.**
P.O. Box 437
Severn, MD 21144
(301) 969-8068
Dear Sol:

Recently you published an announcement of the ZCPR3 Manual, by Richard Conn. I immediately bought it, and it contains a goldmine of information, but is no easier to understand than the first CP/M manuals. The first issues of Microsystem were a great help to many of us by making CP/M understandable. How about doing it again for the Z-system? The combination of Z-system with the HD64180 super-Z80 (I hear the 9MHz version is due this month) is an important revival for us simple-minded folk for whom the Berkeley Unix manuals are clear as a bell, but overkill. An important question is, will the Z-system continue to evolve, as Unix has?

Cal Herrmann
Richmond CA(a2)

We expect to shortly publish reviews of several HD64180 products and an article on constructing an S-100 card using the device. We hope to also publish a review of the new Z-System for the 64180. If anyone is using the Z-System and is interested in writing an article or two about it please contact us.

Dear Sol:

I would like to see the following subjects described in your magazine:

1. Networks for IBM PC computers. What are the different systems, their specs, pros and cons, manufacturers of cards and software, etc. Although networks are a major asset of micros, I have never seen any good article about them.

2. How to install drivers in the PC-DOS. A good example could be a driver allowing use of a standard printer (such as Epson) on a PC. This driver would have to translate the PC character set into the more common Epson character set. This is a major problem for international characters such as "é" which have values of 8Ah with the PC and 7Bh with the Epson.

3. More news about the industry.
   a) Has Morrow been acquired by Zenith? How are the sales of the Pivot going? What are George’s new projects?
   b) What is Viasyn? What happened to Bill Godbout?
   c) Steve Jobs is surely someone else to follow closely!
   d) What about the turnover of Atari, etc.

   There are many things going on and we would like to have your comments about them.

4. More descriptions about software in the public domain. Your magazine is the only source of info about these programs. It is a pleasure to read your magazine, and I wish you the best success with this venture.

Louis Lemperreur
Embourg, Belgium

Let me respond to your questions in the order in which you raised them.

1) Although we plan to do some articles on PC networks a review of the scope you are asking for is beyond our means. Such a review has appeared in PC magazine which I think was very well done. If you cannot obtain a copy of this review let me know and I will try and get a copy for you.

2) Bill Wong is currently writing a series of 3 articles on writing PC drivers. You will find the first part in this issue.

3) It would take an entire page to respond to these questions. Here is a terse response:

   a) Morrow has not been acquired by Zenith. Zenith is marketing a version of the Pivot which is currently still made by Morrow. There is no doubt the Pivot is probably the best buy in a true PC-compatible portable. Unfortunately the demand for portables and poor quality of the display has hampered the sales of the Pivot as well as all the other portables. Morrow no longer makes S-100 or Micro-Decision products. And, George's chief preoccupation today is getting the company to operate at a profit.

   b) Viasyn is the new name for CompuPro. I suspect Bill Godbout changed the company structure in anticipation of going public. But, that plan fell through when the S-100 and multi-user micro market went soft last year. Viasyn is continuing to make S-100 products and will release a new 80186-based slave card soon. They also expect to shortly release an ARC-NET PC interface card for users who want to use PC's with the CompuPro multi-user system.

   c) I do not think Steve Jobs is someone to follow closely!

   d) Atari, under Jack Tramiel, has turned around and I suspect is already profitable. Although the ST series of computers is not that popular in the U.S. it is selling very well in Europe. And Atari is continuing to make updated versions of the 800 and 600 machines which continue to sell in respectable numbers.

   4) There is no doubt that MISJ is the leading magazine for information on PC, CP/M and Unix public domain software. However, keep in mind that there is also a large amount of public domain software available for Apple, Macintosh, Commodore-64, Atari, etc. machines which we do not cover and for which there are several good publications.

To MISJ:

I applaud your discussion of generic MS-DOS implementations. What would be extremely useful would be a list of software, from the shelf, which is MSDOS-generic and not specific to the IBM-PC. Generic items include, for example: Wordstar, Spellbinder, Fancy Font, Revelation, dBaseII, Knowledgeman, Computer Innovations C, Williams C, Microsoft C, and Instant C from Rational. Not generic are dBase III, Wordstar 2000, William's C Debugger and nearly all copy-protected software.

Horst M. Kasper
Warren NJ

I can report that I have run dBase III, Wordstar 2000 and several copy-protected packages on our clone systems. These packages do require an MS-DOS system that is compatible with the IBM-PC's video, keyboard and disk system hardware. Thus, most of the MS-DOS systems currently on the market today will run the packages you list as "not generic."

Dear Sol:

Please sign me up for a subscription to Micro/Systems Journal. I am subscribing primarily because of Don Libes' column, The C Forum. His treatment of passing different sized multi-dimensional arrays to a C function was worth the price of a year's subscription - this important subject is not treated adequately in any of the 30 C textbooks I've examined.

My second and third reasons for subscribing are your News, Views, and Gossip column and The UNIX File. I have no interest whatsoever in CP/M and S-100 systems, so I only decided to subscribe after seeing your back issues in a computer store.

My primary interests are scientific computing, C, and scientific word processing, especially in the MS-DOS and UNIX/XENIX environments.

With best wishes,
Jeffrey M. Speiser
San Diego CA
THE CHALLENGER XT-186
SINGLE BOARD COMPUTER
FULLY IBM COMPATIBLE BUT FOUR TIMES FASTER

STANDARD FEATURES:
- Intel 80186 CPU, 8 MHz
- On-board 640K, parity checked RAM memory
- 8 slots for I/O Interface Board
- 4 channel 8237 DMA
- 8 channel 8259 Interrupt
- 3 channel 8253 Timer
- IBM PC-AT-like Bus with true 16 bit data path

OPTIONAL FEATURES:
- 10 MHz operation
- 8087 Numerical Processor Support
- New ROM BIOS

The Challenger XT-186 offers full IBM PC-XT compatibility. It supports industry standard operating systems: MS, DOS, PC-DOS, 1.0 through 3.1, UNIX and CP/M and runs all existing software with higher performance. The XT-186 motherboard can directly replace any existing PC or PC-XT motherboard, as it has the same physical dimensions and mounting holes. The Intel 80186 and 640K on-board 16 bit path RAM makes the XT-186 the fastest PC currently available.

MOTHER BOARD, 8MHz, 640K, RAM, 8 I/O slots
$795.00

The XT-186 ROM BIOS version 2.0 supports the IBM PC-AT combined Hard Disk/Floppy Controller on the Challenger XT-186 motherboard. With the new ROM BIOS installed the XT-186 can support two 1.2 MB floppy drives and two hard disk drives with the same fast access time of the IBM PC-AT. No other XT compatible system can offer either the speed or the disk storage (230 Mbytes maximum) capacity of the XT-186.

XT-186 ROM BIOS version 2.0 Upgrade Kit
$50.00

ADD-ON CARDS:

Color Graphic Board: RGB and composite. 320X200 Color/B&W, 640X200 B&W only, $120.00
light pen input.................................................................

Multifunction Card: Real Time Calendar Clock with Battery Backup, 2 RS-232 ports built-in, $120.00
1 parallel port.................................................................

Floppy Diskette Controller Card: Double-sided, double density, can support 4 floppy diskette drives $70.00
drives.................................................................

Monochrome Display Card: Supports 256 character codes on 4K ROM, 4K display buffer on static RAM with TTL monochrome video output $110.00

Monochrome Graphic/Printer Card: Two graphic pages with a resolution of 720X348, software supplied to allow the use of the basic graphic command, centronic parallel printer interface $140.00

Visa and Mastercard Accepted
Please Add $3.00 Shipping

HOLLISTON COMPUTER
P.O. Box 615, Chepachet, R.I. 02814
401-568-0522

IBM, PC, XT, AT, PC-DOS are trademarks of International Business Machines Corp. MS-DOS is a registered trademark of Microsoft Corp. CP/M is a registered trademark of Digital Research, Inc.
In the SIG/M Public Domain

by Stephen M. Leon

We recently received a letter from Digital Research! DRI is still alive . . . or are they? The letter said that since they would no longer be able to support their languages, would WE - SIG/M and the Amateur Computer Group of New Jersey - mind if they referred questions to us. A few phone calls brought the matter to a fever pitch as all of us grew indignant over this passing of the buck.

All of a sudden, the phone lines got busy again. Those who were irate only a few minutes before seemed to come to the realization, all at the same time, that it was not DRI who was passing the buck - it was DRI who was recognizing that for many years it has been the computer hobbyists and clubs who have provided software support. Without Rich Conn and his ZCPR series a good percentage of the people still using CP/M would be using other operating systems.

Have you ever tried to get help from DRI, or for that matter MICROSOFT, or almost any software company? With the vast majority of the software companies, it is usually easier to get information from the CIA, than to get a specific answer from them. You can’t blame them because providing this information costs money.

As an example, I have an Everex Graphics Edge color and mono board in my PC. None of the public domain screen blanking programs will work with it and one of the reasons I bought BORLAND’s Superkey was because it claimed to have a screen blanker. To make a long story short, the blanking part of the program did not work with my board and I called and wrote both BORLAND and Everex for help. Never got an answer! One day on Compuserve I noticed they had a BORLAND SIG, and I asked the same question, pointing out that I had not received an answer to my original request. This request even produced a note from Phillip Kahn that they would solve the problem - but of course they never did!

I mention BORLAND because they seem to be one of the better companies to deal with. Their prices are fair, their products great, and their service not at all bad. However, no commercial company can afford to hold hands with every user and still stay in business. User friendly has to be in the program and the documentation, not on the telephone.

I joined a computer club for the same reason most people do: to get the kind of help I needed to make best use of all the fancy equipment I had spent good money to buy. I found the club a place where I could get answers most of the time and guidance to find the answer the rest of the time. Some of the software companies have excellent technical support staffs, but more often than not the best answers come at the User Group meeting.

So, DRI - be assured that SIG/M will continue to provide support for your products. We only wish you would let us release, as part of our Public Domain library, Concurrent CP/M-86. You might suddenly discover that it not only runs well on the scads of S-100 machines that are still out there, but its distribution will generate new demand for your CP/M based software line. By coincidence, the volume that leads the list of new SIG/M releases this month is for DRI’s Concurrent CP/M. The Orlando Concurrent 286 MultiUser RCP/M system sent up a volume of Concurrent CP/M patches and utilities. This is the first software we have received from them, but from what we see, and from their area of specialization, they are worthy of keeping an eye on for those using Concurrent. The phone number for their bulletin board is (305)677-8086.

An old friend has returned on SIG/M Volume 248. Way back when no one ever heard of dBASE, SIG/M, thanks to Dan Dagan, put out Dan’s Information Management System (SIG/M Volume 61). People all over the world discovered that DIMS handled their data management problems more than adequately. Years later, it still is one of the most widely used volumes in the SIG/M library. Well, Dan has updated his program, but not by much since he started out with a really good program.

There seems to be an increased interest in modern and BBS software. We recently discussed SIG/M Volume 241 with the new XMODEM 1024 protocol and an updated version of MEX to support that protocol. On that same volume we released a Turbo Pascal BBS system. This month, we have another second generation Turbo Pascal BBS system as well as an update to the standard BBS system.

Volumes 249 and 250 contain the latest version of RBBS, still the favorite of the BBS systems. (Also included on Volume 250 is source code from some recent Micro/Systems Journal issues as well as a tutorial on Ward Christensen’s Master Disk Catalog System. Volume 251 contains another second generation Turbo Pascal BBS System. This one is called ROS and it warrants a close look if you are thinking of setting up a BBS system.

Since the stories first broke on the prosecution of Tom Tcimpidis for exercising what we consider to be his First Amendment rights, we have taken part in a number of forums on the rights of Bulletin Board operators. Responsible BBS operators are critical to the distribution of SIG/M software and to assisting the users. User groups meet once a month, but the BBS system is open 24 hours a day to find an expert to help with a problem. Any activity which threatens the BBS system is a threat to all of computing. We are pleased to see that, notwithstanding this grandstanding by irresponsible prosecutors, the number of BBS systems is again rising. Moreover, more authors are producing second and third generation BBS systems for public domain distribution. Unfortunately, when the Tcimpidis case first broke, in the ensuing panic many operators imposed restrictions which they believed were needed to be protected from liability. These restrictions are gradually disappearing as prosecutor after prosecutor discovers that the public expects them to put criminals in jail, not people who are providing a service to the community.

Speaking of BBS systems, SIG/M software is available on the two BBS systems operated by the Amateur Computer Group of New Jersey. One is at (201) 753-9758. The other is at (215) 399-1634. There are also BBS systems throughout the country which have SIG/M software available for downloading. Following is a partial list of such systems.

Steve Leon is the SIG/M Disk Editor. In other words, he is the person who assembles, compiles and edits all of the SIG/M public domain software disks. Thus, he speaks with the greatest authority as to what is going on in the SIG/M public domain software area.
California: (415) 383-0473
(916) 483-8718
(805) 682-7876
(805) 492-5472
(303) 465-1313
(404) 636-6130
(617) 646-3610
(718) 539-3338
(516) 561-6590
(216) 645-0827
(513) 256-7227
(918) 446-5219
Tennessee: (615) 528-5039
Texas: (713) 469-8893
Ohio: (216) 645-0827
(513) 256-7227
is available for $6.00. Many bulletin boards have the software for downloading and most new releases are available on the CP/M SIG on Compuserve.

**NEW SIG/M RELEASES**

Vol 247 Concurrent CP/M Patches & Utilities
released November 15, 1985
Concurrent CP/M Patches & Utilities
- CONSEQ .AQ6 MDOS virtual console
- DM-102 .COM Disk Utility on CP/M or CP/M6
- EXAMPLES.LBR CC/M examples
- FREEY .LBR Reassign Compro key
- GREEF .LBR GC/M6 pattern matcher
- MCDS .AQ4 MDOS equates
- NTREE .LBR Display CC/M or DOS dir
- PASS .AQ6 Password utility
- ROUTINES.AQ6 CC/M subroutines
- SACH .LBR Measure MDOS idle time
- TCLCXX .AQ6 Time of day in large nos
- USF.MON .LBR Power supply monitor
- WEEK .LBR Intercept escape sequences

Vol 248 Dan's Information Management System
released November 15, 1985
- DIMS1.1R MBASIC data management
- DIMS13.1R system (Updates SIG/M 61)
- DIMS29.1R Remote Bulletin Board System
(Volume 1 of 2)
- RBBS38A.AQC RBBS ready to run file
- RBBS38A.WO Documentation
- INSTA38.COM Installation program
- INSTA38.MP Help file used by INSTA38
- UTIL38.COM Utility program
- EXIT38.COM Ask for Comments on Exit
- BEL .COM Peaseo BPE to call EXIT
- RBBS.COM Psuedo RBSS to call real RBSS
- STARTUP.COM Program start-up in BPE
- BULG .COM Psuedo program maker
- BULG1 .LBR RBBS38A Support Text files
- HELP .LBR HELP
- INFO .LBR INFO
- MESSBBS .LBR MESSBBS
- NEWCOM .LBR NEWCOM
- NSNS .LBR NSNS
- SGPMENU .LBR SGPMENU
- TWT .LBR TWT
- READ .ME2 Additional information

Volume 249 Remote Bulletin Board System
(Volume 2 of 2)
released November 15, 1985
- RBBS38A.AQC Source file with comments
- RBBS38A.WO 'No comments' source file
- INSTA38.COM Installation program
- INSTA38.MP Help file used by INSTA38
- UTIL38.COM Utility program
- EXIT38.COM Ask for Comments on Exit
- BEL .COM Psuedo BPE to call EXIT
- RBBS.COM Psuedo RBSS to call real RBSS
- STARTUP.COM Program start-up in BPE
- BULG .COM Psuedo program maker
- BULG1 .LBR RBBS38A Support Text files
- HELP .LBR HELP
- INFO .LBR INFO
- MESSBBS.LBR MESSBBS
- NEWCOM .LBR NEWCOM
- NSNS .LBR NSNS
- SGPMENU .LBR SGPMENU
- TWT .LBR TWT
- READ .ME2 Additional information

Vol 250 RBSS (Vol 2 of 2)
Micro/Systems Journal Programs
released November 15, 1985
- RBBS38A.AQC Source file with comments
- RBBS38A.WO 'No comments' source file
- INSTA38.COM Installation program
- INSTA38.MP Help file used by INSTA38
- UTIL38.COM Utility program
- EXIT38.COM Ask for Comments on Exit
- BEL .COM Psuedo BPE to call EXIT
- RBBS.COM Psuedo RBSS to call real RBSS
- STARTUP.COM Program start-up in BPE
- BULG .COM Psuedo program maker
- BULG1 .LBR RBBS38A Support Text files
- HELP .LBR HELP
- INFO .LBR INFO
- MESSBBS.LBR MESSBBS
- NEWCOM .LBR NEWCOM
- NSNS .LBR NSNS
- SGPMENU .LBR SGPMENU
- TWT .LBR TWT
- READ .ME2 Additional information

Vol 251 ROS Turbo Pascal BBS System
released November 15, 1985
- ROS33.LBR Turbo Pascal BBS System
- ROSMAC.LBR Turbo Pascal BBS System

Micro/Systems Journal March/April 1986
Public domain and user support software is readily available from many bulletin board systems and downloading programs from them has evolved into an art form. Many of us take for granted the understanding of the various file naming conventions. I often receive queries from new users why program files with a .CQM suffix will not execute. It occurred to me that it would be worthwhile to review some of the file naming conventions. There are probably more new users than there are veteran owners of S-100 systems.

In the early days of personal computing, files were transferred over modem from one location to another with simple XModem communication programs. To reduce the time it took to transfer a file via long distance lines, the concept of squeezing and unsqueezing files came into being. SQueezed files are normally denoted by a .QS in the filename suffix. If a filename had no suffix, then .QQQ would be appended to the filename. UnSQueezed, of course, reversed the process. The actual amount of space storage saved is dependent on the characteristic of the data in terms of frequency of use of characters. The greater the variance, the greater the opportunity to compress the file. An even distribution of frequency of characters will not result in great savings.

Often a program is really a set of files (typically the executable and documentation files). Thus, when downloading, we find it speeds things up if all related files are consolidated into a library file. The LU and LAR utility programs were created to put file into and get files from a LIBrary file. The LIBrary file may contain squeezed files to reduce file size. Library files are denoted by .LBR in the filename suffix. To make the operation even more efficient, many bulletin board users would squeeze the .LBR file into .LQR. Note that the "Q" remains consistent with the concepts of a squeezed down file. LAR will also similarly extract individual component files for normal use.

Early this year, a new file library utility, called ARC was developed by System Enhancement Associates to handle the transmission of files more efficiently. ARC automatically squeezes component files added to the library file. An ARC processed file will have an .ARC suffix. ARC will automatically sort the file components in the newly created library file. In addition to this, selected file components may be extracted for execution, or for display. The following is an example of functions that are available.

Usage:

    ARC [archive] <archive>

    {filename} ...  

Where:

    a  = add files to archive
    m  = move files to archive
    d  = delete files from archive
    e  = extract files from archive
    r  = run files from archive
    p  = copy files from archive to stdout
    l  = list files in archive
    v  = verbose listing of files in archive
    t  = test archive integrity
    c  = convert entry to new packing method
    b  = retain backup copy of archive
    w  = suppress warning messages
    s  = suppress notes and comments

To place some fairly large application programs into the distribution channels, some of the large size programs were, of necessity, SQueezed, or LIBraried, or ARCed. Hopefully, the variations in filename conventions would only encourage new users to make greater use of public bulletin board systems for download of software.

MORE PUBLIC DOMAIN FAVORITES

To follow-up a previous column, here are more of my favorite public domain utility programs. I find it interesting that IBM defaults to a white text on black background screen when using the color graphics adapter. You would expect color, but this is not the case. If you enter BASICA into your color screen with a color graphics adapter, you will see black text on a white background. To change the default screen attributes, you must invoke a utility called KOLOR which can be invoked in the AU-TOEXEC.BAT file that will set the border, background, and foreground to the colors you prefer. I personally find white on blue more relaxing to the eyes. Each one of us have our own preferences.

Some of us who are, perhaps, perfectionists would like to have the date and time stamp on related files to be identical. You will find this on IBM's PC-DOS distribution diskette. FDATE will allow the user to modify the date and time stamped on each file. Unfortunately it does not have wildcard options. Perhaps someone else would be enterprising enough to add the options for wildcard and modifying the date and time stamp on subdirectories.

Oldtimer who have been using SD or SISR on their CP/M systems, will find similar versions available for PC-DOS. They range from a simple listing of filenames with associated sizes to versions that include date and time stamp with subdirectory information. Unfortunately, the user will have to determine what the differences are between one or the other. One of the things I note about utility programs in the PC world is the similarity and duplication of program names. Many of the good ideas from CP/M usage has been carried over into the PC-DOS environment. As previously noted the Library Update -LU function has been carried over and then improved. The defacto standardization of the IBM hardware environment enables many programmers to take advantage of color graphics. In the CP/M world, many utilities were kept in text form. CP/M programs were written to be hardware independent for transportability. In the IBM environment, programs are highly hardware dependent. How will these programs work on an IBM clone? The great majority of them will work without difficulty. The only positive assurance is to test these programs. Afterall, the price is right even if acquisition of these programs were with long distance access of bulletin board systems.

Editor's Note: Hank Kee is the librarian for the PC/Blue public domain software library. He is the person who collects, assembles, and checks all the software issued by PC/Blue and then compiles and edits them into the released volumes.
NEW PC/BLUE RELEASES

VOLUME 175
QModem - version 1.12
modem communications program
author-John Friel III, Forbin Project
QSYM - version 1.11
virtual memory for Symphony 1.1
using up to 464k on fixed disk
author-SYSCOMP
PROINDEX - version 1.2
indexing system for text files
author-Gary Elfring

VOLUME 174
VOWME 175
QModem - version 1.12
modem communications program
author-John Friel III, Forbin Project
TRYVMSYM - version 1.1
virtual memory for S~phon¥ 1.1
USlng up to 4mb on flXed dlSk
author-SYSCOMP

VOLUME 170
ESIE -version 1.1
(E}xpert (S}ystem (I}nference (E}ngine
author-Lightwave Consultants
CRCBTCOL - eRe version 6.5/CReB ver 1.2
creates PC/Blue table of contents
includes checksum program update
author-Howard Vigorita
HALLEY'S -Halley's comet finder
author-Phil Baughn adapted from Roger

VOLUME 173
ChiWriter - version 1.30 multifont
scientific notation word processor
author-Horstmann Software Design
Bradford -version 1.20
multifont print support
author-Aaron Contorer

VOLUME 172
FASTFMÌ' -fast formatting program
author-cNA HelpWare
GRASE II screen generator
author-Jeff Newbro
Kraft Paint -painting with a joystick
authors-Bill Aching Jr/Dave Nielsen

VOLUME 169
LEARN version 0.6
creates computer assisted instruction (CAI) courses
author-Percy Keeley
The MAILMAN version 2.0
mail list management
author-Philip R. Burns

VOLUME 168
PHASE version 1.02
database management system
author-4B Associates
PC-Recipe
kitchen management tool
author-KC Square
SL -dBASE SideLine version Al.O
flowcharts dBASE III command files
author-Wynn B. Rust

VOLUME 167
PC-Write version 2.55
author-Don Wallace, Quicksoft

VOLUME 166
Program For Simple Algebra - PFSA
author-Don Stevens

VOLUME 165
Deduct-A-Matic
automatically tracks PC usage
author-Eddie Phillippe

VOLUME 164
PRESENT version 5.1
a slide presentation system
author-Alexis Pertuz

VOLUME 163
gENERATE version 1.0
dBASE III screen and code generator
author-Don Pettig Associates

VOLUME 162
OmniEdit
author-Quaid Software Ltd
DOS Assistant version 2.0
author-John Hensley
LetterFall-typing instructor
author-Frank Harris

VOLUME 161
FANSIT-CONSOLE version 1.11.113
fast TNSI X1.64 console driver for IBM
author-Hersey Micro Consulting, Inc.

ADD THE PICDISC TO YOUR PORTABLE AND GET
desk top performance

SOFTWARE FEATURES:
• Filer - A menu driven LOAD/STORE program for
  transferring individual files (or total memory) to disc.
• CP/M 2.2" operating system, provides access to all
  popular CP/M based software (including dBASEII", 
  SuperCalc", and T/Maker")
• Modem - Public domain communications package
  (both terminal and disk file transfer modes)
• Utilities - DISKCOPY, COPY, FORMAT, and CP/M.
Complete Disk Drive System - Only $599

SAVE ON POWERFUL INTEGRATED SOFTWARE -
$200 when purchased with PICDISC:
T/Maker - includes:
• Word Processing
• Spelling Checker with a 50,000 word Dictionary
• Relational Database Manager

HARDWARE FEATURES:
• Lightweight (4.5 lb.) battery powered 3.5 inch micro-
  floppy system. Attaches/detaches easily.
• 360K bytes/diskette (same as on the IBM PC). 348K
  per file, due to CP/M.
• Approximately 20 hours on a single battery charge
  assuming normal disk access.
• 32K bytes additional RAM in the PICDISC -
  converting your portable to a 64K byte CP/M 2.2
  micro-computer.
• Includes all cables, mounting hardware and battery
  charger.

Call Us About Our Free Software Offers
For Literature/Catalog or to order,
Call or write: PERSONAL INTEGRATED COMPUTERS (PIC)
Toll Free 1-800-421-6300
18013 SkyPark Circle, Ste. D., Irvine, CA 92714 (714) 261-0503

CP/M, dBASE II, SuperCalc, & T/Maker are trademarks of Digital Research, Ashton-Tate, Sorcim, & T/Maker respectively.

Micro/Systems Journal March/April 1986
getopt - A Subroutine For Parsing Command-Line Arguments

getopt is available directly from AT&T via their Toolchest system [1]. It is also available via Usenet or Arpanet by copying the file -ftp/pub/mod.std.unix.v3 on sally.UTEXAS.EDU. I have seen numerous versions of getopt, although this one is based on the version given out at the 1985 UNIFORUM conference in Dallas. I have made minor modifications to it, including adding some comments. However, it still conforms to the AT&T standard. Oddly, the page describing getopt in the System V Release 2 manual is licensed, so I will simply describe in my own words how to use it.

getopt is very simple to use and will make your programs simpler to use; the interfaces simpler to write. Further, it is an example of a well-written program that is portable among any C compiler that uses these arge/argv conventions.

Each time getopt is called, it returns the next argument from the command-line. Additionally, it sets a number of external variables (such as the argument value). If you need to reference these, be sure to include extern declarations for them.

g getopt takes three arguments. The first two are the same argc and argv arguments in main. The third argument is a string containing the characters that are used as argument flags. A character followed immediately by a colon indicates that the flag takes a value. (Hence, "-i:" cannot be used as a flag character.) For example,

```c
getopt(argc,argv,"i:n:ab")
```

indicates that the program takes flag arguments of i, n, a and b and that the i and n flags will have values immediately after them. Flags are restricted to one character.

For example,

```c
program -i 12 -n hello -a
```

would be validly parsed by the above getopt call. If 12 is the argument to the i flag. "hello" is the argument to the n flag. a has no argument. b is not used in this call. Flags need not have any space separating them, as long as the first character of the token is a hyphen. For example, we could rewrite the above call as,

```c
program -ai 12 -n hello
```

There have been several efforts to clean up the user interface. Some of them are quite innovative (and would break existing programs). For example, one suggestion has been to use + as well as - as a flag introducer. For example, to compile with optimization, you might then say "cc +opt" and to compile with no optimization, "cc -opt".

Others are not as earth-shattering but useful nonetheless. Included in this month's column is a the source code to getopt, an argument parser. This code was first introduced in UNIX III and later put in the public-domain by AT&T to encourage uniformity and consistency in the way arguments are formed from one UNIX command to another.

C PUBLIC DOMAIN SOFTWARE

The C User Group, Box 97, McPherson KS 67460; (316)241-1065 has released several new volumes of public domain C software. Disks are $8 each (add 30% for overseas) and are available in PC/MS-DOS, 8" SSDD, Osborne SSDD, Heath and North Star Formats. They are listed below:

<table>
<thead>
<tr>
<th>Vol.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>160</td>
<td>Programs from &quot;Learning To Program in C&quot; (Plum Hall)</td>
</tr>
<tr>
<td>161</td>
<td>Programs from &quot;Efficient C&quot; (Plum Hall)</td>
</tr>
<tr>
<td>162</td>
<td>McPhip 80</td>
</tr>
<tr>
<td>163</td>
<td>Small C for MS-DOS (PCC)</td>
</tr>
<tr>
<td>164</td>
<td>Windows</td>
</tr>
<tr>
<td>165</td>
<td>Programs from &quot;Reliable Data Structures in C&quot; (Plum Hall)</td>
</tr>
<tr>
<td>166</td>
<td>CUG Directory (#101 - #155)</td>
</tr>
<tr>
<td>167</td>
<td>Windows, Unix-like utility</td>
</tr>
<tr>
<td>168</td>
<td>Simple Database (PC-SIG 147)</td>
</tr>
<tr>
<td>169</td>
<td>Miscellany IV (PC-SIG 314)</td>
</tr>
<tr>
<td>170</td>
<td>Miscellany V (PC-SIG 315)</td>
</tr>
<tr>
<td>171</td>
<td>Miscellany VI (PC-SIG 341)</td>
</tr>
<tr>
<td>172</td>
<td>LEX Part 1</td>
</tr>
<tr>
<td>173</td>
<td>LEX Part 2</td>
</tr>
<tr>
<td>174</td>
<td>YACC Part 1</td>
</tr>
<tr>
<td>175</td>
<td>YACC Part 2</td>
</tr>
<tr>
<td>176</td>
<td>XLISP Ver. 1.5</td>
</tr>
</tbody>
</table>

Micro/Systems Journal March/April 1986
An excerpt of the getopt calling code is as follows:

```c
int getopt();
extern char *optarg; /* current argv string */
extern int optind; /* current argv index */
extern char optchar; /* option character */

while (EOF != (optchar = getopt(argc, argv, "i:n:ab"))) {
    switch (optchar) {
        case 'i':
            optarg = &argv[optind][1];
            break;
        case 'n':
            optarg = &argv[optind][1];
            break;
        case 'a':
            optarg = &argv[optind][1];
            optarg = optarg + 1;
            optarg = optarg + 1;
        case 'b':
            optarg = &argv[optind][1];
            optarg = optarg + 1;
    }
}
```

Notice that the flags that have values pick up their string values in "optarg". For the i flag to convert it to an integer, all this requires is the call atoi(optarg), to convert the string to an integer.

To complete the documentation of getopt, here are some other things you should know about it.

When all the flags have been scanned, getopt returns EOF. The token "--" may also be used to terminate getopt processing. It is not necessary to supply this as a flag, although it could be useful when you want to specify a file named, say, "-i". (It is not a very smart idea to have file names look like flags.) When "--" is scanned, getopt returns EOF. (For this reason, it is impossible to have a hyphen by itself as an argument.)

After EOF is returned there may be more data on the command line (such as files). optind is the index of the next argv string after the last token successfully read by getopt. "--" is returned when an unknown flag is encountered, or a flag that requires a value does not have one. Thus, you should include a case for "--" (or "default:" will do) that prints out the standard calling sequence to indicate that the user has called your program incorrectly. It is possible to get the actual incorrect flag the user specified by examining the character variable optopt.

When "--" is returned, getopt will print error messages about unexpected arguments or missing argument values if the value of "optopt" is 1. If it is 0, no messages will be printed.

This code assumes the use of strchr. Some systems call this index. If you don't have either, you can easily write it yourself. strchr (or index) takes arguments of a string and a character, in that order. It returns a pointer to the first occurrence of the character in the string. If the character does not appear in the string, NULL is returned.

References:

Don Libes is a computer scientist working in the Washington DC area. He works on artificial intelligence in robot control systems. He is also the son of innie and sol Libes.
CP/M, MS-DOS EPROM PROGRAMMING SYSTEM

- SOFTWARE AVAILABLE FOR CP/M-80, CP/M-86 AND MS-DOS SYSTEMS
- STAND ALONE BOARD - ELECTRONIC SWITCHING OF EPROM TYPES
- USB 24 VOLT XMR FOR POWER - ALL SUPPLIES/TIMING ON BOARD
- NO PERSONALITY MODULES TO BUY - LARGE COMPREHENSIVE MANUAL

PARALLEL PRINTER INTERFACE
- CONNECTS TO ANY PARALLEL PRINTER INTERFACE - USES 8 OUTPUT
  DATA BITS AND ONE INPUT DATA BUSY LINE. BUSY LINE IS A
  HIGH SPEED SERIAL INPUT. FULL EPROM READING AND PROGRAMMING
  UNIT MAY ALSO BE CONNECTED TO ONE 8 BIT INPUT/OUTPUT PORT.

** CONTROL PROGRAM COMMANDS **
- PROGRAM EPROM(S) FROM DISK - SAVE EPROM(S) TO DISK
- READ DISK FILE INTO RAM - PROGRAM EPROM(S) FROM RAM
- READ EPROM(S) INTO RAM - PROGRAM EPROM WITH RAM
- VERIFY EPROM IS ERASED - COPY EPROM
- DISPLAY/EDIT (MONITOR MODE WITH 11 SUB COMMANDS
  FILL-DUMP-XFER-EXAMINE-MODIFY-BIAS-PROGRAM-VERIFY, ETC.)

ASSEMBLED & TESTED UNIT WITH COMPLETE
DOCUMENTATION AND SOFTWARE ON DISKETTE
$199

PARTS KIT WITH SOFTWARE AND DOC. $75
SOFTWARE ON 8 & 5 1/4 DISK FOR IBM, OSBORNE, KAYPRO & OTHER FRNS

SOP'T'WAR & DOC - $69

TO ORDER SEND CHECK, MONEY OR ORDER WRITE OR CALL
ANDRATECH
P.O. BOX 222
MILFORD, OHIO 45150
(513) 762-7218

CALL OR WRITE FOR MORE INFORMATION — ADD $4.00 FOR SHIPPING
OHIO RES. ADD 5.5% TAX — VISA/MC ACCEPTED — $100.00 PER COD

RP/M2™ creates
CP/M©2.2 compatible
IBM PC

1. Remove the 8088
2. Install the NEC µPD70108
3. Boot PC RP/M2

The NEC µPD70108 CPU chip is a fast 8088 that also executes 8080 machine code. PC RP/M2 is an operating system. Either standalone or with MSDOS present, PC RP/M2 provides the solid base of a genuine operating system reliably distinct from the facade created by an MSDOS interface. All 2.2 features are supported, plus file date and time stamping, fast virtual disk, I/O byte redirection, terminal cursor positioning, color console display. PCPIP accesses MSDOS files; MODEMPC transfers files via serial port; SETDISK redefines a drive to any of over 60 formats, allowing PC RP/M2 to directly process your existing CP/M files in their native form. System disk with manual and NEC µPD70108 (V20) $129. Shipping $5 ($10 non-US)

RP/M2™ creates
CP/M©2.2 compatible
IBM PC

1. Remove the 8088
2. Install the NEC µPD70108
3. Boot PC RP/M2

The NEC µPD70108 CPU chip is a fast 8088 that also executes 8080 machine code. PC RP/M2 is an operating system. Either standalone or with MSDOS present, PC RP/M2 provides the solid base of a genuine operating system reliably distinct from the facade created by an MSDOS interface. All 2.2 features are supported, plus file date and time stamping, fast virtual disk, I/O byte redirection, terminal cursor positioning, color console display. PCPIP accesses MSDOS files; MODEMPC transfers files via serial port; SETDISK redefines a drive to any of over 60 formats, allowing PC RP/M2 to directly process your existing CP/M files in their native form. System disk with manual and NEC µPD70108 (V20) $129. Shipping $5 ($10 non-US)

MicroMethods, Inc.
118 SW First St. - Box G
Warrington, OR 97146
(503)861-1765
The Intelligent Disassembler

MASTER*KEY

is an intelligent MS-DOS Disassembler. It instantly and automatically produces easily readable self-documented assembly language segmented source files that can be edited and re-assembled from any executable file (COM or EXE). You may immediately scan the listing online if desired.

MASTER*KEY includes a Pretty-printed Source Code Formatter and Cross-Reference Generator. The Formatter produces a fully-documented assembly language source listing identifying all branch addresses, ROM/BIOS and DOS Functions and Interrupts. It serves as an object code optimizer by helping to identify stack areas, temporary storage, ASCII strings, and unnecessary code. The Cross-Reference identifies the number and location of all branch addresses, labels, symbols, functions, and interrupts.

Minimum System Requirements:
256K 8088/8086/80186/80286 PC (close to IBM compatibility)
MS-DOS 2.0, 2.1, 3.0, or 3.1
One 360K DDS/DD Floppy Drive (IBM PC Format)

714-596-0070
(MasterCard and VISA accepted)
or mail check to:
Sharpe Systems Corporation • 2320 E Street, La Verne, CA 91750

Not copy protected

$49.95
Plus $2.50 shipping/handling (CO orders add $3.50)
CA_Res._add 8% Sales Tax
Announcing a New Product...  
OPEN SPOOL PRINTER RIBBON  
THAT RE-INKS ITSELF  
FOR USERS OF  
Okidata and Other  
Open Spool Printers  
Including Teletype  
MONEY BACK GUARANTEE

OUR SELF-INKING DEVICE WILL LAST 15 TIMES  
THE RIBBON YOU ARE NOW USING.  
• 15 TIMES LESS RIBBON CHANGES  
• NO MORE MESSY HANDS

CONTROLLED PRINTOUT DEVICES, INC.  
P.O. BOX 869, BALDWIN ROAD  
ARDEN, NC 28704  
(704) 684-9044 • TELEX: (FILMON-AREN) 577454

CONTACT US BY MAIL, PHONE OR TELEX AND WE WILL FORWARD YOU A BROCHURE

S-100 EPROM PROGRAMMER  
EPROM - 32

• Field-proven board meets IEEE-696 standard.  
• Programs 1K through 32K (byte) EPROMs.  
• Textool zero-insertion-force programming socket.  
• EPROM is programmed through 1/0 ports and can be verified through 1/0 ports or located in memory space for verification.  
• Programming voltage generated on-board.  
• Personality Modules adapt board to EPROMs:  
   PM-1—2508, 2758  
   PM-2—2532  
• Feature-packed CP/M-compatible control software includes fast programming algorithm.  
• One year warranty.  
$269.95*  
(A & T)

MicroDynamics Corporation  
P.O. Box 17577 • Memphis, TN 38177  
(901) 755-0619

* Price includes EPROM-32, documentation and two Personality Modules(specific). Additional Modules—$17.95, Control software on 8" SSD diskettes—$29.95, UPS ground—$2.00, UPS air—$4.90, COD—$2.00, foreign add $15.00. VISA & MASTERCARD welcome.  

M68000 SINGLE BOARD COMPUTER

On board 6-10 MHz CPU, 20K RAM, 32K EPROM, two RS-232, 16-bit port, 5-counter/timers expandable via Memory/FDC Board.  
M68K CPU (bare board) ................................................. $ 89.95
M68K CPU A&T (6MHz) ................................................ $495.00
MD512K Memory/FDC (bare board) ................................. $ 89.95
MD512K Memory/FDC (128K) ....................................... $495.00
FDC/Hard Disk interface option .................................... $150.00
M68KE Enclosure w/power supply .................................... $249.00
M68K Monitor EPROM’s ................................................ $ 95.00
M68K Macro Assembler ................................................ $195.00
CP/M 68K OS w/“C” compiler ....................................... $395.00

EMS Educational Microcomputer Systems  
P.O. Box 16115 • Irvine, CA 92713  
(714) 854-8545

FORTRAN GRAPHICS

MicroGlyph/SciPlot™ graphics library provides FORTRAN routines for scientific and engineering applications.  
• Presentation quality high resolution graphics with 240 by 216 dots/inch.  
• Software generated text fonts, data centered symbols, uniform or proportional spacing, string plotting with rotation and size scaling capability, 14 sets.  
• Linear or Log scaled axes.  
• Vector graphics, point to point plotting with user selectable origin and data scaling.  
• Multiple plot frame processing.

SYSTEM REQUIREMENTS:  
IBM PC/XT/AT 256k RAM, DOS 2.0, MS FORTRAN-77  
V3.2 or IBM Professional FORTRAN, and graphics printer or color card.

Trademarks: IBM of IBM, MS of Microsoft.

TERMS: $59.95 plus $3.00 shipping.  
Mass. residents add 5% sales tax.

MicroGlyph Systems  
P.O. Box 1066 • East Arlington, MA 02174

MicroSystems Journal March/April 1986
THE PROGRAMMER'S SHOP
helps save time, money and cut frustrations. Compare, evaluate, and find products.

SERVICES
- Programmer's Referral List
- Dealer's Inquire
- Compare Products
- Help Find Publisher
- Rush Order
- Evaluation Literature FREE
- Over 700 products
- BULLETIN BOARD - 7PM to 7 AM 617-826-4086

SERVICES
- BULLETIN BOARD - 7PM to 7 AM 617-826-4086

BULLETIN BOARD

AL - Expert System Dev't

- ExpertEASE - Inductive. PCDOS Call
- EXSYS - All RAM, Probability. Why!
- Trees, Solid, files, popular PCDOS $35
- INSIGHT 1 - Probabilities, required
- thresholds, menus, fast PCDOS $95
- INSIGHT 2 - add, backward, forward, partitions, db2, lang. accessed. PCDOS $449
- Others: APES ($359), Advisor ($949),
- ES Construction ($100), ESP ($845),
- Expert Choice ($449), more.

AI - LISP

- GC LISP - "Common", rich.
- Interpreter - Interactive Tutorial 495 Call
- LARGE Model - 2 to 15 meg. 695-649
- Compiler and LM Interpreter 1190 105
- TLC LISP - "FRANZ LISP" - like, big
- others: APES ($359), Advisor ($949),
- Entry System for C - Bellesoft .
- XTC - multitasking PCDOS $119
- ARITY PROLOG - full, debug, ASM, C,
- large progs. MSDOS $249
- INSTANT C - Source debug, edit to
- Run-3 seconds MSDOS $399
- INTRODUCING C - Interactive C to
- learn fast, tutorial PCDOS $119
- RUN/C - improved MSDOS $109

Editors for Programming

- BRIEF Programmer's Editor - undo,
- windows, reconfigure PCDOS Call
- C Screen with source 80/86 $75
- EMACS by UniPress - powerfull,
- multfile, windows, DOS, MLISP,
- programming. Source: $949 $299
- Entry System for C - Bellesoft PCDOS $325
- FirstTime by Spruce - improve
- productivity. Syntax directed for Turbo
- (869), Pascal ($229), or C ($239)
- PMATE - power, multitask 80/86 $159
- VEDIT - well liked PCDOS $119
- XTC - multitasking PCDOS $95

Feature

- Paragon PASCAL - for performance:
- extensions like "packages"; "Iterators";
- memory models, 64 bit, 8087; strings.
- space vs. speed optimization options.

Contact

TELEPHONE NUMBERS

- 800-421-8006
- 800-421-8007 or 617-826-7531

SOFTWARE DEVELOPMENT

- FirsTime by Spruce - Improve
- productivity. Syntax directed for Turbo
- (869), Pascal ($229), or C ($239)
- RUN/C - improved MSDOS $109

Ask about Atari ST, Amiga

Note: All prices subject to change without notice.
Mention this ad. Some prices are specials.

Low Cost Languages

- C language - Interpreters
- C-terp by Gimpel - full K, & R., OBJ
- and ASM, large progs. MSDOS $249
- INSTANT C - Source debug, edit to
- Run-3 seconds MSDOS $399
- INTRODUCING C - Interactive C to
- learn fast, tutorial PCDOS $119
- RUN/C - improved MSDOS $109

C Libraries - General

- Blaise C Tools 1 ($109), C Tools 2 $89
- C Food by Lattice - ask for source $119
- C by Lattice - ask for source $125
- C Utilities by Essential - 300+ $149
- Greenleaf Functions - portable & ASM $149
- Polytron - for Lattice, ASM source $99
- Software Horizons - Pack 1 $129

C Libraries - Applications

- COMMUNICATIONS: Asynch Mgr $175
- Greenleaf - full, respected $149
- Software Horizons - Pack 3 $139
- FILEs: Browse - multi-language $199
- C Index by Trio - full B + Tree,
- vary length field, multi compiler
- /File is object only $89
- /Ptr is partial source $179
- C Tree by Faircom - source, port. $349
- dbISAM by Lattice for db2 or 3 $219
- dbVISTA - full indexing, plus optional
- record types, pointers, Network.
- Object only - MS C, LAT, C86 $179
- Source - Single user $459
- Source - Multisuer $929

C Libraries - Interpreters

- TURBO PASCAL and SUPPORT

- Borland: Turbo 3.0 $49
- 3.0 with 8087 or BCD $79
- 3.0 with 8087 and BCD $85
- Turbo Graphix - graphs, windows $39
- Turbo Toolbox or Editor $55
- Turbo Tutor $29
- TURBO - Asynch by Blaise, full $89
- MetaWindow by Metagraphics $49
- Power Tools by Blaise - library $89
- Power Utilities - profiler, pp $89
- Professional - interrupts, macros, $50
- OTHERS: FirstTime ($69), Screen
- Sculptor ($99), Pascal Pac ($100),
- Tidy ($45), Multi Halo ($95).

Cost Support - Systems

- C Debug - Source debuggers -
- by Complete Soft ($269), MSD ($149).
- C Sharp - well supported, Source,
- realtime, tasks MSDOS $600
- C Sprite Debugger by Lattice $149
- C ToolSet - Diff, xref, source $135
- PC Lint - full C program checking
- and big, small model. All C's $119

Call for a catalog, literature, and solid value

SUPPORT

- TurboEdit - powerful, multitask
- TurboGraphix - graphs, windows
- Turbo Tutor $29

Call for a catalog, literature, and solid value

800-421-8006
THE PROGRAMMER'S SHOP TM
128-31 Rockland Street, Hanover, MA 02339
Muns: 800-421-8070 or 617-826-7531
C Interpreters

by Don Libes & Graham Morris

This is a review of three C language interpreters. For an overview of what interpreters are and how they differ from compilers, read the C Forum column in the last issue of M/SJ.

Instant-C

Instant-C (which we will refer to as IC from now on) by Rational Systems is a C programmer's dream. You can type expressions and they are evaluated immediately. The expressions can be any valid C statement as well as preprocessor directives.

The system prompts with a #. So in the example below, we typed the number 17 and hit return. Then we made a declaration and typed in a for loop. Let's see what happened.

```
# 17
17
# int i;
# for (i=0;i<10;i++) printf("%d",i);
1 2 3 4 5 6 7 8 9 10
```

Wow! Is this great stuff?! You don't have to compile, link or load. It's totally interactive! It looks like a whole new way of programming.

Because of the # prompt, commands in IC look like preprocessor directives. This is very good for experienced C users who are used to saying things like "#include file" to load in source files. These commands have always been a means of not programming, but manipulating programs and in IC they are extended in a very consistent manner.

For example, to run a program just give the command #go. #trace will turn on tracing. #shell allows the user to execute DOS commands directly without leaving the IC environment.

#ed quickly starts up a generic screen editor. At first, we sighed in anticipation of having to learn yet another screen editor, but it was easy to learn and they allow customizing of functions by changing key associations. The best thing about it though is that it is fast to start up. This enhances the feeling of IC helping you in every way.

Surprisingly, it is not a syntax-directed editor (although it makes a small attempt at it, by putting up function templates when you create a new function). Instead, you can press a key (control-p) occasionally, and it will reformat your code appropriately while pseudo-compiling it. If an error is detected, a message is displayed and the cursor is left (usually) close to where the problem is. The editor forces your code to be correct before it will save it and this was a nuisance. For example, IC checks that the number of arguments in a function declaration match those in the actual call. When we changed them from inside the editor, it would complain about not having the correct number of arguments to a function and would not let us save the changes. Our only solution was to comment out the new code, make the changes in this fashion to all the functions, and then uncomment out the new code. And there were instances of not being able to ever figure out what IC was complaining about. Again we couldn't save the code without commenting it out, and we thought this whole concept needs rethinking.

The idea behind this is that IC wants you to think about your incorrect code when you write and are probably best able to fix it. The alternative is to wait until a number of things are to be compiled and linked, but then you may have forgotten about how you wrote this routine. Of course, it hardly matters since you can subvert it so easily.

One thing we know many people will be sensitive about is IC's reformatting of C programs. We have been the witness of endless debates on the display of C programs and IC takes a side in this that is not particularly standard. Unfortunately, there is no way to turn this off. Our opinion is that we like it, because if a gross mistake occurs like leaving out a brace, we see graphically how we have erred when the program is indented wildly differently than the way we wrote it.

The editor and interpreter are married together in IC. You can load multiple files into memory and move between them easily. Once they are loaded into memory, you can edit individual function or variable declarations in the buffers. Declarations typed directly to the interpreter are added to the end of your current buffer, so that it can be saved to a file.

We think it's a mistake not to be able to edit an entire file. It can be done by starting up the IC editor outside of the interpreter, so we don't understand why this restriction exists. We often want to look at a data structure as we are writing code for it. And we can't do that with IC. A more grievous problem is that we could not edit a function that had used a #define'd constant. The editor refused to recognize the macro.

Debugging is fun. Programs may be run under control of the interpreter. Programs can pass control to the interpreter by faulting or calling a breakpoint function explicitly. Because compiling is so fast, one can add sophisticated tests before breaking, such as:

```
/* breakpoint iff x is out of bounds */
if (x > x_bound) { };
```

Once you are at the interpreter command level, you can type arbitrary C expressions and statements that are evaluated in the context of the current function. This context may be changed to another function by the #local command. This is very powerful, because it gives you the power to move up and down the stack, resetting your context bindings. IC was the only interpreter reviewed that had this ability.

Note, that IC commands are not reserved words. You can use them as function or variable names but they over-ride the ability to use the corresponding IC command. So for example, it's probably not a good idea to have a variable name ed, since you won't be able to edit if you do!

Libraries: Math and stdio libraries are included. File routines support pathnames and devices and are extended to provide newline to crlf translation on request. Functions are supplied to interface with DOS. These include functions to generate interrupts, call DOS routines, read and write I/O ports, change segment registers and to peek and poke memory.

Manual: The manual is readable, but it assumes that you know C thoroughly. There are some examples to illustrate the style of IC, which seems appropriate. It could use some more examples, particularly for the commands that are unique to the IC environment.

Since the manual makes no pretense at teaching C, it will help to have a C language reference alongside it when you use IC.
**Limitations:** Our copy of IC did not have the ability to access compiled code, however a new version (that we were not able to review in time) is supposed to be able to link to compiled Lattice C. The ability to link with other compilers will be forthcoming, no doubt.

IC also seemed to have some problems with macros. The most annoying was that when we edited a function containing a macro, we could not save the function, because the editor didn’t know the macro. It handled it like an undeclared variable. IC also does not handle #undef, although it recognized it. Also, there is an odd restriction on #define which is that the strings to be substituted must be valid C expressions. Unfortunately, that means that you can’t say popular things like:

```
#define ( BEGIN
```

While we were able to define data structures larger than 64K, sizeof reported incorrect values for such data structures, leaving us wondering if there were more such problems with the large model.

Bit fields are not implemented, nor are the major V7 enhancements (structure copying by assignment or argument passing and enumeration types) although void is.

The last limitation we’re aware of is that initialized arrays must have the dimension specified, while multiple dimension arrays cannot be initialized at all.

IC will soon remove most of the restrictions noted here, as well as enhancing the check features, including array bounds and pointer checking in upcoming versions.

The version of IC reviewed was 1.40 (although they have released version 1.43). IC will run on the PC and most other computers that run MS-DOS or CP/M-86. A minimum of 320K of memory and 240K disk is required. IC can interpret programs up to 10000 lines with 640K of memory.

IC is marketed by Rational Systems. IC is not copy protected and sells for $495.

**Run/C**

Run/C (RC) takes a different approach to the user interface than IC. RC mimics the environment of BASIC. This is nice for people who have grown up with BASIC and are switching to C. They do not have to learn a new set of commands. All the typical BASIC commands such as LIST, RUN, NEW, AUTO and even TRON exist.

RC takes the approach that a substantial amount of program editing consists of either changing one line or making gross changes to a large section of code. They support this by providing a means to edit one line at a time, or alternatively, you can invoke a screen editor on a function or file. Thoughtfully, RC allows you to choose the screen editor by setting a variable in the DOS environment. We tried it with WordStar and it worked fine. But it became obvious that the best editor would be the one that could load and run the quickest. Loading WordStar off floppies, for example, while OK for a long editing session would not be appropriate for this repeated editor startup and exit. Ideally, your editor should be stored on a ramdisk.

Unlike IC, RC does not provide the ability to execute arbitrary expressions and statements. Program fragments must be placed in a main in order to be evaluated. This can be awkward, especially when you already have a main defined. It certainly seems artificial in this environment. It does not make for more flexibility. What we ended up doing was defining a main that simply made one function call and passed on the standard argv and argc to the function with no change. In this way, we could play around with different functions easily. But this does seem like a silly restriction for a development environment. (Lifeboat claims that a new version of RC is available now that does have the ability to execute an arbitrary expression directly, however we were not able to get a copy in time to review it.)

The single-line editor is certainly very quick. The commands are patterned after WordStar, so that it was pretty simple to pick up. But we did not like using it. For errors isolated to one-line, it worked, but a fair enough number of code problems extend over several lines, and the hassle of dealing with line numbers seemed to remind us of the days when we were all using Telent types and it really was time-consuming to print several lines at a time. Sorry, but we don’t care to see another line-number as long as we live.

Once you have entered your program, you can trace all statements or all variable references. This is a nice feature. You can also profile the code, which determines the number of times each line has been executed.

A weak point of the debugger is its idea of breakpoints. The only way to set a breakpoint is to press control-c followed by a return (although the manual says just a control-c will do it). What we ended up doing was defining our own breakpoint function which consisted of a prompt to press control-c and then calling getchar. We could then plan ahead where we wanted the program to stop, rather than just blindly pressing control-c when the time seemed about right (or more often, too late).

Once the program has halted, you can 1) continue, 2) dump all the non-struct variables or 3) exit. This seems exquisitely limited. You can’t see the stack (although you can tell what line you are on by the line number) and you can’t see the values of structures! This is less useful than a debugger. Yes, this is the way BASIC does things, but that’s only because there are no structures in BASIC, and the stack is not always reliable due to the GOTO statement. Gee, you might as well use BASIC, if you’re going to give up all the power of C like this. (Again, the new version of RC may overcome this limitation along with being able to modify variables by allowing execution of arbitrary expressions.)

**Libraries:** Math and stdio libraries are included. The math library senses and uses the 8087 if present. File routines support pathnames and devices and are extended to provide newline to crlf translation. Functions are supplied to interface with DOS. These include functions to generate interrupts, call DOS routines, read and write I/O ports, and to peek and poke memory.

**Manual:** At first, we were very non-plussed by the manual, the very first example we were supposed to type in was incorrect, and the thing looked like a dictionary with every command and function in one pile. However, we continued reading, and found that it was by far the better and most complete of the three interpreters, giving examples of every command and function in the interpreter. Why doesn’t everyone do this? Maybe RC guessed that we wouldn’t read the manual through cover-to-cover so they made it easier to use as a reference. There is no distinction between commands, subroutines or system calls. You just look up the word you are interested in and there is the information (complete with an example). Of course, it helps if you have some idea of what you are looking for. This worked well for us, but we are readily familiar with the C libraries (as well as BASIC commands). We’re not so sure less experienced C programmers would enjoy it.

Similarly, every error message is explained, as well as problem areas and unsupported features. In fact, they document their problems so well, it is possible that we got more of a negative impression of RC than any of the other interpreters simply because of that! Of course, even though RC is extensively documented, the manual makes no pretense at teaching C, so we recommend that you keep a C manual alongside the RC manual when you read it.

There is an on-line HELP command that points the way towards lists of functions and commands if you don’t have the manual by your side. HELP also includes several configuration parameters that can be changed such as stack space, etc. While we feel even more on-line help could be provided, RC is the only interpreter reviewed here that provided any interactive help at all.

Also included are the source code to the standard C library and the stdio and math libraries along with some other random examples. This allows you to trace down through areas you would normally not be able to, since these functions are interpreted also.

**Limitations:** As just mentioned, the entire source to the C libraries are available. This is a necessity since RC cannot link in compiled programs. They have been forced to supply you with sources! The drawback, of course, is that this will slow
down the interpreter. Lifeboat has pledged that a future release of RC will include the ability to link in compiled code.

The C preprocessor is very limited in RC. Only #defines and #includes are supported, and the #includes must use absolute file names. #defines behave as if they all precede the first function in a file. sizeof will only take arguments that are declared variables, not types.

There are also quite a few restrictions against declarations. Typedefs, externs, and registers are not implemented. Also, RC explicitly warns against declaration in blocks. It says that will be treated as if they are local to the function, not to the block. This certainly invalidated a lot of my code.

Multiline string literals are not supported. If you try to type a string that extends over a line, RC terminiates it for you. Isn’t that nice of it?

Lastly, pointers to functions are not available.

The version of RC reviewed was 1.3. RC will run on the PC and most other computers that run MS-DOS 2.0 (and up). A minimum of 256K of memory and 320K of disk is required. This does not include whatsoever space is needed to run your screen editor. Thus if your editor requires 128K, you will need at least 384K to have both programs be resident at the same time.

RC is marketed by Lifeboat Associates and was developed by Age of Reason Co. RC is not copy protected and sells for $150.

C-terp

C-terp (CT) is a C interpreter that provides yet another idea of what a user interface should look like. In style it is patterned after the (Pascal) p-system.

It is heavily screen oriented, with a screen for debugging, one for editing, and one for program output. There are multitudinous displays for things like selecting a command and displaying help menus, all very reminiscent of something like the P-system, although it is not as well refined as say, Lotus' Symphony.

CT is similar to IC in that files are loaded into memory and kept as buffers that can be played around with individually. Similarly, CT is integrated with a (reconfigurable) screen-oriented editor. However, this editor does not reformat your code or provide skeleton functions.

CT places the entire buffer in the screen editor. This seems much more natural to us than only editing one function at a time, as in IC. Once editing is done, a single keystroke can compile the program. The program is preprocessed and lexically scanned at this point, which happens very quickly. Parsing and other errors are handled at run-time (we figured this out, when CT informed us that a semi-colon was missing at run-time). If an error is detected, the user is left in the editor, with the cursor at the point of error (detection).

Besides compiling a program from the editor, other single keystrokes are available to simply run the preprocessing phase, or to compile and run the program immediately. Running the program causes CT to compile all the buffers that have been edited since they were last compiled. While it is typical to compile a buffer when you are finished editing, CT doesn’t insist that this be done.

The debugging phase in CT is quite distinct from the command or editing phase. Initially, this seemed somewhat artificial, but the implementation is done well. When the program is run under control of the debugger and a breakpoint is reached, the program source is displayed and the cursor is left at the code where it was executing. At this point, the user can display the stack or evaluate any expression. This is not quite as general as IC, since IC allows evaluation of arbitrary C statements also (such as control statements or declarations). The program can be single-stepped with very good control, going into or across function calls.

Besides single-stepping, the only way to set a breakpoint is to insert a function called breakpt. Since compilation is so fast, this is not a drawback, but an advantage since complex conditions can be used to trigger the breakpoint as discussed earlier.

If at any time during debugging, the program must be modified, one keystroke starts the editor, which is positioned at exactly the statement which was being executed. As mentioned earlier, two different screens (and modes) are used for this, but they are displayed very similarly and use many of the same commands, so that after awhile the user is not even conscious of exiting the debugger to enter the editor. Of course, when the editor is exited, the program must be restarted. The one drawback we noticed, is that upon exiting the debugger, the error message disappears with it. It would be nice if the error message could be displayed while the program is being edited.

Since CT is screen oriented, it handles output from the program by placing it on another screen. This screen and the normal debugger screen can be flipped back and forth, allowing them not to interfere with each other. Since the IC and RC user-interfaces are not screen-oriented, they do not have to deal with this problem.

Libraries: The standard C library and stdio libraries are included. File routines support pathnames and devices and are extended to provide newline to crf translation on request. Functions are supplied to interface with DOS. This include functions to generate software interrupts and to peek and poke memory.

CT also has the ability to use compiled or assembled functions produced by either Microsoft C or the Lattice C compiler. In both cases, functions can be linked in with the interpreter. To do this, a table of subroutines to be linked in is augmented with the subroutines of your choice and a new copy of CT is generated which is used from then on.

Not only does this provide great flexibility, but it allows proven code to be compiled after being tested. As each piece of code proves out that it is bug-free, it can be compiled, linked in and forgotten about. A side effect of this, is that you will be able to run much faster and develop larger programs using the interpreter.

Manual: The CT manual was the most of the batch, giving in-depth reasons and explanations as to why the CT is the way it is. C is discussed more deeply than in the other manuals, although CT, like the others, makes no attempt at teaching C and assumes that you are C knowledgeable.

The CT manual is much like an UNIX manual - concise and short. And without many examples. This is its worst drawback. In fact, it’s so short (100 pages) it doesn’t even bother with an index. It could use one, though.

The version of CT reviewed was 2.09 (although they have released 2.131). Different versions are necessary depending on which compiler you want to use (see Libraries above). CT will run on the PC and most other computers that run MS-DOS 2.0 and up. A minimum of 192K of memory is required.

CT is marketed by Gimpel Software. CT is not copy protected and sells for $300. A demonstration disk and manual is available for $45 (which can be applied towards the purchase of the interpreter).

Lint

We tested all the the interpreters for their ability to detect errors that compilers typically do not detect. It seems very appropriate to provide this capability in the interpreter, where you are developing code, but not in the compiler, where your code is assumed to be correct. Indeed, historically, C compilers have been notorious for ignoring all but the most flagrant errors. In the last 15 years though there has been much research on error-detection and how to continue compiling in the face of errors because compilers are costly (in time) to run. But if the interpreter is handling error checking and each run is very fast, there is no longer any need to detect more than one error at a time (which is exactly the way all of these interpreters behave). This long-standing problem of computer science has not been solved, but rather, has disappeared!

The tests were as follows:

A function was declared to return one type and then returned another (incompatible) type. An assignment was performed between two wildly (double and char *) different types without using a cast. This test was run, just in case the interpreter was doing type checking at runtime.
Indexing beyond the end of an array was performed. This test was repeated with an array greater than 64K. We ran each program, since array bounds checking must be performed at runtime.

The final test was using a variable before setting it.

Major V7 extensions were also tested. This included enumeration types and structure assignment and passing. If these extensions are not implemented, they should be reported in this way, or at least as errors.

IC was able to catch syntactic errors in our code and was good at identifying exactly where the error was detected. Occasionally, it would give errors that seemed to have no relation to the real error. Sometimes there was no error and restarting IC would cause the error to go away.

The IC manual says it performs code-checking in the style of lint, but it failed to catch any of the problems we tested it for. This was disappointing. IC does not implement any of the V7 extensions (except for void) and reported them all as errors.

RC was only slightly better than IC in this aspect. It found the obvious problems and also reported the wild assignment without cast. It let all of the other problems go.

RC correctly complained about the declaration of the data structure that was larger than 64K. But even when it was less than 64K, RC failed to catch the reference beyond the end of the array.

We were surprised at this, because the RC manual specifically states that array bound checking is performed. The manual also claims that RC performs a gross check of pointer assignments by examining whether the pointer is within the user program space or not. This could explain the reason why RC is quite a bit slower than the other interpreters.

RC did not implement any of the V7 extensions (except void). It reported that enumerations were not implemented but gave an error message when trying to copy structures by assignment.

CT wasn’t any better at this game then either IC or RC. It failed to report any of the operations that mismatched types, and it did not report our use before set.

CT could not handle declarations larger than 64K and it generated and evaluated incorrect code without error when this happened. CT claims that it performs runtime checking on array and pointer accesses and that this can be turned off. CT did catch an invalid array access once, when we were testing it, but it did not do so during this test. Turning off this checking feature did not make CT run any faster.

CT did not implement any of the major V7 extensions, however it did give the best error messages, accurately reporting that enum was unknown and structure assignment is not allowed.

In general, we were extremely disappointed with lax typechecking and error detecting given to us by these C interpreters. Clearly, here is an area that these products can be sold on. No one wants their compiler to generate array-bounds or pointer checking, but there are times, when we would have sold our souls for this capability. Sanity checks such as making sure a variable has been set before it is read is something good compilers do, but it should also be in these interpreters. There is no reason to go out and buy yet another product (i.e. lint).

**Benchmarks**

At first we thought that benchmarks of the interpreters would not be that important since they were just for development and the final programs would be compiled any-way. However, some of our test programs ran so slowly that we decided the interpreter speed (or lack of it) could actually be a drawback when using them.

We used the sieve benchmark from the 1/83 Byte (Eratosthenes Revisited) as a test of raw cpu power. Our test machine was an IBM AT with 512Kb.

<table>
<thead>
<tr>
<th>Type</th>
<th>Brand</th>
<th>Seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>Aztec C</td>
<td>3.5</td>
</tr>
<tr>
<td>I</td>
<td>Instant C</td>
<td>16</td>
</tr>
<tr>
<td>P</td>
<td>p-system</td>
<td>56</td>
</tr>
<tr>
<td>I</td>
<td>C-terp</td>
<td>1100</td>
</tr>
<tr>
<td>I</td>
<td>Runc</td>
<td>5400</td>
</tr>
</tbody>
</table>

**What Our Users/Reviewers Are Saying**

"... easy to use, powerful, and a timesaver."

"... we absolutely love C-terp..."

"... has restored my faith in interpreters."

"... a programmer’s dream."

"... wonderful technical assistance."

"... increased our productivity by a factor of 40."

"... the best C product ever, in any category."

---

**C-terp**

**The C Interpreter You Won’t Outgrow**

C-terp will grow with you as you progress from novice through professional to guru. Unbelievable, but true, the easiest-to-use C interpreter will provide you with the most advanced programming features for upward growth. Our exclusive object module support enables you to add libraries (like HALO, PANEL, Windows for C, etc., or your own homebrew libraries) to C-terp as you add them to your computing repertoire. Use C-terp as a microscope on your libraries! Mix a bit and allow our software paging (NEW) to handle those big jobs! There are no fixed-size tables to overflow, and C-terp can be configured for different screens and screen adapters (NEW). With multiple modules and full K&R support, we offer a dream C environment.

- Our new improved configurable editor contains anything going.
- Speed - Linking and semi-compilation are breathtakingly fast.
- Convenience -- errors direct you back to the editor with the current set to the trouble spot.
- Symbolic Debugging -- Set breakpoints, single-step, and directly execute C expressions.
- Compatibility guaranteed -- batch file to link in your compiler's entire library.
- Supported compilers include: Computer Innovations C86, Lattice C, Microsoft C 3.0, Mark Williams C86, and Aztec C.
- Many more features including batch mode and 8087 support.

---

**Micro/Systems Journal March/April 1986**
We were quite surprised that IC is several times faster than the P-system. (The P-system semi-compiles code, producing P-code at runtime.) Obviously, the IC writers put a lot of work into optimizing the interpreter itself. At the other end, CT was very slow and RC was very slow. Obviously, we know what they’ll be working on next.

Let us restate, while testing small pieces of code, it really shouldn’t be that significant how slow the interpreter is. In fact, one would imagine that the slower interpreters are making more safety checks for us. Not only does this speed up development by catching our errors faster, but it saves us catching our errors faster, but it saves us of huge amounts of work into optimizing the interpreter itself. At the other end, CT was very slow and RC was very slow. Obviously, we know what they’ll be working on next.

Let us restate, while testing small pieces of code, it really shouldn’t be that significant how slow the interpreter is. In fact, one would imagine that the slower interpreters are making more safety checks for us. Not only does this speed up development by catching our errors faster, but it saves us of huge amounts of work into optimizing the interpreter itself. At the other end, CT was very slow and RC was very slow. Obviously, we know what they’ll be working on next.

We were quite surprised that IC is several times faster than the P-system. (The P-system semi-compiles code, producing P-code at runtime.) Obviously, the IC writers put a lot of work into optimizing the interpreter itself. At the other end, CT was very slow and RC was very slow. Obviously, we know what they’ll be working on next.

Let us restate, while testing small pieces of code, it really shouldn’t be that significant how slow the interpreter is. In fact, one would imagine that the slower interpreters are making more safety checks for us. Not only does this speed up development by catching our errors faster, but it saves us of huge amounts of work into optimizing the interpreter itself. At the other end, CT was very slow and RC was very slow. Obviously, we know what they’ll be working on next.

Let us restate, while testing small pieces of code, it really shouldn’t be that significant how slow the interpreter is. In fact, one would imagine that the slower interpreters are making more safety checks for us. Not only does this speed up development by catching our errors faster, but it saves us of huge amounts of work into optimizing the interpreter itself. At the other end, CT was very slow and RC was very slow. Obviously, we know what they’ll be working on next.

We were quite surprised that IC is several times faster than the P-system. (The P-system semi-compiles code, producing P-code at runtime.) Obviously, the IC writers put a lot of work into optimizing the interpreter itself. At the other end, CT was very slow and RC was very slow. Obviously, we know what they’ll be working on next.

Let us restate, while testing small pieces of code, it really shouldn’t be that significant how slow the interpreter is. In fact, one would imagine that the slower interpreters are making more safety checks for us. Not only does this speed up development by catching our errors faster, but it saves us of huge amounts of work into optimizing the interpreter itself. At the other end, CT was very slow and RC was very slow. Obviously, we know what they’ll be working on next.

Conclusion

Besides the price (which is surprising in variation from Run/C at $150 to Instant-C at $500), there are several other important factors in deciding which (or even whether) to buy. First off, each of these C interpreters has significant problems that make us question their current viability as development tools for professional programmers. However, all of the companies have stated that they are working on fixing the major bugs and problems in their products. In particular, they are all working on being able to incorporate compiled code from various C compilers (C-terp and Instant-C do this already but are compatible with a limited number of compilers). Also, they do or soon will conform to K&R C. It is inconceivable that they would not also conform to the new C standard when it is finally approved.

However, no matter how much these products are refined, they will continue to have their minor quirks that you will have to live with and code around just like your C compiler. In fact, for that very reason, we suggest that you look for an interpreter by how compatible it is with the compiler you use. (We will be reviewing several more C interpreters in a future issue.)

These C interpreters are, however, admirable for beginners who are learning C. In particular, they almost seem targeted to pick up different markets of the C beginner depending on what language you are coming from. Instant-C is aimed at the programmer weaned on C. Run/C is oriented towards people in love with BASIC who are forced to use C, and C-terp is for Pascal programmers who have seen the light.

The interpreters are also appropriate for programmers who want to try out half-baked ideas before putting a lot of work into something. This suits us just fine.
PUT A CP/M COMPUTER IN YOUR PC!
And run 1,000's of CP/M programs up to 30% faster, directly from your CP/M disks!

How does it work?
RUNCPM virtually transforms your PC into any of the most popular CP/M systems. A simple replacement of your PC's 8088/186 microprocessor with our N.E.C. V·20/30 microprocessor gives your computer the ability to run both 8 bit CP/M and 16 bit MS-DOS programs. RUN/CPM will transform your PC's floppy drives into CP/M drives able to directly read, write, and format over 100 CP/M disks!

Performance?
Depending on the application, many of your CP/M programs will run up to 30% faster on your PC. Other features include: ability to run CP/M programs in color, logical and physical drive assignments, run CP/M or MS-DOS programs from the same prompt, RUN/CPM is the solution to running CP/M software on PCs.

Turbocharge your CP/M Applications!
For programmers, developers, and advanced enthusiasts.

Features
- Utilization of 1 full mega byte address space!
- Direct access to DOS functions
- Direct access to PC 1/0 ports
- Direct access to PC BIOS calls

ADD CP/M DISK COMPATIBILITY TO YOUR PC!
Now your IBM PC or compatible can directly read, write, and format over 100 of the most popular CP/M disks.

How does it work?
READ/CPM virtually transforms your PC's floppy disk drives into any one of more than 100 CP/M drives. Simply run the READ/CPM program, and choose the CP/M formats you want your PC's floppy disk drives to emulate. Now you can access data from your CP/M disks using standard DOS commands like COPY, DIR, TYPE etc. No need for modems or additional hardware, and READ/CPM supports more formats than any other similar product. READ/CPM is the ideal solution to the incompatibility problem.

Attention Programmers and Developers!
Our MICRUN 80, and MICRUN 86 Universal Development Interfaces will allow you to run your 8 bit or 16 bit Intel languages on your IBM PC or MS-DOS compatible! Your PC will become a high performance MDS, and save you time and money. Call for more information.

PC Speed Demon!
Now your IBM PC, or XT can run up to 3 times faster!

CALL FOR PRICE!

COMPATIBLE WITH VIRTUALLY ALL SOFTWARE:
- Applications programs
- CAD/CAM
- Engineering
- Scientific Applications

CALL FOR PRICE!

COMPATIBLE WITH VIRTUALLY ALL ACCESSORY CARDS:
- Extended memory
- Hard disk controllers
- Printer cards
- Floppy disk controllers
- Serial cards
- No preboot software, virtually transparent to user.

Micro Interfaces Corporation
6824 N.W. 169th Street, Miami, Florida 33016
(305) 823-8088
Telex 5106004680 MICRO INTER CO

ORDERS ONLY
1-800-637-7226

To order send check or money order (U.S. funds) add $5.00 shipping/handling.

Trademark: CP/M (Digital Research, Inc., IBM, DEC Corp), RUNCPM (Micro Interfaces Corp.), MS-DOS (Microsoft, Inc.), INTEL (Intel Corp.)

OEM, VAR, Dealers, Inquiries Invited
C Source-Level Debuggers

by Jonathan Sachs

A compiled language like C lets a programmer concentrate on solving the problem at hand, while ignoring the details of how to realize the solution on the computer he or she happens to be using. But when a programmer starts debugging, this benefit is traditionally lost. A C program must be debugged as though it were written in assembly language. Execution is traced one assembler instruction at a time, and data values are displayed in whatever way C represents them on that machine.

Debugging a C program this way is actually harder than debugging an assembly program. One must be familiar not only with the computer's hardware, but also with many details of how the compiler generates code. And one must move back and forth between two different views of the program as one shifts from coding to debugging and back.

The natural solution to this problem is a debugger that views the program in terms of the source code rather than the object code. Several such source level debuggers are now available for C compilers running under PC DOS and similar systems. This review evaluates three of them.

WHAT IS A SOURCE LEVEL DEBUGGER?

For the purposes of this review, a source level debugger is a debugging tool that can do the following things:
1. Show the current location in the program in terms of source code.
2. Allow stepping, tracing, and breakpoint setting in terms of source code.
3. Accept C expressions in debugger commands. This is not an all-or-nothing proposition; a debugger that does not accept every C expression may still be a useful tool. At a minimum, it should support:
   a. The basic C concepts of expression syntax, operator precedence, and addressing.
   b. A substantial subset of C operators, including the basic operators for arithmetic, logic, and assignment.
4. A window into the source code.
5. A context line that displays the program screen display with the target program's display. This is valuable for debugging programs that display menus, tables, or other two-dimensional data. Most debuggers let you switch back to the debugger's display by pressing any key.

Some Generalities

All of the debuggers reviewed here are designed for use with MS-DOS or PC-DOS on an IBM-PC or compatible system. Some can run on other types of hardware, but you may have to do some programming to adapt them.

Most source level debuggers work in similar ways. The modules to be debugged must be compiled with a command line option that makes the compiler generate information the debugger will need. After the target program has been linked, the debugger is run; it loads the program and waits for a command. As the program is debugged, the debugger reads relevant parts of the source file(s) and displays them on the screen.

All of the debuggers discussed here have a display program screen command which replaces the debugger's entire screen display with the target program's display. This is valuable for debugging programs that display menus, tables, or other two-dimensional data. Most debuggers let you switch back to the debugger's display by pressing any key.

All of the debuggers share certain limitations. They suffer added overhead due to the time spent processing the source files. The amount of overhead varies from one to the next, as do the operations that are affected the most, but you'll need a fast hard disk to use any of these programs efficiently.

Since a source level debugger reads source files at run time, you must not alternate between debugging and editing the source. If you do so, the debugger either will display the wrong source statements or fail disastrously. Defer your changes until you're done debugging; then edit, recompile, and relink before running the debugger again.

While source level debuggers let you ignore the operation of the compiler's code generator, they don't let you ignore the pre-processor. For example, a debugger won't let you execute the expression 'putchar(c)', since 'putchar' is a macro, not a function. You must enter 'putc(c,stdout)' instead.

All of the debuggers are easy to install. Just copy the necessary files to your working disk, compile and link a program with the appropriate debug option, and the debugger will run. All of the debuggers have provisions for keeping the debugger in one sub-directory and debugging programs in another.

THE DE SMET COMPILER & DEBUGGER

The C-Ware Corporation sells de Smet C and a source level debugger designed for use with it. The two may be purchased separately or together.

How to Use It: To use the de Smet debugger, you must compile and link the target program with the '-C' option. The program may contain modules compiled without '-C', but the debugger cannot be used to debug them.

The debugger divides the screen vertically into four parts (see Figure 1). From top to bottom, they are:
1. A prompt line listing the debugger commands you may enter. The debugger commands are all a single keystoke, but the prompt line gives them mnemonic names.
2. An expression line where you may enter an expression to be evaluated.
3. A context line that displays the source file, function name, and line number of the next statement to be executed.
4. A window into the source code. An arrow points to the next statement to be executed.

When you start the debugger, the cursor appears on the prompt line. When you enter a debugger command, the debugger executes the command.

You may begin debugging a program by entering the 'S' ("step") command. This moves the cursor to the end of the 'main' function's first line. Each subsequent 'S' executes one source statement. The source window scrolls,
Figure 1. The de Smet C debugger's debugging screen. Prompt line, context line, and source code window are shown.

Figure 2. The 'E' command prompts you to enter an expression, then displays its value at the bottom of the screen.

when necessary, to keep the next source statement in view.

When the target program calls a function in a module that was compiled with the '-C' option, the debugger steps through the called function, then resumes stepping through the caller. You may enter 'P' ('procedure-level step') instead of 'S' to make the debugger step through the current function only, executing each called function in a single step.

When you want to do something other than step, you return to the prompt line by pressing RETURN.

The debugger's 'G' command ('go') runs the program to the next breakpoint. You can set a breakpoint at the start of a named function, or at a specified line in the source file. You can set three different breakpoints with the 'break' command, and a fourth with the 'go' command itself.

The 'G' command illustrates how many debugger commands prompt you for options. First it prompts you to enter 'A' ('break at start of Procedure'), 'L' ('break on line'), 'F' ('break on function'), 'P' ('break on line number'), or 'R' ('run forever' or until a numbered breakpoint is found). If you enter 'A', 'L', or 'F', you are prompted to define the appropriate kind of break point. Then execution begins.

The 'F' ('find') command can locate a piece of code by context, provided you know which source file it is in. Thus you can set a breakpoint by line number (or just examine source code) without referring to a line-numbered listing. In fact, much debugging can be done with no source listing at all.

The 'E' command prompts you to enter an expression, then evaluates it. The result is displayed at the bottom of the source window (see Figure 2). You can change a variable's value by entering an expression like 'x = x + 1;' or 'x = 0.'

The debugger tries to display expression values in appropriate forms. A character is displayed in ASCII, decimal, and hexadecimal, for example; a character array is displayed as a hexadecimal pointer value and an ASCII string value.

The 'C' ('Collection') command displays the members of a structure, or the elements of an array that is not a string. Some design flaws (described below) limit its usefulness, though. To display often-used structures it is most convenient to write special debugging functions into the target program, to be called as needed with the 'E' command.

**Performance:** The debugger loads fast, even when the program being debugged is large. It slows down program execution by only a moderate amount.

The only debugging operation that is objectionably slow is the single-stepping function. If the target program is large, the debugger may take several seconds to advance one step when running on a standard IBM PC. Storing the source files on a RAM disk doesn't speed things up at all. Presumably a computer with a faster CPU would help.

The debugger has three significant limitations. First, it does not support some standard C operators, such as '&&' and '++=', even though the compiler does. And, very strangely, it does not use C syntax for numeric constants. Hexadecimal constants are entered with a leading zero ('01F' instead of '0x1F'), and octal constants are not supported. This oddity is easy to learn but hard to remember, and is a constant source of irritation.

The second limitation is the lack of any facility for machine-level debugging (a limitation shared by all three products reviewed here). To debug a function written in assembly language, you must use a standard low-level debugger like DEBUG, and you must then debug your program by addresses alone.

The final limitation concerns the use of the 'collection' command, 'C', to display structures. You must enter the name of the first member to be displayed, as well as the name of the structure itself. Since the order of the members irrelevant in most other contexts, it is hard to remember.

Also, de Smet C follows Kernighan and Ritchie on treatment of member names: if several structures have identically named members, the compiler and debugger treat those members as a single entity. Thus the debugger sometimes displays the contents of one structure with the format and member names of another. This happens whenever the name of the first member to display is present in another structure that was defined before the one you want to look at. This is not a bug - it's an unavoidable result of the way Kernighan and Ritchie treat structures - but it can make the 'C' command very tricky to use.

**Compiler and Linker:** While this article is about debuggers, a few words about compilers and linkers are in order. After all, a debugger is never used alone.

De Smet supports the full C language standard as defined by Kernighan and Ritchie. Today this is a limitation, not a feature. Most other modern C compilers try to support the 'standard' implemented in Unix Version 7. Version 7 has important features that de Smet C lacks, such as the 'enum' data type and more flexible structure member naming rules that would remove the 'collection' problems discussed above.

C-Ware says that the next version of the compiler will implement most or all of the Version 7 extensions. This should remove some of the product's current limitations.

The compiler currently supports only the small program model, which limits a program to 64K of code and 64K of data. This too, is supposed to change in the next version.

De Smet C is disturbingly casual about violations of data type rules. For example, if you write

```c
struct etab xyz;
function(xetab);
```

it compiles code as though you wrote

```c
struct etab xyz;
function(xetab);
```

Micro/Systems Journal March/April 1986
This is not exactly wrong, since Kernighan and Ritchie do not allow a structure to be passed as a function argument. Quite likely the de Smet compiler is doing what you 'mean' if you're following Kernighan and Ritchie. But in UNIX Version 7, C does allow a structure to be passed as a function argument, so in Version 7 the first construction above would be valid, and would not mean the same thing as the second one.

Thus, de Smet C lets you write programs that confuse structure names with structure pointers; such programs may compile without errors on compilers that observe Version 7 rules, but they won't run correctly. It will be interesting to see how the promised new version of de Smet C will deal with this.

One must balance these shortcomings against de Smet C's impressive speed. Both the compiler and linker are among the fastest available for the PC. For developers of large programs, that can be as important as a powerful debugger. The best debugger in the world is of limited value if you grow old waiting for a chance to use it.

Documentation: The de Smet compiler's manual is not beautifully written or printed, but as a reference manual it is adequate. Most of the necessary information is present and accurate. Novice C programmers will find it heavy going, though. There is no index.

Summary: Despite some troublesome limitations, the de Smet debugger is an impressive performer. It lets you work quickly and effectively. It compares favorably with other products that are much more expensive.

MARK WILLIAMS C

Mark Williams Company's C was originally developed as part of its Unix-like operating system, Coherent. The compiler and source level debugger are now offered separately as a product running under PC-DOS.
go at the debugged program's normal full speed. 'Procedure-level step,' F4-o, is about 300 times slower; this sounds awful, but in fact it is acceptably fast for most uses. (In an earlier version of the debugger, 'procedure-level step' was really slow; existing users are well advised to upgrade!) The delay is associated with calls to lower-level functions compiled with 'VCSD'. Stepping through code that doesn't involve such calls is virtually instantaneous.

The debugger's highly visual orientation is convenient for localized debugging, but tends to be a hinderance when one is working with widely separated parts of source code. The only practical way to do a long-distance move is with the 'find' command, which is slower than it should be (about four times slower than WordStar's 'find'). There's no way to mark a spot in the source code and return to it later.

Compiler and Linker: Since the Mark Williams compiler was developed as part of a UNIX-like operating system, it has a strong UNIX flavor. The compiler is designed to act the same way on any host, even if its behavior violates the customs accepted on a particular host.

For example, when a 'char' is cast to an 'int,' Mark Williams extends the sign bit. On an 8086, the compiler must generate an extra machine instruction to do that! The sign extension is likely to surprise seasoned PC DOS programmers, although it is not a violation of the C standard.

The compiler supports much of the UNIX Version 7 extensions to the C language. It supports the 'enum' data type, for example, and the use of structures in function arguments and assignment statements.

The Mark Williams compiler optimizes rather extensively. This is nice for a finished program, but makes debugging hard. Source statements can be optimized right out of existence, making the execution path jump around in ways not suggested by the source code. Setting breakpoints becomes hard; a breakpoint can't be set on a statement that's been optimized away, and to find the right place for the breakpoint you must guess what the optimizer did. There's no way to turn off optimization — at least not in a way that is documented.

Documentation: Mark Williams C comes with two manuals in a single IBM-style binder. One manual describes the compiler, linker, and library, and one describes the debugger. The manuals are very nicely produced. Their content is not quite so great.

Some important pieces of information (such as compiler and linker options) are scattered throughout the manual. Others (such as how to make the linker produce a map) are omitted completely.

On the other hand the documentation is extensive, and includes several valuable tutorial examples. The debugger's documentation is particularly good in this respect.

Both manuals have indexes, but they are so skimpy as to be almost useless.

Summary: This is a powerful and sophisticated debugger built on a well-designed, 'serious' compiler.

C-SYSTEMS C-WINDOW DEBUGGER

The c-window debugger, by c-systems, was the first source-level debugger released for a microcomputer implementation of C. It works with the c-systems C compiler.

How to Use It: The c-window debugger is unique in that it is not a separate program; it is a function library that is linked into the target program itself.

Modules to be debugged must be compiled with the '-W' option; other target program modules may be compiled without it. (The module containing the 'main' function must always be compiled with '-W'.) The program then is linked using a c-window library as well as the standard C run-time library. Then, when the target program is run, the debugger takes control and manages the target program's execution.

The debugger divides the screen into two parts (see Figure 5). The upper two-thirds are the 'user I/O area,' where the user enters debugging commands and sees their results. The lower third is the 'source code display area,' which shows the context of the current source line in the target program.

When you start the debugger, an arrow in the source code display area points to the first executable statement of 'main.' A double arrow in the user I/O area prompts you to enter a debugger command.

All debugger commands consist of an opcode and some number of operands, ended by RETURN. The debugger has commands for advancing execution one step at a time ('s', for 'step') or n steps at a time ('t', for 'trace'), and for running until execution reaches a specified line number in a specified function ('g', for 'go'). The 's' and 't' commands descend into a lower-level function if it was compiled with the '-W' option. There is no way to advance one step or n steps within the current function only.

The debugger has commands for viewing other parts of the source code, and for evaluating expressions and displaying their results in several formats. The 'fill string' command, 'fs', can set the value of a string — an operation that is rather awkward with the de Smet and Mark Williams debuggers. This command's syntax unfortunately limits its usefulness; it cannot set a string value that contains spaces, commas, or escape characters.

The debugger's breakpoint facilities are more powerful than those of the de Smet and Mark Williams debuggers. A breakpoint's effect can be delayed until execution has passed that breakpoint a specified number of times. A breakpoint can also be made conditional, so that the program will halt there only if a specified expression evaluates to a non-zero result. This makes it easy to stop only when some condition has occurred that one wants to examine.

The debugger lets you define 'auto commands,' which will be executed each time it regains control after a 'step,' 'trace,' or 'go' command.

Performance: The debugger loads very quickly. This is probably due to the fact that it is linked into the target program, not stored in a separate EXE file. The presence of the debugger slows down the target program by a factor of about 120. This is not noticable during debugging itself, but can cause long waits when the program must run a substantial distance to a breakpoint. Modules compiled without the '-W' option run at full speed, though; and one can insert special
pre-processor statements in modules compiled with `-W' to turn `-W' off for parts of the code that need not be debugged.

The debugger's commands depend heavily on the use of line numbers. To set or clear a breakpoint within a function, for example, one must enter the function name and the breakpoint's line number. This leads to one of the major drawbacks of this debugger: it is almost impossible to use without a current line-numbered listing of the code.

There is no 'find' function, so there is no easy way to find line numbers using the debugger itself. The 'display source' command doesn't help, since it too needs a line number to identify the part of the source to be displayed. Its display gives a line number for only one line, so one usually must count lines to find a specific line's number even when that line is on the screen. And the 'display source' command functions only within the module containing the function currently being executed.

The debugger has another major limitation: while running, it holds source code in the target program's data segment. The source code thus competes for space with the data structures used by the target program itself. This makes it very difficult to debug a large, complex program, which could require both a lot of run-time data and a lot of source code.

The Compiler and Linker: The c-systems compiler was the only one used for this review that presented significant problems. It has two passes, an EXE file meant to run them automatically did not work at all. A batch file, intended for use under DOS 1.1, was used instead. The compiler had some odd bugs. For example, it completely ignored the statement

```c
FILE *fopen(), *fclose(), *fp;
```

and later treated 'fp' as a reference to an externally defined 'int'. When the statement was changed to

```c
FILE *fopen(), *fclose(); FILE *fp;
```

it compiled '*fp' (and references to 'fp') correctly.

Once such problems are evaded, the compiler performs solidly, if unspectacularly. Unlike the de Smet and Mark Williams compilers, it produces Microsoft format object modules and uses the Microsoft (or IBM) linker in its normal mode of operation. In fact, the compiler generates assembler code, and the Microsoft/IBM assembler must be run to produce object code. (c-systems sells a high-speed non-macro assembler for use with its compiler, but that was not made available for review.)

### Table 1
#### Compiler, Linker, and Debugger Timings

<table>
<thead>
<tr>
<th></th>
<th>de Smet</th>
<th>Mark Williams</th>
<th>c-systems</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Compile time</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>without &quot;debug&quot; option</td>
<td>0:20</td>
<td>0:45</td>
<td>1:573</td>
</tr>
<tr>
<td>with &quot;debug&quot; option</td>
<td>0:22</td>
<td>0:54</td>
<td>2:58</td>
</tr>
<tr>
<td><strong>Link time</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>without &quot;debug&quot; option</td>
<td>0:08</td>
<td>0:22</td>
<td>0:18</td>
</tr>
<tr>
<td>with &quot;debug&quot; option</td>
<td>0:10</td>
<td>0:28</td>
<td>1:18</td>
</tr>
<tr>
<td><strong>Debugger load time</strong></td>
<td>0:03</td>
<td>0:14</td>
<td>0:04</td>
</tr>
<tr>
<td><strong>Run time</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>without debugger</td>
<td>0:08</td>
<td>0:06</td>
<td>0:10</td>
</tr>
<tr>
<td>with debugger, &quot;run to end&quot;</td>
<td>0:08</td>
<td>0:06</td>
<td>20:00</td>
</tr>
<tr>
<td>with debugger, &quot;proceed&quot;</td>
<td>0:08</td>
<td>29:109</td>
<td>n/a</td>
</tr>
<tr>
<td>with debugger, &quot;run to breakpoint&quot;</td>
<td>0:08</td>
<td>0:06</td>
<td>20:00</td>
</tr>
<tr>
<td><strong>Object module size</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>without &quot;debug&quot; option</td>
<td>3081</td>
<td>3244</td>
<td>4150</td>
</tr>
<tr>
<td>with &quot;debug&quot; option</td>
<td>5216</td>
<td>9764</td>
<td>11,052</td>
</tr>
<tr>
<td><strong>EXE file size</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>without &quot;debug&quot; option</td>
<td>9728</td>
<td>7605</td>
<td>16,904</td>
</tr>
<tr>
<td>with &quot;debug&quot; option</td>
<td>9728+2353</td>
<td>12,720</td>
<td>100,962</td>
</tr>
</tbody>
</table>

1 - second number is the size of the .OBJ file produced by the linker for a program linked with the "-C" option.
2 - extrapolated from time measured for 1000 loops.
3 - includes run time for Microsoft Assembler, version 3.00.
4 - includes c-window debugger code.

### Table 2
#### Features of Source Level Debuggers

<table>
<thead>
<tr>
<th></th>
<th>de Smet</th>
<th>Mark Williams</th>
<th>c-systems</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>COMPILER FEATURES</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Memory models supported</td>
<td>small³</td>
<td>small² small, large⁴</td>
<td></td>
</tr>
<tr>
<td>Supports major UNIX Version 7 extensions</td>
<td>N3</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td><strong>DEBUGGER FEATURES</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Procedure-level step</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Breakpoints (not counting &quot;run&quot; command's built-in breakpoint)</td>
<td>3</td>
<td>no limit</td>
<td>9</td>
</tr>
<tr>
<td>Automatic evaluation of expressions at each step</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Delayed &amp; conditional breakpoints</td>
<td>N</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td>&quot;Display target program screen&quot; command (on IBM PC &amp; compatibles)</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Source code &quot;find&quot; within module</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Global source code &quot;find&quot;</td>
<td>N</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>View source modules other than one now executing</td>
<td>Y</td>
<td>Y</td>
<td>N</td>
</tr>
<tr>
<td>Machine-level debugging</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Source code capacity</td>
<td>no limit</td>
<td>no limit</td>
<td>1000 lines or 32 Kb</td>
</tr>
<tr>
<td><strong>Compiler version reviewed</strong></td>
<td>2.41</td>
<td>2.1.5</td>
<td>2.08A</td>
</tr>
<tr>
<td><strong>Debugger version reviewed</strong></td>
<td>1.4</td>
<td>2.1</td>
<td>2.0</td>
</tr>
<tr>
<td><strong>Price (if compiler &amp; debugger are separately priced, compiler is listed first)</strong></td>
<td>$109</td>
<td>$50</td>
<td>$295</td>
</tr>
<tr>
<td><strong>Runs under MS DOS on computers not compatible with IBM PC</strong></td>
<td>Y</td>
<td>N</td>
<td>Y</td>
</tr>
<tr>
<td><strong>Operating systems supported other than PC DOS &amp; MS DOS</strong></td>
<td>CP/M-86</td>
<td>Coherent</td>
<td>none</td>
</tr>
</tbody>
</table>

1 - user must write a custom terminal interface.
2 - compiler supports medium & large models; debugger does not.
3 - more models & Version 7 extensions promised in next version.
4 - Medium & compact model support available at additional charge.
DeSmet C  
Best of Breed

"The DeSmet Compiler ... is a standout product now just as it was two years ago ... compiler has a real personality ... Its speedy compiles make developing C programs fun ..."
- William J. Hunt, PC TECH 1/86

"...the easiest DOS C compiler to bring up. Twenty minutes out of the box, it compiled a program."
- Leibson, Pfahler, Reed and Kyle, COMPUTER LANGUAGE 2/85

"...designed for use by serious software developers..."
- Rex Jaeschke, SOFTALK 3/84

"...a stunning amount of bang for the buck ....loaded with excellent features."
- Houston, Brodrick and Kent, BYTE 8/83

$109
(Source Level Debugger $50)

C Ware Corp., P.O. Box C, Sunnyvale CA, 94087, U.S.A.
Street Address: 505 W. Olive, Suite 767, Sunnyvale CA 94086 (408) 720-9696

Csharp Realtime Toolkit

Realtime on MSDOS! Csharp can do it! Get the tools without operating system overhead. Cut development time with C source code for realtime data acquisition and control. Csharp includes: graphics, event handling, procedure scheduling, state system control, and interrupt handling. Processor, device, and operating system independent. Csharp runs standalone or with: MSDOS, PCDOS, or RT11. Csharp runs on: PDP-11 and IBM PC. Csharp includes drivers for Hercules and IBM graphics boards, Data Translation and Metabyte IO boards, real time clock, and more. Inquire for Victor 9000, Unix, and other systems. Price: $600

Systems Guild, Inc., P.O. Box 1085, Cambridge, MA 02142
(617) 451-8479

Micro/Systems Journal March/April 1986
The compiler does support all four 8086 memory models—compact, small, medium, and large—and is the only one of the products reviewed here that does so. (Mark Williams C supports the small, medium, and large models, but only when producing Microsoft format object modules; the Mark Williams debugger works with Mark Williams's 'native' object format, which appears to support only the small model.)

The compiler also supports an impressive array of command line options for such purposes as generating ROMable code, limiting the significant length of variable names to eight characters, and determining whether 'char' values converted to 'int' will be sign-extended.

The compiler conforms to an older version of the C standard. Like the de Smet compiler, it silently compiles a reference to a structure in an assignment or a function argument as a pointer to the structure; this is liable to cause portability problems. Unlike the de Smet compiler, it fails to recognize the 'void' type for function definitions.

Documentation: c-systems provides two manuals: one for the compiler and run-time library, and one for the debugger. The manuals are not beautifully written, but are complete and accurate.

The debugger manual, in particular, is not easy to read, suffering from an excess of terminology and a shortage of examples. With a little patience, though, any reader familiar with C can figure it out.

The compiler's manual has a very good index; the debugger's manual has none.

Summary: The debugger is simple but elegant, and is built on a compiler that is somewhat clunky, but serviceable. The debugger has two serious limitations: its dependence on source code line numbers and its method of storing source code in the target program's data segment.

**QUANTITATIVE COMPARISONS**

Several quantitative comparisons were performed on the debuggers and the compilers and linkers that go with them. The results are presented in the Table 1 and Table 2.

All of the timings in Table 1 were taken on an IBM PC equipped with a 10 Mb Davong hard disk. No RAM disk was used.

The compile times, link times, and debugger load times are based on a one-module C program that calls a representative set of standard library functions ('printf' and 'scanf' not included). The source program is 337 lines or 8 Kb long. When comments and blank lines are deleted, the program is 231 lines or 5.2 Kb long.

'Debugger load time' is the time it took the debugger to load itself and the target program. It was measured from the time when the appropriate command line was entered and the RETURN key was pressed to the time when the debugger was ready to accept a command.

The target program run times are based on a small program that is entirely CPU-bound. Since a debugger should affect CPU execution speed, but not I/O wait time, it was felt that this would produce the most meaningful comparison of running speed. The program is reproduced in Figure 6.

'Run time with debugger' is the time the program took to run through 50,000 loops when loaded without the debugger. Run time was measured from the time when 'number of loops' was entered and the RETURN key was pressed to the time when execution ended. It was measured on target programs compiled and linked without the 'debug' option.

'Run time with debugger, run to end' is the time a program took to run through 50,000 loops when loaded with the debugger, but allowed to run freely. This measured the inherent overhead caused by using the debugger. It was measured the same way as 'run time without debugger.'

'Run time with debugger, procestep' is the time the program took to run the function 'process' through 50,000 loops when the debugger's 'procedure-level step' command was entered at the 'process(lim)' statement.

'Run time with debugger, breakpoint' is the time the program took to run the function 'process' through 50,000 loops when a breakpoint was set at the 'lim = 0' statement, and a 'run to breakpoint' command was entered at the 'process(lim)' statement.

**CONCLUSIONS**

All of the debuggers performed competently, and would be useful additions to a C programmer's library of tools.

The de Smet and Mark Williams debuggers were about equal in quality, although they represented fundamentally different approaches to user interface design. The c-systems debugger had limitations that interfered with its usefulness: most notably its dependence on line numbers and its practice of storing source code in the data segment.

Mark Williams had the only compiler that accepted substantially all of Unix Version 7's language extensions. The de Smet and c-systems compilers offered only a little more than the Kernighan and Ritchie standard.

Given its low price, de Smet C can be considered a 'best buy' for the economy-minded user who can survive (for the present) without Unix Version 7 language extensions. This is particularly true if the user has an 8088 processor, making compiler and linker speed a significant factor in productivity. For a programmer who prefers compatibility with Unix (and particularly with Version 7), Mark Williams C is the clear choice.

Jonathan Sachs is President of Sand River Software, Inc., a consulting firm based near San Francisco. He specializes in text processing software development and technical writing. He is the author of three books, the most recent being the "CP/M-86 User's Guide" published by Osborne/McGraw-Hill.

```c
process(lim)
unsigned lim;

(unsigned u,v)
for ( u=0; u<lim; u++ )
if ( u%2 )
  { v = u/5; v *= 5; v /= 5; }
else
  { v = u/4; v *= 5; v /= 4; }
}
main()

unsigned lim;
printf("How many loops? ");
scanf("%d", &lim );
process(lim);
lim = 0;
```

Figure 6. The program used to compute target program run times.
COMPETITIVE EDGE
631 S. Main St. — Plymouth, MI 48170 — (313) 451-0665
Competitive Edge brings you Lomas Data Products Inc.
S-100 CIRCUIT BOARDS

**Thunder 186**, 256K, 2 Serial, 1 Parallel, Floppy Disk Controller, Clock. All on One Board with Concurrent DOS $895

<table>
<thead>
<tr>
<th>Board</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>8MHX Lighting 286 CPU</td>
<td>$821 NV Disk 512K, Memory Drive</td>
<td>$371 512K Dram Megaram</td>
</tr>
<tr>
<td>10MHZ Lighting 8086 CPU</td>
<td>520 Concurrent DOS Single User</td>
<td>280 2048K Megaram</td>
</tr>
<tr>
<td>Control It All Floppy &amp; HD Controller</td>
<td>487 MSDOS for 86, 186, or 286</td>
<td>200 Ram 67 128K W/Bat B/U</td>
</tr>
<tr>
<td>256K Dram Megaram</td>
<td>260 CP22EM 8080 Emulator</td>
<td>55 Octopart 4 Serial</td>
</tr>
<tr>
<td>1024K (1 Megabyte) Megaram</td>
<td>358 6MHZ Lighting 286 CPU</td>
<td>756 NV Disk 2048K Wowf</td>
</tr>
<tr>
<td>Ram 67 128K Static 100ns Chips</td>
<td>599 8 MHZ Lighting 8086</td>
<td>420 Concurrent DOS Multi-user</td>
</tr>
<tr>
<td>Octopart 8 Serial to 38.4K</td>
<td>320 Color Magic Color Graphic Board</td>
<td>220 LDP-COM Modem Program</td>
</tr>
</tbody>
</table>

**Lomas Static RAM** NEW 256K TO 1024K PRICES START AT $412

**COMPETITIVE EDGE INTEGRATED SYSTEMS**

<table>
<thead>
<tr>
<th>System</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>THUNDER 186, 4 SLOT PC STYLE CABINET, 2-5&quot; FLOPPYS, CDOS</td>
<td>$1595</td>
<td></td>
</tr>
<tr>
<td>THUNDER 186, 4 SLOT, 20 MB HARD DISK, 1-5&quot; FLOPPY, CDOS</td>
<td>2595</td>
<td></td>
</tr>
<tr>
<td>THUNDER 186, 4 SLOT, 20 MB HD, 512K, 1-5&quot; FLOPPY 4 USER</td>
<td>3195</td>
<td></td>
</tr>
<tr>
<td>THUNDER 186, 4 SLOT, 2-5&quot; FLOPPY, COLOR MAGIC, KEYBOARD</td>
<td>2250</td>
<td></td>
</tr>
<tr>
<td>6MHZ 286, 1-5&quot; FLOPPY, 1024K, 20MB HD, 10 SERIAL, 512K, 7-8 USERS</td>
<td>4695</td>
<td></td>
</tr>
<tr>
<td>6MHZ 286, 1-5&quot; FLOPPY, 1024K, 40MB HD, 1 SERIAL, 512K, 7-8 USERS</td>
<td>5295</td>
<td></td>
</tr>
<tr>
<td>8MHZ 286, 1-5&quot; FLOPPY, 1024K, STATIC, 40 MB HD, 10 SERIAL, 7-8 USERS</td>
<td>7550</td>
<td></td>
</tr>
<tr>
<td>8MHZ 286, 1-5&quot; FLOPPY, 512K STATIC, 40 MB HD, 2 SERIAL &amp; 80287</td>
<td>6495</td>
<td></td>
</tr>
<tr>
<td>8MHZ 8086/8087, 1-5&quot; FLOPPY, 512K DRAM, 20 MB HD, 2 SERIAL CDOS or MSDOS</td>
<td>3695</td>
<td></td>
</tr>
<tr>
<td>8MHZ 8086/8087, 1-5&quot; FLOPPY 1024K 120MB HD 10 SERIAL SLOT 7-8 USERS CDOS</td>
<td>7295</td>
<td></td>
</tr>
</tbody>
</table>

**COMPETITIVE EDGE INTEGRATED SYSTEMS**

<table>
<thead>
<tr>
<th>System</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>8MHZ 286 SYSTEM</td>
<td>$5495</td>
<td>10MHZ 8086-85/88 SYSTEM</td>
</tr>
<tr>
<td>8MHZ 286 &amp; 512K STATIC RAM</td>
<td>85/88 CPU &amp; 128K STATIC</td>
<td></td>
</tr>
<tr>
<td>9 SERIAL PORTS, 551 &amp; IO3</td>
<td>4 SERIAL PORTS &amp; 1 PAR</td>
<td></td>
</tr>
<tr>
<td>ONE 5&quot; FLOPPY &amp; 40MB HARD DISK</td>
<td>SYSTEM SUPPORT &amp; IO4</td>
<td></td>
</tr>
<tr>
<td>DISK 1A &amp; DISK3 CONTROLLERS</td>
<td>TWO 5&quot; FLOPPY.</td>
<td></td>
</tr>
<tr>
<td>CONCURRENT DOS 8-16 MULTI-USER</td>
<td>CP/M 8-16 &amp; 16BIT</td>
<td></td>
</tr>
<tr>
<td>15 SLOT CABINET, 30 AMPS + 8</td>
<td>15 SLOT CABINET</td>
<td></td>
</tr>
<tr>
<td>EM6860 SOFTWARE 8 BIT EMULATOR</td>
<td>5&quot; FLOPPY WILL READ IBM</td>
<td></td>
</tr>
<tr>
<td>OPTIONAL 8MHZ 286 SLAVES</td>
<td>SYSTEM upgradeable to multi-user &amp; Z80 slaves all</td>
<td></td>
</tr>
<tr>
<td>COMPONENT ASSEMBLED &amp; TESTED TOGETHER, ALL INTERNAL CABLES SUPPLIED</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8MHZ 286 SYSTEM AS ABOVE BUT 80 MB HD INSTEAD OF 40 MB HD</td>
<td>$5095</td>
<td>10MHZ 8086 SYSTEM</td>
</tr>
<tr>
<td>AS ABOVE BUT 80 MB HD INSTEAD OF 80 MB HD &amp; ONE FLOPPY</td>
<td>SAME AS ABOVE BUT 40 MB HD &amp; ONE FLOPPY</td>
<td></td>
</tr>
<tr>
<td>ALL PRICES SUBJECT TO CHANGE — SHIPPING EXTRA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

IBM is a registered trademark of International Business Machines. CP/M, Concurrent DOS are registered trademarks of Digital Research Inc. MSDOS is a trademark of Microsoft. All above circuit board names are either registered trademarks or Trademarks of Viasys Corporation. CompuPro is a registered trademark of Viasys Corporation.

NO EXTRA CHARGE FOR VISA OR MASTER CHARGE
INTRODUCING

VELOCITY 286-8™
VELOCITY 286-10™
A T™ COMPATIBLE

8 MHz 80286
10MHz 80286
1024K on MOTHERBOARD

16 BIT HARD DISK TRANSFERS
SERIAL, PARALLEL, CLOCK

HERCULESTM Compatible Monochrome or Color Card
1.2 MB Floppy, A T™ Compatible Keyboard, DOS 3.1

20 MEGABYTE FAST HARD DISK

PRICES START AT $2995
DEALER & QUANTITY PRICING AVAILABLE

SHIPPING NOW!!!

— OPTIONS —
80287 Math CoProcessor
Enhanced Graphics Adapter
30 to 100 MB Hard Drives
20 to 100 MB Streaming Tape Back (2 minutes per 10 MB)
CPM®/Z80H Emulator Card Only $395.00
8MHZ 8088 Slaves (up to 31) for Multi-User
3 MB Memory Expansion Only $595.00
Monochrome & Color Monitors
NO EXTRA CHARGE FOR VISA OR MASTER CHARGE

CPM is a registered trademark of Digital Research Inc. Hercules is a trademark of Hercules. A T is a trademark of International Business Machines. Velocity 8 and are a trademark of Competitive Edge.
Upgrade Your IBM PC®, XT™, or AT™

MAKE IT GO FASTER (PC OR XT) WITH TURBO ACCEL-286
512K — $895. 1024K — $995.

RUN CPM® 2.2 SOFTWARE ON YOUR PC, XT, OR AT WITH TURBOSLAVE PC
395.

NETWORK PC'S, XT'S, AND OR AT’S WITH EARTH NET, ARCNET BOARDS
395.

SOFTWARE FOR EACH EARTHNET BOARD
149.


ADD A 20 MEGA BYTE HARD DISK TO YOUR PC LOW POWER 15 WATT HD
499.

ADD A STREAMING TAPE 10MB PER 2 MINUTES TO PC, XT, OR AT 20MB
695.

MONITORS
AMDEX 310A AMBER $159.
NEC JB-1285DA AMBER 125.
PRINCETON MAX-12 169.
PRINCETON VX-12 459.
PRINCETON VX-12E 530.
PRINCETON SR-12 599.

FLOPPY DRIVES
TOSHIBA 360K /PC
TOSHIBA 360K /AT
TOSHIBA 1.2 MB/AT
MITSUBISHI 360K
MITSUBISHI 1.2 AT
HD/ FLOPPY CABINET

GENERIC BOARDS
HI RES MONO/GRAPHIC/PAR
STD/COLOR CARD W/PAR
STD/COLOR CARD
PBS 7PAK 384K
MF3000/AT OK TO 3MB P/S

ADD A 20 MEGA BYTE HARD DISK TO YOUR PC LOW POWER 15 WATT HD
499.

MONITORS
AMDEX 310A AMBER $159.
NEC JB-1285DA AMBER 125.
PRINCETON MAX-12 169.
PRINCETON VX-12 459.
PRINCETON VX-12E 530.
PRINCETON SR-12 599.

FLOPPY DRIVES
TOSHIBA 360K /PC
TOSHIBA 360K /AT
TOSHIBA 1.2 MB/AT
MITSUBISHI 360K
MITSUBISHI 1.2 AT
HD/ FLOPPY CABINET

GENERIC BOARDS
HI RES MONO/GRAPHIC/PAR
STD/COLOR CARD W/PAR
STD/COLOR CARD
PBS 7PAK 384K
MF3000/AT OK TO 3MB P/S

QDP VIVA 640 x 400 Silver Board $1295. — VIVA GOLD 1024 x 1024 $2295.

VIVA CARD Makes Hi-Performance Graphics possible using NEC 7220 for AUTO CAD™ etc.

COMPLETE TURBODOS SYSTEMS AND COMPONENTS

EARTH TURBO ACCEL-286 8MHZ 512K $895. — 1024K $995.
EARTH TURBO SLAVE PC RUN CPM 2.2 ON PC Z80H — $395.

XT CLONE 640 K QUANTITY ONE $895.
XT Clone includes Parallel, Serial, Hi Res Mono Graphic Card, One 360K Drive

DEALER AND QUANTITY PRICING AVAILABLE

IBM, AT, PC, XT, ARE EITHER TRADEMARKS OR REGISTERED TRADEMARKS OF INTERNATIONAL BUSINESS MACHINES. CPM, CODS, CCDOS ARE REGISTERED TRADEMARKS OF DIGITAL RESEARCH INC. SYSTEMASTER, SYSTEMASTER II, HOC ARE REGISTERED TRADEMARKS OF TELETEK ENTERPRISES INC. AUTO CAD IS A TRADEMARK OF AUTO DESK INC.
Implementing PC-DOS on Non-IBM Compatible Computers

By Christopher Cochran & Kristofer Sweger

©1985 Christopher Cochran & Kristofer Sweger

This is the concluding part of an article we began in the previous issue. Part I discussed the DOS, BIOS and startup module structures, BIOS initialization, ROMBIOS emulation, and the built-in device driver chain. It also included several references and the author biographies. We apologize for not including Figure 1, Tables 1, 2 and 3 and the listings, in part I, where they really belong.

Implementation Strategy

We recommend that for your first BIOS you:

• Develop the Startup Module first. If this tedious task gives you too much trouble, give up. This module must operate correctly for the system to come up at all.

• Implement a minimum system. A minimum system includes one floppy disk driver, a console, and dummy PRN, AUX and CLOCKS devices. This will be easier to debug than a full-blown system. Once the minimum system is working, you can proceed to add what you really want.

• Write your code in a straightforward way and don't worry about efficiency until you have the system working reliably.

After you have prepared your first complete BIOS, the tricky work has just begun. You must now get your PC-DOS system running reliably. To accomplish this requires that you:

• Establish a method for loading the BIOS and IBMDS.COM files into known locations in memory, then jump into the BIOS;

• Prepare a DOS-readable diskette with COMMAND.COM and the other PC-DOS system utilities on it so that the Startup Module can load COMMAND.COM and transfer control to it; and

• Get the DOS working by debugging the loader, initialization and startup processes, and by testing all DOS commands and utilities.

Loading System Into Memory

To appreciate how the BIOS components interact when the system is booted and finally reaches its operational state, we have provided below a condensed account of the sequence of operations that takes place whenever the system is loaded into memory:

1. The CPU jumps to the boot ROM at the reset address of FFFF:0000.

2. The boot ROM loads some fixed region of the boot disk (usually the first few sectors) containing a boot-strap loader into memory that is out of the way, and then starts the loader by jumping to it. If you want your DOS system to start in this manner, you will have to write a loader and place it on the reserved sectors of your boot disk.

3. The loader now brings the two system files (BIOS and DOS) into memory with the BIOS at 0070:0000 and the DOS somewhere above it that is also known by the BIOS. If your boot ROM or loader need to be modified to support PC-DOS, you can replace steps (1) through (3) with a loader program which runs under control of your development operating system, and defer the ROM changes or loader rewrite until after you have a working DOS system.

4. The loader then jumps to address 0070:0000 to start the initialization process. The loader has no further purpose at this point. The BIOS will reside at location 0070:0000 from now on.

5. The BIOS initialization now begins by determining how much memory is available to the system, calls the ROMBIOS initialization routine (if any), performs any other required initialization, and then jumps into the special, independent DOS Startup Module that occupies memory only during the startup phase.

6. The Startup Module, located at the end of the BIOS but before the DOS, begins by moving itself up to approximately 4k below the end of memory. From this vantage point, it can orchestrate the remaining startup tasks without being overlaid.

7. Knowing where the DOS image (IBMDS.COM) was loaded into memory back in step (3), the Startup Module moves the DOS down to its final residence above the BIOS. The BIOS will vary in size and during its initialization may also reserve some memory immediately after its code region. Therefore the Startup Module has to know where the BIOS or its reserved memory (if any) ends so that it can move the DOS to the first free paragraph address above it.

8. With the DOS in place, the Startup Module calls the base offset of the DOS so it can perform its own initialization, which sets up various interrupt vectors that interface with the DOS, the most important of which is INT 21h. The DOS also initializes all of the devices that are built into the BIOS by calling command 0 for each device driver. The DOS then returns the address of a major internal data structure to the Startup Module so that subsequent startup operations may alter the contents of the data structure.

9. The Startup Module continues on to allocate all free memory to itself, and determines the initial default drive for the DOS. It then searches this drive for
the presence of the CONFIG.sys file that describes any custom configuration options to be installed. If found, the entire CONFIG.sys file is processed at this time by the Startup Module.

(10) The Startup Module next constructs final file handle, FCB and disk buffer tables located just above the end of the last attached device driver, or after the DOS image if no drivers were added, and then releases all unused memory to the DOS.

(11) Now that all devices are known and initialized, and all the major DOS tables have been built, the standard devices are opened as device 'handles', i.e. console input, console output, error message output, printer output, and auxiliary output.

(12) The command shell is then located (usually from file COMMAND.com) and loaded as an ordinary program. After providing a suitable command string to the shell that tells it the default path and the name of the command shell, the last act of the Startup Module is to jump to the command shell which then takes over and moves itself to high memory.

(13) The command processor then locates AUTOEXEC.bat from the default drive and, if found, executes the batch file or, if not found, requests the data and time and displays the command shell sign-on message. In either case, the system prompt follows and the system is ready to accept commands from the console.

The memory map in Figure 2 shows the complete layout after the system reaches its operational state.

Preparing DOS-Readable Diskettes

Access to differing media types is controlled in PC-DOS by a table known as the BIOS Parameter Block (BPB), which tells the DOS what sector size, capacity, and other parameters the media type has. Table 4 contains recommended BPB values for a variety of 8" and 5.25" floppy diskette types. You should write your floppy disk drivers to conform to these specifications. Conforming to standard BPBs makes it possible for you to exchange data and programs with others who use the same diskette formats. This will be a critical factor in determining the utility of your DOS system.

Notice in Table 4 that every BPB has only one reserved sector. It is on this single sector that you must place your loader program if you want a diskette to be directly bootable, since the second and subsequent sectors of each diskette are used for the file allocation tables (FATs) and the diskette root directory. Table 4 also shows the first available sector number on a diskette where you can store your BIOS image and IBM/DOS.com system files for the loader program to find them. If you do store the system as the first files, you must also be sure that the FAT locations corresponding to the sectors used are marked as allocated. (Copying the files into place on an empty diskette with PC-DOS will do this.)

When stepping through the memory image, view what you see as if it has a base address of 0070:0000. Your debugger will actually place it at XXXX:0100, so you must account for this in what you see.

The memory map in Figure 2 shows the memory configuration after system finishes boot process.
entry for the file (including correct file size and first cluster number), and you must also create all the 12-bit FAT entries for the file's chain of clusters. The format of PC-DOS directory entries is described in the IBM DOS Technical Reference as are file's chain of clusters. The format of as you have COMMAND.com on your FAT. Needless to say, the whole exercise to specific floppy disk sectors. As soon development system supports direct access will be impossible unless your development system supports direct access to specific floppy disk sectors. As soon as you have COMMAND.com on your system disk, you can try to get the DOS to come up.

Another problem you will face if you can't directly read IBM-PC diskettes is getting the DOS utilities onto your system disk. One way to do this is to write two programs. The first runs under your development system and loads the name, size and contents of a file into an area of memory that won't be altered by booting PC-DOS. The other program is designed to run under PC-DOS and saves this memory area to a file on disk. You will have to transfer the second program to a DOS diskette in a manner similar to COMMAND.com. You then do the following once for each file to be moved: boot your development system, load a PC-DOS utility file into memory, boot PC-DOS, save the file in memory to disk, etc.

Getting The System To Work
So now you have a complete BIOS, and it, plus IBMDOS.com, COMMAND.com and a loader are on a PC-DOS readable diskette. The time has come to get the system working. To do this, proceed with the following eight steps:

1. Make sure your loader process works correctly;
2. Make sure your BIOS initializes itself and enters the startup module (print a signon to confirm this and the fact that your console works);
3. Get the startup process to complete successfully with a COMMAND.com signon. Don't use a CONFIG.sys or AUTOEXEC.bat file until the system is reliable without them. Add trace code to the BIOS drivers to show each function call from the DOS and leave the trace in until you are certain that each driver is working properly. Tracing the BIOS driver calls is a major aid in debugging the system. You may need to add tracing to the startup module to find out where this process fails if it does;
4. Test all built-in DOS commands. Copy lots of files to see if your floppy drivers are working;
5. Test the batch and AUTOEXEC.bat facilities, as they can aid in testing;
6. Place the DOS utilities on your system disk. Make sure DEBUG.com works, since it may help you with future debugging;
7. Test CONFIG.sys; and
8. Test all the utilities. If any fail, it is probably due to bugs in your drivers.

You now have a working copy of PC-DOS running on your computer. It should be a straightforward task to complete your I/O system (add more devices, clock, etc.) now that the minimal system is running.

Extensions To Your Completed System
Once your system is complete, you have the freedom to experiment with some extra features that can make your system superior to the IBM-PC implementation. One of the real benefits in porting the DOS to your machine is that you have the source code under your own control, which opens many possibilities that would otherwise have been unavailable. Listed below are some of the extensions we have added to
our own S-100 implementation plus a few others that you might consider:

Extensions to the block devices - Fully support all the 8" and 5.25" formats so that you can exchange data with a wide variety of systems via floppy. Automatic detection of disk changes and recognition of newly inserted disks go along with this.

Data transfers with floppy disks can be significantly optimized by reading the sector IDs on-the-fly to determine the instantaneous disk position. Full track transfers can then begin from any sector instead of wasting time waiting for the beginning of the track before beginning the transfer.

By supporting the system boot process from more than one drive, hardware problems with your main drive cannot prevent your system from booting.

The subdirectory facilities in MS-DOS provide outstanding control over large numbers of files. Supporting a hard disk is not difficult and has enormous advantages over floppies. It can sometimes be useful to divide a large hard disk into several partitions, eg. two for CP/M and one for MS-DOS. Booting from any of these partitions and booting the hard disk from a floppy are facilities that should be considered. Some automatic mechanism for retracting the disk heads away from the file allocation table (FAT) and root directory during idle periods can provide an extra level of protection.

Virtual disks (ie. disk drives emulated in RAM) can be easily supported under MS-DOS, usually as an attached driver. Avoid using your real system memory for this because many applications are now written to take full advantage of the 8086 address space and may not run in severely reduced memory environments.

Character device handling - You can directly support all the devices that are installed in your system, because the DOS can have virtually any number of devices. Say goodbye to the CP/M limitation of a console, list device and one auxiliary device.

Recently, IBM-PC compatible video boards for the S-100 bus have been announced by several manufacturers. By properly supporting one of these in your emulated ROMBIOS, you will be able to run virtually all programs that require an IBM-PC compatible display. Detection of ANSI control sequences on output allows you to run programs designed for the IBM-PC ANSI.sys driver.

The IBM-PC keyboard returns a binary zero followed by a non-zero code whenever a function key or other special key is struck. You could alter your console input driver to emulate this feature, whether you have an IBM-compatible keyboard or not. You could also translate single keys into arbitrary multi-key sequences, so you could enter whole commands with a single keystroke.

Interrupt-driven buffered I/O can allow you to type ahead or accept serial input while your programs are doing something else, and can empty an output buffer at a pace determined by the output device after your program has gone on to other tasks. XON/XOFF flow control can start and stop input or output operations automatically.

There is no reason why the device driver header cannot be extended to include additional custom data fields, such as baud rate, port addresses, initialization sequences, interrupt configuration, test and data masks, flow control method, stop bits, word length, device redirection, etc.

If all your devices conform to the same standard extended header, you will be able to treat all devices in a consistent manner with virtually the same driver code for all. You also can develop a configuration utility which modifies selected fields for any device to change subsequent device behavior without reprogramming. In addition, the IOCTL feature can be used to change baud rates, etc. on the fly.

### Table 1c

<table>
<thead>
<tr>
<th>File Name</th>
<th>DOS Versions</th>
<th>ROMBIOS Calls</th>
<th>Program Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANSI.sys</td>
<td>2.0 2.1 3.1</td>
<td>10h 11h 16h</td>
<td>ANSI screen driver</td>
</tr>
<tr>
<td>BASIC.com</td>
<td>2.0 2.1 3.1</td>
<td>10h 15h</td>
<td>Basic Interpreter</td>
</tr>
<tr>
<td>BASICA.com</td>
<td>2.0 2.1 3.1</td>
<td>10h 11h 15h</td>
<td>&quot;Advanced&quot; Basic Interpreter</td>
</tr>
<tr>
<td>DATE.COM</td>
<td>2.0 2.1 3.1</td>
<td>10h 13h 15h</td>
<td>Format hard disk</td>
</tr>
<tr>
<td>FNAME.COM</td>
<td>2.0 2.1 3.1</td>
<td>10h 11h 13h</td>
<td>Format floppy diskettes</td>
</tr>
<tr>
<td>GRAPTRBL.COM</td>
<td>3.1</td>
<td></td>
<td>Graphics character table</td>
</tr>
<tr>
<td>GRAPHICS.COM</td>
<td>2.0 2.1 3.1</td>
<td>10h 17h</td>
<td>Print screen on dot-matrix printer</td>
</tr>
<tr>
<td>IBMBIO.com</td>
<td>2.0 2.1 3.1</td>
<td>10h almost all</td>
<td>DOS BIOS for the IBM PC</td>
</tr>
<tr>
<td>KEYBFR.COM</td>
<td>3.1</td>
<td>15h 16h 18h</td>
<td>French keyboard</td>
</tr>
<tr>
<td>KEYBG.COM</td>
<td>3.1</td>
<td>15h 16h 18h</td>
<td>German keyboard</td>
</tr>
<tr>
<td>KEYVID.COM</td>
<td>3.1</td>
<td>15h 16h 18h</td>
<td>Italian keyboard</td>
</tr>
<tr>
<td>KEYISP.COM</td>
<td>3.1</td>
<td>15h 16h 18h</td>
<td>Spanish keyboard</td>
</tr>
<tr>
<td>KEYIT.COM</td>
<td>3.1</td>
<td>15h 16h 18h</td>
<td>British keyboard</td>
</tr>
<tr>
<td>MODE.COM</td>
<td>2.0 2.1 3.1</td>
<td>10h 14h 17h</td>
<td>Set baud rate parity etc.</td>
</tr>
<tr>
<td>SELECT.COM</td>
<td>3.1</td>
<td>11h</td>
<td>Select keyboard layout</td>
</tr>
<tr>
<td>SYS.COM</td>
<td>2.0 2.1 3.1</td>
<td>10h 11h 13h</td>
<td>Copy DOS to a diskette</td>
</tr>
</tbody>
</table>

### Table 2

<table>
<thead>
<tr>
<th>Interrupt Number</th>
<th>Implementation Difficulty</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>10h</td>
<td>Moderate</td>
<td>Video Display</td>
</tr>
<tr>
<td>11h</td>
<td>Difficult</td>
<td>Equipment check</td>
</tr>
<tr>
<td>12h</td>
<td>Trivial</td>
<td>Memory check</td>
</tr>
<tr>
<td>13h</td>
<td>Moderate</td>
<td>Diskette/hard disk</td>
</tr>
<tr>
<td>14h</td>
<td>Moderate</td>
<td>Communications</td>
</tr>
<tr>
<td>15h</td>
<td>Moderate</td>
<td>PC/AT process switching</td>
</tr>
<tr>
<td>16h</td>
<td>Moderate</td>
<td>Keyboard</td>
</tr>
<tr>
<td>17h</td>
<td>Simple</td>
<td>Printer</td>
</tr>
<tr>
<td>18h</td>
<td>Not Needed</td>
<td>Resident Basic</td>
</tr>
<tr>
<td>19h</td>
<td>Not Needed</td>
<td>Bootstrap</td>
</tr>
<tr>
<td>1Ah</td>
<td>Moderate</td>
<td>Timer</td>
</tr>
<tr>
<td>1Bh</td>
<td>Trivial</td>
<td>Keyboard break</td>
</tr>
<tr>
<td>1Ch</td>
<td>Not Needed</td>
<td>Timer tick</td>
</tr>
<tr>
<td>1Dh</td>
<td>Not Needed</td>
<td>Video initialization</td>
</tr>
<tr>
<td>1Eh</td>
<td>Not Needed</td>
<td>Diskette parameters</td>
</tr>
<tr>
<td>1Fh</td>
<td>Not Needed</td>
<td>Video graphics characters</td>
</tr>
</tbody>
</table>

Timer Tick Interrupt - The IBM-PC increments a counter located in the ROMBIOS data area at the rate of 18.2 times per second. This timing source is used by some programs and can be useful in custom applications involving time slices. ROMBIOS interrupt 1Ah may be used to set or retrieve the current counter value.

Additional CONFIG.sys Options - Since you have the source to the Startup Module, you have the freedom to add features to it, such as loading the system files (CONFIG.sys and the command shell) from a subdirectory instead of the root. You can also expand the CONFIG.sys capabilities by recognizing and processing additional commands. Consider some of the following:

(a) Change the names of the standard devices.
(b) Specify the drive and subdirectory path to come up in.
(c) Echo CONFIG.sys commands as they are executed (for debugging).
Utilities we have written and found useful:
- INTERDOS - CP/M to/from PC-DOS file transfer.
- CONFIGIO - change system configuration without re-assembling.

COPYHF - copy hidden files.
REFORM - Non-destructive hard disk re-formatter.

Background Processing - Limited background processing capabilities that you might find useful include: file transfers to and from a modem; background dispatching of I/O among devices (pass-thru); emulation of the DOS 3.1 network capabilities using serial, RS422, SDLC or other available hardware.

We are very interested in hearing about your experiences getting PC-DOS to run on your computer and your ideas for extensions. We can be reached at: Box 378, Larkspur, CA 94939. Our PC-DOS implementation for CompuPro computers is currently distributed under the name "PC-PRO" by Computer House, Inc., Box 709, Woodacre, CA 94973. Address PC-DOS inquiries for other computers directly to us.

EDITOR'S NOTE
We have gotten very favorable feedback from a large number of readers on the first installment of this series on implementing PC-DOS on non-IBM compatible systems. Fred Greeb, 8403 W. Iliff Lane, Lakewood CO 80227, (303)986-6651 is publishing a newsletter titled "Generic PC-DOS Newsletter" devoted to implementing and running PC-DOS on non-IBM systems. Send Fred a stamped, self-addressed business size envelope to receive a free sample copy. As we pointed out in the last issue, Fred has implemented MS-DOS on his S-100 system by writing a BIOS and suitable loadable device drivers. He has written a small book on the subject. It includes a complete, well documented, BIOS. A copy, on disk, can be obtained by sending him $15.

Readers should also be aware that Computer House (see ad in this issue) sells an implementation of PC-DOS Version 3.1 for CompuPro S-100 systems. This is a complete, ready-to-run system that takes most of the work out of getting PC-DOS running on a CompuPro S-100 system.

Also, we would like to point out that S-100 system owners can get a very high level IBM-PC compatibility by constructing the intelligent keyboard described in this issue and the S-100 to PC bus interface described in the May/June 1985 issue (check page 94 for ordering information). Using the latter interface, S-100 users can interface to low-cost PC color graphics and disk controller cards (providing there are no address or interrupt conflicts). Thus, with an IBM PC compatible keyboard, disk system and display and running MS-DOS, S-100 users can run many of the programs written for the IBM PC.

---

Table 3

<table>
<thead>
<tr>
<th>INTERRUPT 2IH CALLS USED IN STARTUP MODULE</th>
<th>Plus Other Undocumented Int 2ih Calls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function(All)</td>
<td>Description</td>
</tr>
<tr>
<td>09h</td>
<td>Display string DS:DX on console.</td>
</tr>
<tr>
<td>0Ah</td>
<td>Select drive DL as default drive.</td>
</tr>
<tr>
<td>19h</td>
<td>Return current default drive number in AL.</td>
</tr>
<tr>
<td>25h</td>
<td>Set vector for interrupt AL to address DS:DX.</td>
</tr>
<tr>
<td>*32h</td>
<td>Check drive DL (1=A, 2=B, etc) for validity. Return AL with error code (0=OK, FFh=error), and DS:DX pointing to memory structure in DOS. For example, DS:18[8] points to device driver header of drive DL.</td>
</tr>
<tr>
<td>33h</td>
<td>Get or set state of Ctrl-Break check.</td>
</tr>
<tr>
<td>*37h</td>
<td>Perform variety of operations depending on value in AL: 0 - Read switch character into DL. 1 - Set switch character to character in DL.</td>
</tr>
</tbody>
</table>

Other even values in AL read other system parameters into DL and their corresponding odd values set same parameter to value in DL.

38h | Get or set current country type. |
39h | Open a device or file and return its file handle in BX. |
3eh | Close open file or device specified by handle in BX. |
3fh | Read from a file or device specified by handle in BX. |

42h | Obtain file size or position file pointer. |
44h | Determine status of an open handle (file vs. device). |
45h | Duplicate a file handle. |
46h | Allocate BX paragraphs of memory in one block. |
49h | Free memory block allocated at segment ES. |
4Ah | Modify size of allocated block at ES to BX paragraphs. |
46h | Load an overly or execute a program. |
*50h | Unknown DOS INT 2ih function. |
*52h | Return a pointer to a DOS data structure in ES:BX. |
*53h | Unknown DOS INT 2ih function, possibly having something to do with setting a BPB pointer in DOS (OS:S1). |

All INT 2ih function calls for Startup Module are listed above, plus several undocumented INT 2ih calls we have identified. See DOS 3.1 Technical Reference Manual or equivalent for complete information. Function numbers marked with asterisks (*) are not documented in available DOS documentation. Their descriptions above have been determined through careful analysis.

Table 4

<table>
<thead>
<tr>
<th>FLOPPY DISK BIOS PARAMETER BLOCKS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BPB Field</strong></td>
</tr>
<tr>
<td>Bytes/sector</td>
</tr>
<tr>
<td>Sectors/allocation unit</td>
</tr>
<tr>
<td>No. of reserved sectors</td>
</tr>
<tr>
<td>No. of FATs</td>
</tr>
<tr>
<td>No. directory entries</td>
</tr>
<tr>
<td>Total sectors on media</td>
</tr>
<tr>
<td>Media byte value</td>
</tr>
<tr>
<td>Sectors per FAT</td>
</tr>
<tr>
<td>Sectors/track</td>
</tr>
<tr>
<td>Sectors for directory</td>
</tr>
<tr>
<td>Sector addr of 1st file</td>
</tr>
</tbody>
</table>

MicroSystems Journal March/April 1986
Following routine will return register DX with top memory paragraph available:

TOPMEM: MOV DX,1000H ;Begin search at 1000:0000 (64k)
XOR DX,DX
PUSH ES
NEXTRY: INC DX ;Advance to next paragraph
JZ RETTOP ;Done if memory wrap-around (Pull Moyte)
MOV ES,DX
MOV AX,ES:[BX] ;AX = memory contents
NOT Word ptr ES:[BX];Modify memory contents
CMP AX,ES:[BX];Test to see if modify took place
JNE NEXTRY ;Memory changed, so try next paragraph
RETTOP: DEC DX ;Backoff to prior paragraph
POP ES ;Restore ES
RET

Routine requires modification if a memory-mapped video board lies immediately beyond physical end of memory, as it does on IBM-PC. It is important to leave memory unchanged by search to avoid modifying DOS or any other memory-resident structure you may have now or in future.

Listing 2

Public Parameters In DOS 3.1 Startup Module

Address  Code  Label  Opcode  Operands
0000  STARTUP SEGMENT PARA
0000  ES 00F3 SYSINIT: ORG 0
0000 0000 LOADER DOS LOCN: JMP MOVINIT ;Jump over data area
0003 0000 FINAL DOS LOCN: DD 0 ;DOS loader offset and segment
0007 0000 DEVICE LIST: DD 0 ;End of BIOS where DOS will go
000B 0000 MEMORY SIZE: DD 0 ;Start of device chain
000F 0001 DEFAULT DRIVE: DW 1 ;Memory size in paragraphs
0011 00 00 DEFAULT DRIVE: DB 0 ;Initial default drive number
0012 0002 NUMBER BUFFERS: DW 2 ;Number of sector buffers
0014 00 00 NUMBER FILES: DB 8 ;Max. number of handles
0015 00 04 NUMBER FCBS1: DB 4 ;FCBS = 1st parameter
0016 00 00 NUMBER FCBS2: DB 5 ;FCBS = 2nd parameter
0017 00 05 LAST DRIVE: DB 5 ;Highest acceptable drive no.

; More working data variables go here

G0F3 ORG 00F3H
G0F3 PC MOVINIT: CLD
; Body of startup code goes here, followed at
; end by messages & other character string data
G0F4 STARTUP ENDS

Note: Locations and presence of these PUBLIC variables may vary for DOS versions other than 3.1, as will the offset address of MOVINIT and the total size of the Startup Module.
PORT-A-SOFT
Aardvark to Zorba
We Can Handle It

TRANSFER PROGRAMS, DATA AND OTHER FILES BETWEEN OVER 400 COMPUTERS!

13 OPERATING SYSTEMS
WORD PROCESSORS TOO!!

Prices From $7.00 Per Disk
Software and Hardware So You Can Do Your Own

Call or write today for your FREE CATALOG
P.O. BOX 1685 555 S. STATE, STE. 12
OREM, UT 84058 (801) 226-6704

CP/TREE

Tree-Structured Named Directories for CP/M 2.2
- Transforms user areas into Unix-like directories
- Provides Unix-like directory commands:
  - CD, MKDIR, PWD, RMDIR, TREE
- Includes a CCP replacement featuring:
  - Command and file search path. Use programs like
    WordStar from any directory!
  - Erase with query
  - Wildcard rename with query
- Provides output redirection to disk file
- Uses as little as ½ k RAM, never more than 2½ k
- A must for hard disks
- Installs easily: requires no modifications to BDOS or BIOS
- Requires standard CP/M 2.2 (not 3.0 or Apple), Z80, 48k RAM

$29.95 plus $4.00 s&h

To order: Specify disk format (8" SSDD, NorchScar DO. Call for info on others.) MC, Visa, COD (add $1.90), check (delays shipping 2 weeks). MA residents add 5% sales tax. POs not accepted.

Precise Electronics
P.O. Box 339
New Town Branch
Boston, MA 02258
tel: (617) 332-3977


For $100 bus by S. C. Digital, Inc.

256 K/1M DYNAMIC RAM Board Model 256KM-512 $375
- 256K/1M bytes using 64K or 256K DRAMs
- 8/16b data • 24b Address
- Parity per byte • 175ns access time • runs on 780/28000 to 6mb,8000, 83186, 80000 to 1mb without wait states • transparent refresh, unlimited DMA
- with 512Kx using 256Kx drams.

256K/1M DYNAMIC RAM Board Model 256KB-256 $325
- 256K/1M bytes using 64K or 256K DRAMs
- 8b-data • 16 or 24b address
- parity per byte • Memory mapping in 16K blocks • 175 ns access time • Addressable in 128K, 192k, or 256k boundaries, compatible with Z-100™ systems
- with 256x using 256Kx drams, expandable to 1 mega byte, less memory mapping • add 520 for memory mapping.

FLOPPY DISK CONTROLLER Board Model FDC-1 $325
- Single or double density, sides, in any combination of up to four 8" or 5½" drives
- Digital phase-locked loop • DMA data transfer with cross 64K boundaries, 24b address. DMA arbitration • built in monitor/boot EPROM that accommodates two different processors • serial port to 19.2K baud • uses 1655A/9272 with
  CPM bios programs

8086 CPU Board Model 8086 CPU $325
- 8/4 or 10-5 MHz 5W selectable • 8/97 interface • provision to run two processors on a bus such as our 280 CPU • convertible to 10, 12mhz clock • optimized for DRAM boards • specify clock speed.

80286 CPU Board Model 80286 CPU $326
- 8/4 MHz switchable • 8/827 interface • provision to run two processors on a bus • convertible to 8mhz • separate built in clock for 80287 • optimized for DRAM boards.

280 CPU Model 28CPCPU $249
- 6 or 8mb, specify • memory mapping in 16K blocks, addressable four M bytes.

SUPPORT Board Model Support-1 $325
- 4 serial, full handshakes, two with software programmable baud rates. • Centronics • SASI interface • Real/interval times • Calendar-clock with battery backup • expandable interrupt controllers for 8086 or 8080/286 • CPU switching to run 2 processors on a bus such as our 8086 or 80386 and 280 CPU boards.

1/0 Interface board Model 35PC-N $229
- 3 serial RS-225 with switch selectable baud rates, 110 to 19.2kbaud.
- 1 parallel.

128K STATIC RAM/EPROM Model 128KS $349
- Single or double data rate, 16 or 24b address, computer board • bank select, RAM shadowing, etc. • ROM simulation in RAM, battery back-up provision.

S-100 COMPUTER ‘System 16’ $3290
- 8086 based at 8mhz, with 512K, 5 serial ports, 1 centronics, 1 SASI, battery backed calendar clock, real time clock, interrupt driven, 10 slot card cage, two 5.25" floppy drives with 500 kb transfer rates and 1.2 mbyte storage each, with CPM-88 operating system ( Concurrent C.Wos available soon). Cabinet has room for full size 5¼" hard disk.

Operating Systems available: CPM 2.2, CPM 3.0, CPM 86, MS DOS.

**CPM is registered trade mark of Digital Research Inc. Z-100 is registered trade mark of Zenith Corporation.

Please call for latest prices.
Prices subject to change without notice.
YOU CAN’T BUY HIGHER QUALITY,
MORE RELIABLE S-100
STATIC MEMORY BOARDS
AT ANY PRICE!

CALL FOR LATEST PRICES!

STANDARD FEATURES:
- Operates in excess of 12 MHz
- Certified system ready
  (industrial grade dynamic burn in)
- Supports 8 and 16 bit data transfers
- IEEE 696/S-100 compatible
- 24 bit addressing
- Address strappable to any 128K block
  within the 16 meg address range
- Extremely low power consumption
- Single +5 volt operation
- One year warranty

OPTIONS:
- Military MIL-STD-883B type burn in
- Faster ram chips available

NO HIDDEN CHARGES! Performics Inc., prices include dynamic burn in, insurance and
UPS ground delivery within the continental U.S.

TERMS: Certified check, Visa/MasterCard Volume discounts available.
Performics continues to deliver high performance products and excellent service at realistic
prices.
S-RAM 128 and S-RAM 256 are trademarks of PERFORMICS INC.

SPECIAL OFFER
ORDER NOW!
(603) 881-8334

11 Morning Dove Rd. • Kingston, New Hampshire 03848

Micro/Systems Journal March/April 1986
**NEW**

**Z80 Symbolic Debugger**
- Only $49.95 plus shipping.
- Screen oriented with a simultaneous display of instruction mnemonics, register, stack, and memory values.
- Breakpoints may be set on any combination of fixed memory, addresses, register values and/or memory values.
- Uses Digital Research compatible SYM files.
- Supports Hitachi HD64180.

**TO ORDER. CALL TOLL FREE: 1-800-367-5134, ext. 804**
For information or technical assistance: (808) 623-6361
Specify desired 5½” or 8” format. Personal check, cashier's check, money order, VISA, MC, or COD welcomed.

P. O. Box 2151
Honolulu, HI 96805

**MITEK**

Z80 is a trademark of Zilog, Inc. MAC and RMAC are trademarks of Digital Research, Inc. Turbo Pascal is a trademark of Borland International, Inc.

---

**QPASER™**

**Translator Writing System**

**THE PRODUCTIVITY TOOL FOR SOFTWARE DEVELOPERS**

QPASER assists you in writing:
- Compilers
- Translators
- Interpreters
- Prototypes
- Simulators
- Syntax Checkers
- Data Converters
- Assemblers

QPASER is a unique LALR(1) parser generator:
Generates complete source code for your application in C, Pascal, or another language of your choice;
Extensive examples include a Pascal subset compiler, assembler, and simulator;
The widely used college text, Compiler Construction: Theory & Practice, from SRA Associates, was written by the author of QPASER
Lauded by both industrial and university users
Available for: IBM PC XT AT, DEC VAX, HP 9810, MACINTOSH
(PC System $400; Demo $10; Educational/Site Licenses available)

"LEADERS IN SOFTWARE TOOLS"

**BOBCAT**

The finest disk catalog program available for PC - DOS or CP/M

- Keeps track of files on floppies or hard disks
- Compatible with PC - DOS 2.0 or 3.0; CP/M 2.2 or 3.0
- Contains the most advanced features:
  - 65 character individual file comment line
  - 45 character individual disk title
  - ASCII BOBFIL (disk number file) storing the disk title and file comment lines. Great for quick finds or looks in each disk or directory
  - full directory and subdirectory compatibility
- File comment lines for both text and binary files
- Unprotected for ease of use
- A proven utility sold since 1981

**PRICE LIST**

Z80 Macro Assembler: $49.95
Assembler, Linker, and Library Manager: $95.00
Manual Only: $15.00
Z80 Symbolic Debugger: $49.95
Manual Only: $15.00
Assembler, Linker, Library Manager, and Debugger: $134.95
Include $5 for shipping and handling.

**ATTENTION Turbo Pascal Users:**
Assembler will generate Turbo Pascal in-line machine code include files.

**BOBCAT**

The finest disk catalog program available for PC - DOS or CP/M

- Keeps track of files on floppies or hard disks
- Compatible with PC - DOS 2.0 or 3.0; CP/M 2.2 or 3.0
- Contains the most advanced features:
  - 65 character individual file comment line
  - 45 character individual disk title
  - ASCII BOBFIL (disk number file) storing the disk title and file comment lines. Great for quick finds or looks in each disk or directory
  - full directory and subdirectory compatibility
- File comment lines for both text and binary files
- Unprotected for ease of use
- A proven utility sold since 1981

**Price:**

US Residents $49.95 US funds
Canadian Residents $49.95 Canadian funds
Other Countries $54.95 US funds
plus $3.00 postage and handling
Ontario Residents please add 7% sales tax
Extra DOS or licenses — $15.00 each to $75.00 maximum

**MASTERCARD, VISA, BANK DRAFTS, MONEY ORDERS**

**COMPANY CHECKS, PURCHASE ORDERS**

Please allow 10 days clearance for PERSONAL CHECKS

R & L Micro Services Inc.
Box 15668, Station F
Ottawa, Ontario, Canada
K2C 3S8
(613) 225 - 7904

The home of the BOBCAT
STARTER SYSTEM SPECIALS

WOW! Z-148-21 Only $1195.00
one drive, 128K
FCC-SYS148-02 only $1595.00
148, 2 drives
640K RAM
1220 or 1230 Monitor
FCC-SYS158-02 only $2099.00
158, 2 drives
640K RAM
1220 or 1230 monitor

WOW! POWERFUL WINCHESTER SYSTEMS

FCC-SYS158-11 only $2475.00
158, one floppy
11 meg half high winchester
640K RAM
1220 or 1230 monitor
With ZVM-135 color monitor only $2899.00
FCC-SYS158-25 only $2849.00
158, one floppy
25 meg half high winchester
640K RAM
1220 or 1230 monitor
With ZVM-135 color monitor only $3299.00

WOW! FREE FRAMEWORK!
with purchase of 36 meg SuperSystem!
Z158, one floppy
36 Meg winchester,
full height, 40ms access time
640K RAM
ZVM-135 color monitor only $3875.00

AUTO CAD SYSTEM
Complete workstation with plotter and digitizer

Z-158 8 Mhz
one floppy, 25 meg H/H internal
8087-2 8 Mhz
ZVM-135 monitor
AutoCAD w/ADE-1, 2, & 3
GTCO 12 x 12 4 button digitizer
DMP-41 or 42 plotter w/cable
ZVM-136 w/ Techmar GraphicsMaster
640 x 400 Color, add $ 785.00
only $9599.00

WOW! Printers with above systems:
Epson LX-90, only $259.00
Epson FX-85, only $399.00
Toshiba P-1340, only $596.00
Epson FX-185, only $549.00
Toshiba P-351, only $1225.00

We also have the two hot new machines from Zenith, the 171 and the 200! Call for our latest price and specials, as well as custom configurations on the 200 and the new 158.

Call for pricing on tape backup systems and cartridge winchester.

E MOST COMPLETE
COMPATIBLE LINE

Zenith
data systems
AUTHORIZED SALES AND SERVICE

First Capitol Computer
1-800-TO-BUY-IT (800-862-8948)
Orders and quotes
1-314-946-1968
Technical support and order status
1106 First Capitol Dr.
St. Charles, MO 63301
(314) 946-1968

FIRST CAPITOL — THE ZENITH EXPERTS!
Order direct from First Capitol Computer.
All prices pre-paid (cash, check, Mastercard or Visa).
Add 2% Shipping charge.
Missouri residents add 6.225% sales tax.
Call for purchase order terms, government, and quantity pricing.

We will meet or beat any verifiable advertised price on stock Zenith Data Systems CPU's, from any legitimate dealer.
The SANYO complete word processing system
The alternative for WANG, Xerox or any dedicated word processing system.
At Micro Supply Organization we offer the lowest prices on Sanyo computers and software. With prices like these you can afford the convenience of owning and operating more than one computer. We also offer the User Support Hotline for questions concerning your computer or about software availability. Whether you need one or a dozen computers, Micro Supply Organization is the place to get them!
The MBC 1250 Accounting Software
We carry a complete line of ADS accounting business software. Buy G/L, A/R, A/P, Inventory and receive the Payroll module FREE. The current retail price is $398. per module. Now from MSO you pay only $99 per module.

COMPT
Read, write, and format over 50 different CP/M and MS-DOS disks on your MBC 1250 CP/M computer. $79 $59 with purchase of MBC 1250

6-Bit Integrated Computer with High-Resolution Display
• Two Z-800 CPUs (main and secondary) with no-wait mode and large 64KB RAM/4KB ROM memory capacity for fast execution.
• High-resolution 640 x 400 dot matrix display with full graphics functions.
• Choice of 33-line or 40-line text mode.
• CP/M operating system with editor, assembler and all standard utilities.
• Easy-to-use Sanyo Graphic BASIC.
• Two (MBC 1250) internal double-sided, double-density, double-track, 5½" slim-type mini floppy disk drives with 640KB formatted capacity.
• Specially-designed detachable keyboard with coiled cable for easier operation.
• Interfaces for one Centronics printer one RS-232 port.

NEC PC-PR103A
Dot Matrix 110 cps
• 16 Wire printhead, 40 cps NLQ
• 80 char/line or dot-image graphics
• Centronics parallel interface
• Tractors or Friction feed
• Pica, elite condensed or proportional
• Includes printer cable & full warranty

This complete package lists for $3194.00 Computer & Printer
ONLY $899

PR 5000
Letter quality Daisy Wheel Printer
• Letter-quality printer with 96-character daisy wheel printing element
• Accepts paper up to 13 inches in width.
• 14 cpi bidirectional printing.
• 10, 12 and 16 cpi printing pitches.
• Centronics parallel interface.
• Optional form tractor.
• Includes printer cable & full warranty.
MSO
MICRO
SUPPLY
ORGANIZATION INC.

the advantage.

SANYO
MBC 550 Series
MS-DOS Computer
Complete with over $1000 of FREE Software!
• MS-DOS 2.11 • MS-DOS 1.25
• Wordstar • Spellstar • Mailmerge • Calcstar
• Infostar • Easywriter I • BASIC

80K System
with SANYO
monitor
only $899

ONLY $599 (Driveless) (without monitor)

The OWL
SANYO internal 10MB Drive
Complete with all manuals, software, and cables.

$799

Accounting Software
G/R, A/R, A/P, for small businesses with under 20 employees. Designed
for the MBC 550 in color.
Entire package only $149

SANYO internal 10MB Drive
Complete with all manuals, software, and cables.

$799

MS-DOS & CP/M
COMPUTER
MS-DOS 2.11 & CP/M 80 Computer
Two Fast Z80 A's & one 8088 - Processor

FREE Software Included
Wordstar (Wordprocessor) • Calcstar (Spreadsheet)
Data Plot + (Graphics Program)
MS-DOS 2.11 CP/M 80 operating systems
BASIC - Microsoft BASIC
Dual 64K drives CP/M - 800K Drives MS-DOS 2.11
256K RAM expandable to 512K for MS-DOS
8087 Math Processor (optional)
64K RAM under CP/M Plus 32K RAM for video
Graphics - 512x256 pixels Alpha - 24 x 80 plus attributes
SASI interface built in (works with 10 meg OWL)
2 Serial ports bi directional ASYNC & BSYNC 60K bit/sec
9" Green screen or optional external monitor

At these prices you can enjoy the convenience of owning
more than one computer!

CHOOSE THE SYSTEM THAT'S RIGHT FOR YOU!

805/393-2247

MON. - FRI. 7am - 5pm PST • SAT. 9am - 5pm PST
All systems carry full 90 day warranty. Check in advance. Add 3% for VISA/MC.
Shipping & handling charges will be added to each order.
CASH PRICE ONLY For our catalog with complete
details and prices, send $1.00 to: Micro Supply Organization, Inc.
4909 Stockdale Hwy. #180
Bakersfield, CA 93309
Part VI
Device Drivers -
Why and How

Disk Operating System (BDOS) and the
Basic Input/Output System (BIOS). The
latter normally contained ALL device
drivers for the system. These two items
were normally placed at a fixed location in
high memory when the system was
loaded.

The BDOS interfaced to the BIOS
through a jump table with entry points for
console and printer devices and a set of
disk drives (up to 16). This table normally
referenced routines contained within the
BIOS.

CP/M drivers are divided into two
types: character devices and block (disk)
devices. CP/M has distinct entry points
for character devices and a common set for
disk drives. There are no clock or null de-
vice drivers.

Builders of loadable device drivers had
to be very creative because CP/M V2.x had
no provisions for such entities. The basic
approach was to reserve memory either
above or below the BDOS/BIOS. This area
was where the device driver would be
placed by a program which initialized the
device driver. The initialization procedure
also included modification of the BIOS
jump table for those routines which were
supported by the device driver. The original
values of the BIOS jump table were
copied to specific locations in the device
driver (Figure 2).

A function request by a program would
be handed to the BDOS which would then
process the request using calls to the
BIOS jump table. A call to a modified entry
would then use one of the routines found in
the device driver. This routine would per-
form the function if it were supported by the
driver, otherwise, it would jump to the
BIOS routine originally associated with the
BIOS jump table entry point.

This approach allows multiple device
drivers to be loaded since the modification
to the BIOS jump table actually creates a
chain among the device drivers. Each
driver passes a request to the next driver,
if it does not support the request, until it
reaches the BIOS.

This chain occurs because there is
only one set of entry points for the disk
driver even though the BIOS drivers may
support only a few of the sixteen possible
drives. A device driver determines
whether it is being used by the selected
drive number.

An interesting extension of this device
driver installation method is that a loaded
device driver may interface with hardware
supported by the BIOS. In this instance,
the loaded device driver simply translates
requests to the proper BIOS requests. A
simple case would be renaming of disk
drives. The loaded device driver would
contain a table of new names for drives and
each select disk request would index this
table. The entry in the table would be the
one actually sent to the BIOS. A more
complex driver might perform translation,
sector skewing (for disks from a different
system), password protection, or data
encryption.

The disadvantage of this approach is
that some CP/M programs use system
specific information to perform functions.
For example, disk image copy programs
often overwrite BDOS which can then be
reloaded when the program terminates.
This can cause havoc if a device driver is
loaded below the BDOS but above the pro-
gram. Alternatively, programs modify
memory above the BIOS to pass param-
eters between programs. There are usually
ways of working with these problem pro-
grams but the solutions tend to be as
arcane as the programs themselves.

DEVICE DRIVERS WITH MS-DOS
V1.x

MS-DOS V1.x is functionally
identical to CP/M. The major differences
are the placement of the operating system
and the larger memory access space. Un-
lke CP/M, MS-DOS is loaded in low
memory just above the interrupt vector
table. Programs are then loaded above this
point. Like CP/M, MS-DOS is divided into
two parts with a common operating system
segment and machine specific I/O segment
which correspond to the CP/M BDOS and
BIOS.

Creating a device driver for the 8086/88
is simpler than for CP/M because the pro-
gram code relocation problem associated
with an 8080/Z80 system is overcome by the segmentation scheme employed by the 8086/88.

Installation of a device driver is the same as with CP/M, only the memory locations have changed. A program leaves the device driver in a reserved location of memory, normally just above MS-DOS or at the end of memory. This area is reserved by changing limit locations within MS-DOS. The installation program must also modify the I/O jump table.

This method has the same problems and advantages the CP/M device drivers have. However, the larger address space of the 8086/88 makes adding drivers less painful since drivers tend to be about the same size on either system. Losing 2Kbytes to a device driver on a 256Kbyte 8086/88 system is better than losing 2Kbytes on a 48Kbyte CP/M system.

**DEVICE DRIVERS WITH MS-DOS V2.x & LATER**

MS-DOS V2.x (and later) support a standard interface for installable device drivers. These drivers are loaded at boot time by the operating system and have a special format. Special installation programs are not required although device drivers can have initialization code. The major advantage of this approach is the consistency of the device drivers. A device driver written for MS-DOS V2.0 should work just as well under MS-DOS V2.1 since the operating system to device driver interface remains the same.

The method used for building CP/M and MS-DOS V1.x device drivers normally requires modifications to work with different versions of an operating system. This occurs because the installation program must modify locations within the operating system which are version specific. Although these locations and values may remain the same between versions, they often do not.

Even so, device drivers can be installed using either approach using MS-DOS V2.x but the standard method is preferred. This section will discuss the general operation of the standard device driver interface to MS-DOS.

A standard device driver is linked as a .COM file with an origin of 0 instead of the normal 100 hex. The file name extension is normally .SYS instead of .COM which prevents inadvertent execution of the driver as a program. This file is placed on the boot disk along with a configuration text file named CONFIG.SYS. The configuration file is read by MS-DOS when it boots and sets up the system using the parameters specified in the file. Each parameter is specified on a line of text. A device driver is loaded using the following format:

```
DEVICE = DRIVER.SYS
```

This would load the file DRIVER.SYS which would be installed as a device driver. Multiple device drivers can be specified in the CONFIG.SYS file. This allows easy modification by a user via a text editor since adding a new device is done simply by adding a line of text and removing a device driver consists of deleting the line of text. Of course, the device driver file must be on the boot disk at the time the system is started.

This type of device driver remains resident at all times and is only loaded at boot time. This differs from the non-standard device drivers, mentioned earlier, which are loaded by a program some time after the system is initialized.

Also, the non-standard device drivers may be configured such that they can be removed before the system is turned off.

Unlike non-standard device drivers, standard device drivers are initialized by the operating system. The device driver file starts with a device header and not program code. The header contains the following fields:

```
Device Driver Header

<table>
<thead>
<tr>
<th>Offset</th>
<th>Size</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>4</td>
<td>Link to next device driver</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>Attributes</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>Device strategy routine offset</td>
</tr>
<tr>
<td>8</td>
<td>2</td>
<td>Device interrupt routine offset</td>
</tr>
<tr>
<td>10</td>
<td>6</td>
<td>Device name or unit number</td>
</tr>
</tbody>
</table>
```

Figure 1 - Device Driver Relationship

Figure 2 - CP/M Installable Device Driver

Notes:
Base Page is from 0 hex to 100 hex.
BIOS jump is at 0 hex.
BDOS jump is at 5 hex.
End of Program area is marked by start of BDOS.
These fields will be discussed in more detail in the next article and covered briefly here. The Link to the next device driver contains either a "-1" if this is the last driver in the file or an offset to the next device driver header in the same file. This implies that multiple device drivers can be contained in the same file (Figure 3). This format is similar to that found in memory once a driver is loaded (Figure 4).

The attribute word indicates the type of device and other items of interest. A device driver can be either a character or a block oriented. The name field contains an ASCII name for the driver, such as "AUX:", if the driver is a character device. The first byte of the field contains the unit number if the driver is a block device instead. This leaves the two routine offset fields.

MS-DOS uses these two routines to interface with the device driver. The first routine is the strategy routine. This routine is called with a pointer to a variable length parameter block in the ES:BX registers. The strategy routine must use the values in the parameter block to setup an operation. This operation is performed when the second routine, the device interrupt routine, is called by MS-DOS. The strategy routine typically saves the ES:BX pointer for use by the interrupt routine.

The general format for the parameter block is:

<table>
<thead>
<tr>
<th>Offset</th>
<th>Size</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2</td>
<td>Size of parameter block in bytes</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>Unit code (base 0)</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>Command code</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>Status</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>Reserved</td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>Depends upon command code</td>
</tr>
</tbody>
</table>

The Command code determines the type of operation to be performed and indicates the type of additional parameters which may be included at offset 13. The status word will be described in more detail in the next article. It essentially lets MS-DOS know when an operation is completed and whether it was successful. The unit code specifies the logical device number being used. This allows a single driver to handle multiple devices with each device being selectable by MS-DOS.

The command code values include:

<table>
<thead>
<tr>
<th>Command Code Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>7</td>
</tr>
<tr>
<td>8</td>
</tr>
<tr>
<td>9</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>11</td>
</tr>
<tr>
<td>12</td>
</tr>
</tbody>
</table>

The Initialize command is used first, and only once, when the driver is loaded. The initialization routine is responsible for performing any hardware or software initialization for the device and placing various results in the parameter block to be examined by MS-DOS when the initialization is done. One of the parameters is the ending address of the device driver. This allows a device driver to either extend the amount of memory to use for buffers or to reduce the size and free up the area used by the initialization routine.

The common routines for both character and block oriented devices include Input, Output, and Output with verify. Two optional routines are for IOCTL Input and Output functions. These are device dependent functions and allow for control of device specific functions such as setting baud rates for a serial character device. The remaining functions are divided into character device and block device specific functions.

The character device functions include Input Check, Status and Flush, plus Output Status and Flush. The Input Check function is used to examine the contents of the input buffer without actually removing characters via the Input command. The Input and Output Status commands simply indicate whether data is available or whether data may be Output. The Input and Output Flush commands simply clear out any data within driver buffers. MS-DOS assumes that the device driver performs all buffering.

Block device specific commands include Media Check and Build BIOS Parameter Block (BPB). The Media Check lets MS-DOS know whether the media associated with a drive has not been changed, has changed, or may have changed. Obviously most hard disks and RAM disks are not removable while floppy disks are. MS-DOS asks a device to build a BPB when the media is changed or if there are buffers associated with the device that must be written and the media may have changed.

The BPB provides MS-DOS with information about the size of the block de-
Device drivers are only required to support the commands associated with the specific device driver type. For example, character devices do not have to implement the Media Check and Build BPB commands.

Writing standard installable device drivers is much easier than writing non-standard ones, due to the simpler interface presented by MS-DOS V2.x. No installation program need be written. Also, the hooks into the operating system are well defined and consistent.

**SUMMARY**

Field installable device drivers can provide new options and hardware support for existing microcomputers. Building a device driver is much more difficult than building a typical application, but can be done.

Device drivers for CP/M and MS-DOS V1.x do exist, but tend to be used in a limited number of installations due to their general complexity and difficulty in interfacing with the operating system. The exception is the hard disk drivers for the IBM PC and compatibles using MS-DOS V2.x. Even so, each vendor has their own driver and installation procedure, which can interfere with some programs.

MS-DOS V2.x, and later, brings standardization to installable device drivers. This has been a blessing to hardware developers, as well as users, since it means more user control over what is to be loaded into their system. It also reduces the possibility that some of the more hardware specific programs will not work with these installed drivers.

The next article will cover the various parameter blocks and protocols which must be supported by an MS-DOS V2.x device driver. The article after that will present the source code for a simple device driver.
THE GUARDIANS ARE GATHERING

To Protect Your Information Investment

G25-Z100 from $1,095.00
25 megabyte file oriented cartridge storage for the Zenith Data Systems Z100 computers

G25-IBM from $1,095.00
25 megabyte file oriented storage for the IBM, PC, XT and AT (adapter required) and selected compatibles

G25-PC from $1,295.00*
25 megabyte high performance cartridge tape for most IBM compatibles

G2x7-Z100 from $795.00
Internal and Single and Dual External 2.7 megabyte floppy disk drives for Zenith Data Systems Z100 computers

G2x7-PC from $995.00
Internal and Single and Dual External 2.7 megabyte floppy disk drives for the IBM, PC, XT, AT, Zenith Z150 series and most compatibles

Call or write for information and the name of your nearest Guardian Data Systems Dealer.

*Available Soon

GUARDIAN Data Systems, Inc.

Distributed by SYSTEMS INNOVATIONS INC.
44 Stedman Street
Lowell, Massachusetts 01851

HOURS: 9 AM-6 PM MON.-FRI.
THURS. TIL 8 PM • SAT. 10 AM-3 PM
(617) 459-4449

"Your Complete Computer Resource Center"

10 to 40 Meg Hard Disk Upgrades for Zenith Data Systems Z150 and IBM Compatibles

10 to 40 Meg Hard Disk Upgrades for Zenith Data Systems Z150 and IBM Compatibles
HIGH
PERFORMANCE S-100

THE MOST POWERFUL 8 BIT MICROPROCESSOR YOU CAN BUY FULLY Z80
CAPATIBLE, CP/M COMPATIBLE, Z-SYSTEM COMPATIBLE

Use the PRO-180 processor with your current controller, or buy the Magnum MDC-1 at
great savings and have one of the most powerful microcomputers anywhere.

PRO-180
PROCESSOR BOARD
(HD64B180 for S100's)

The PRO-180, using Hitachi's new high integration
HD64B180 processor, packs a lot of performance in a
small area, while maintaining the modularity of the S100
structure.
• Executes all Z80 instructions. The HD64180 instruction
  set is a superset of the Z80, so the Pro-180 will run all
  software written to run on the Z80 or 8080 processors.
• 6 MHZ or greater operation.
• Hardware multiply (8 bit multiply, 16 bit result).
• Two standard built-in serial I/O ports that require no wait
  states. Standard baud rates up to 36,400 baud.
• Clocked serial port for multiprocessor/multicomputer
  communications at up to 300,000 baud on a pair of
  wires.
• Has 65,000 I/O ports (not just 256 like older processors).
• HD64180 has 19 address lines for directly addressing
  512K bytes of memory with built-in MMU.

MDC-1
Floppy Disk Controller

• The MDC-1 floppy disk controller can control any mix-
  ture of up to four 5 ¼ or 8” drives.
• Onboard shadow ROM.
• I/O mapped. Does not take up any memory space.
• Available with bios for CP/M 2.2, or with complete
  Z-SYSTEM.
• Runs 48tpi drives, 96tpi drives, or 48tpi diskettes in 96tpi
  drives.
• Runs with 8 bit or 16 bit processors.

PRO-180 processor w/64K static RAM ........ $349
  w/32k static RAM and ROM monitor .......... $349
  without RAM or ROM ..................... $299
MDC-1 floppy disk controller w/bios ........ $199
  w/complete Z-SYSTEM & shadow ROM ....... $279
COMPLETE SET:
  PRO-180 w/64k SRAM, MDC-1, Z-SYSTEM,
  S-ROM, UTILITIES ....................... $569


magnum
digital, inc.

Route 2, Box 223, Stover, MO 65078
Mail Orders to: Magnum Digital Inc.
3211 South Providence Rd., Suite 302
Columbia, Missouri 65203
(314) 449-7199
or call:
For technical assistance (314) 377-4419
Trademarks: CP/M2.2 by Digital Research, Z SYSTEMS by Conkor Inc., 8080 by Intel Corp.
PUBLIC DOMAIN SOFTWARE

Our public domain software library:
• now in excess of 1000 disks
• over 30,000 programs
• includes the complete CP/M UG, SIG/M, PCSIG libraries
• 20-40 new volumes added per month
• supporting over 200 CP/M computers
  (including Northstar and Apple) and all major IBM type computers (including DEC)

Available In One of Two Ways

Via Modem
• online directly from one of our 11 remote RCP/M, RBBS or FIDO Host systems
• 24 hours per day, 7 days per week
• limited access, restricted membership
• access fee only $35 Can ($30 US) covers one year access
• supporting 300/1200 and 2400 baud modems
• telenet access also available

By Mail
• all software available by mail on over 200 different disk formats
• priced by disk, from $10 Can ($8 US) per disk
• all major user groups available

Canadian Users
• a full line of commercial software available
• 12 different brands of modems including the US Robotics 300/1200 baud Password and the US Robotics 300/1200/2400 baud Courier
• Echelon and Night Owl software available directly from us

For a free minicatalog, call (416) 239-2835 or write:
CANADA REMOTE SYSTEMS LTD.
4691 Dundas Street West
Islington, Ontario, Canada
M9A 1A7

CACHE22 is a front-end system program that buries all of CP/M 2.2 in banked memory. It helps 8080/Z80 computers to survive by providing up to 63.25K of TPA, plus the ability to speed disk operations, eliminate system tracks, and run Sidekick-style software without loss of transient program space. Complete source and installation manual, $50.00.

CP/M is a trademark of Digital Research Inc.
Sidekick is a trademark of Borland International

MIKEN OPTICAL COMPANY
53 Abbott Avenue, Morristown, NJ 07960
(201) 267-1210

No source code for your REL files?

REL/MAC
converts a REL file in the Microsoft™ M80 format to an 8080 or ZILOG™ Z80 source code MAC file with insertion of all public and external symbols.

• REL/MAC makes MAC source files
• REL/MOD lists library modules
• REL/VUE displays the bit stream
• REL/PAK includes all of the above
• 8080 REL/MAC demo disk $10.00
REL/PAK for 8080 only ................ $99.95
REL/PAK for Z80 & 8080 ............... $134.95
on 8"SSSD disk for CP/M™ 2.2

Send check, VISA, MC or C.O.D. to
MICROSMITH
COMPUTER TECHNOLOGY
P.O. BOX 1473 ELKHART, IN 46515
1-800-622-4070 (Illinois only 1-800-942-7317)
A good C book just isn’t complete without a good C compiler to go with it. That’s why we give you both. You get a comprehensive 450 page book and a full feature standard K&R C compiler with the Unix V7 Extensions. The book is loaded with examples that teach you how to program in C. And our fast one pass C compiler comes with an equally fast linker so you don’t waste a lot of time watching your disk drives spin. You also get a Unix compatible function library that contains more than 150 functions (C source code included). And if all that isn’t enough, we offer you a 30 day money back guarantee. So what are you waiting for? The exciting world of C is just one free phone call away.

**Language Features**
- Data Types: char, short, int, unsigned, long, float, double
- Data Classes: auto, extern, static, register
- Typedef, Struct, Union, Bit Fields, Enumerations
- Structure Assignment, Passing/Returning

**Functions**

**MIX Editor**

When you're programming in a high level language you need a high powered editor. That's why we created a programmable full/split screen text processor. It lets you split the screen horizontally or vertically and edit two files at once. You can move text back and forth between two windows. You can also create your own macro commands from an assortment of over 100 predefined commands. The editor comes configured so that it works just like Wordstar but you can change it if you prefer a different keyboard layout. The editor is a great companion to our C compiler. Because they work so well together we want you to have both. To make sure you do, we're offering the editor for just $15 when purchased with the C compiler.

**ASM Utility**

The ASM utility disk allows you to link object files created by Microsoft’s MASM or M80 assemblers. Lots of useful assembly language functions are included as examples.

**NOT COPY PROTECTED**

<table>
<thead>
<tr>
<th>Editor</th>
<th>$29.95</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>$39.95</td>
</tr>
<tr>
<td>C &amp; Editor</td>
<td>$54.95</td>
</tr>
<tr>
<td>ASM Utility</td>
<td>$10.00</td>
</tr>
<tr>
<td>TX Residents</td>
<td>$31.125 (6.125% sales tax)</td>
</tr>
<tr>
<td>Shipping</td>
<td>$4.00 (see below)</td>
</tr>
<tr>
<td>Total</td>
<td>$60.95</td>
</tr>
</tbody>
</table>

**Shipping Charges:**
- USA: $5/Order
- Canada: $10/Order
- Overseas: $10/Editor, $20/C, $30/C & Editor

**Orders Only**

1-800-523-9520

**Canadian Distributor**
Saraguay Software: 416-923-1500

**Orders Only**

Canadian Distributor
Saraguay Software: 416-923-1500

**Ask about our volume discounts.**

Micro/Systems Journal March/April 1986
Lomas Data Products’ S100-PC

by Dave Hardy and Ken Jackson

INTRODUCTION
The S100-PC is Lomas Data Products’ latest entry into the highly competitive PC-compatible market. Although (almost) completely IBM-PC software compatible, the S100-PC has several distinct hardware differences. The most obvious is that it is based on the S-100 (IEEE-696 standard) bus, rather than the IBM-PC bus. Unlike the IBM-PC, which uses the 8088 CPU, the S100-PC takes full advantage of the S-100 bus by using true 16-bit operations with an 80186 processor at an 8MHz clock rate.

FEATURES
The S100-PC is actually made up of several Lomas Data Products boards in a modified Integrand S-100 mainframe with an optional hard disk. Our evaluation unit included a 20MB Quantum hard disk that was partitioned equally for MS-DOS and Concurrent CP/M. Although up to a megabyte of RAM can be installed in the S100-PC, our machine had only 512K, which is adequate for most applications, and caused us no trouble at all. We plugged in a standard IBM-PC keyboard and color graphics (RGB) monitor and were up and running without a single problem.

Inside the Integrand box, we found the LDP Thunder-186 80186 processor board (which has several additional functions, including serial and parallel I/O and a floppy controller), the LDP Megaram memory board, the LDP Color Magic video board, the LDP Hazitall general purpose I/O board, and a Western Digital WD1002 Hard Disk Interface board (driven by the Hazitall). All of the S-100 boards are fully IEEE-696 compatible, and of very high quality construction.

HARDWARE DESCRIPTIONS
Because the S100-PC is inherently a modular system, that is, several S-100 boards with specific functions combined to make a PC-compatible, the best way to describe its hardware is to describe each S-100 board individually.

A PC-Compatible S-100 System

The THUNDER-186 processor board
The heart of the S100-PC, the Thunder-186 processor board has the following features:
- 80186 processor at 8MHz
- On-board EPROM (2 sockets for 2732, 2764, 27128, or 27256's)
- 256k on-board RAM
- Floppy disk controller for both 5¼" and 8" drives
- Two serial ports, up to 9600 baud (8251)
- One centronics-style parallel port (8255)
- On-board programmable interrupt controller
- Two full DMA channels

The Thunder-186 is capable of being a complete stand-alone computer system, and comes with an EPROM monitor and power-up diagnostic program. Although the Thunder-186 inside the S100-PC comes configured ready to run, it has several strappable options, including EPROM type selection, floppy write precompensation, and optional slave clear on reset.

The 80186 processor allows the Thunder-186 to perform 16-bit bus cycles while still maintaining compatibility with the 8088 processor that is so widely used in PC's. With a clock rate of 8MHz, the '186, of course, runs faster than the standard IBM-PC.

Because we were not provided with circuit diagrams for this board, we were unable to determine the functions of its on-board dip switches, and whether or not the I/O can be re-addressed. These items were not covered in the preliminary Thunder-186 manual. Circuit diagrams ARE available to board owners who return a non-disclosure form to Lomas.

An interesting feature of the Thunder-186's floppy controller is its ability to SIMULTANEOUSLY control 5¼" and 8" drives. However, because the write precompensation must be fixed by jumpers to either 125 or 250ns, we suspect that there could be some difficulty mixing certain combinations of 5¼" and 8" drives and disk formats in the same system.

The MEGARAM memory board
Unlike the IBM-PC, the MEGARAM maintains a parity check circuit (the ninth bit). Unlike the PC, the MEGARAM can be used in memory configurations of up to 16MB (which would require 8 MEGARAM's in a single S-100 box), although the Thunder-186 can't handle that much in a DOS or CCPM environment. Power dissipation for a fully loaded MEGARAM is a hefty 30 watts, which means that forced air ventilation is a necessity.

The MEGARAM can be used with 64K or 256K dynamic RAM's, and provision is made for up to 7 wait states via jumper selections.

Circuit diagrams and a theory of operation are provided in the manual, which also contains explanations of the jumper settings and gives some tips on integrating the board into other non-Lomas systems.

The COLOR MAGIC video board
The COLOR MAGIC provides IBM-PC compatible video (the equivalent of a color graphics board), keyboard, speaker and light pen connections for the S100-PC. This is really the board that provides PC-compatibility to the S100-PC.

Although the COLOR MAGIC uses some different hardware to accomplish these tasks (but it does use the same video
controller, the 6845), it is claimed to be completely compatible in function to the PC. Our tests results agreed.

By using dual-ported video RAM, hash and time delays for video sync are eliminated, although video RAM accesses by the processor may still cause a wait state or two.

Standard PC-compatible connectors are provided for the video output (both composite and RGB) and the keyboard input. A speaker is not provided in the board which contains two (8251) serial timer, interrupt logic, a math processor may still cause a wait state or two.

The COLOR MAGIC video RAM can be re-addressed to any 32K boundary, which makes it possible to have more than one in a single system. The default address set is to B8000H to maintain compatibility with the IBM color board. The board’s I/O addressing can also be changed, if desired.

True to its S-100 roots, the COLOR MAGIC also has a PHANTOM output so that it can deselect any conflicting system RAM when it is selected.

The HAZITALL board

Hazitall is a good description for this board which contains two (8251) serial ports, an 8255 parallel 1/O port, an 8253 timer, interrupt logic, a math processor option, a 58167 clock/calendar with battery back-up, and an interface for the Western Digital WD1002 Winchester controller.

This board takes up a full 64 port block of I/O, and allows either 8- or 16-bit I/O addressing. Wait states are automatically generated for the I/O chips as needed.

Unfortunately, the math processor (an INTEL 8231 or 8232) is NOT an 8087-compatible.

The WD1002 hard disk controller board is controlled by the HAZITALL board via control and data cable outputs. It is important to note that the HAZITALL contains only an interface for a WD1000 series hard disk controller, not an interface to an actual hard disk.

SOFTWARE DESCRIPTIONS

As we mentioned above, our evaluation machine from Lomas Data Products arrived with both MS-DOS and Concurrent ACPI. For adventurous programmers, the source to the CCPM XIOS is provided, along with the source for most of the CCPM hardware utility programs, such as FORMAT.

Most of our tests were performed under MS-DOS, because it is the more popular operating system. Both operating systems performed well, although we did notice that CTRL/NUMLOCK, which will cause the PC to pause screen output under MS-DOS, would cause the S100-PC to hang up sometimes, requiring a HARDWARE reset to start up again. (Fortunately, the S100-PC has a hardware reset switch on its front panel.)

Because the MS-DOS hard disk drivers are not inherent (that is, the system doesn’t boot up with them already installed, they must be installed from an AUTOEXEC.BAT file), some programs do not seem to realize that the hard disk exists, although all of the applications programs that we tested operated fine. For example, we were unable to convince the installation program for MicroPro’s EASY (that’s its name) word processor that the system had a hard disk. We were also unable to perform many of the hard disk benchmark tests (including DISKIP) for the same reason.

We tried several PC games, including Flight Simulator II, JET, King’s Quest, and others, and had no trouble using them, except that they sometimes ran faster due to the S100-PC’s 8MHz system clock.

The people at Lomas make very clear that the S100-PC may not operate with all PC software, but, overall, we were pleased to find that most PC software ran without any problems.

The benchmark tests used (the Laboratory Benchmark Series from PC Magazine) generally verified the higher speed system clock, and confirmed the S100-PC’s compatibility to the IBM-PC. Except for the hard disk problems mentioned previously, we had no trouble running the benchmarks at all. Executing BENCH02 (the prime number generation test) for example, took 10 seconds, compared to about 35 seconds on an IBM-PC. The CPU speed test that normally takes 10 seconds, executed in 2.2 seconds on the S100-PC. Disk I/O speed proved (not surprisingly) about the same for the S100-PC and an IBM-PC.

CONCLUSION

The LDP S100-PC represents a hybrid of S-100 hardware with IBM-PC software compatibility that outperforms the IBM-PC from the processor’s point of view. Although it sacrifices a small amount of PC software compatibility to gain additional speed and mass storage, the advantages should outweigh any compatibility problems in most applications. With the added attraction of the IEEE-696 (S-100) bus’ versatility, the S100-PC represents a marriage of two different systems that is hard to beat.

AS WE GO TO PRESS

LDP has informed us of the following changes:

The bugs in the video routines have been fixed, including the CTRL/NUMLOCK problem and the final manual is now being shipped with the board and has been sent to all previous purchasers. LDP now also supports the CompuPro 85/88 CPU card so that users can boot directly from PC-DOS. Also, two users have already used the Color Magic board with the CompuPro 86000 board.

And lastly, LDP is now shipping Concurrent DOS version 4.1 with the Thunder186/Color Magic combo. The XIOS is no longer included as DRI has drastically increased the cost of the documentation needed to modify the XIOS and many users indicated they did not need it. LDP does offer the DRI XIOS source and documentation separately for $109.
Hardware Review

CompuPro S-100 PC Video Board

by Alex K.H. Soya

Most new software is specifically written to run under MSDOS on IBM-PC and compatible systems. Thus, S-100 manufacturers have felt a need to make their systems capable of running PC software. The video section of the PC is the part to be imitated on S-100 systems to achieve a reasonable level of compatibility and thus run these software products on S-100 systems. Viasyn Corporation has created the CompuPro S-100 PC Video board, compatible with the IBM-PC CGA board (Color Graphics Adapter), and modified Concurrent CP/M to allow MSDOS software to execute.

CRT AND KEYBOARD

Besides the video card one has to purchase a monitor (monochrome or color) and a Keyboard. Viasyn points out that not all RGB color monitors will work correctly with the PC-VIDEO card. Viasyn recommends the IBM-PC or a Zenith Data Systems model ZVM-135 color monitor. I chose an AMDEK 700 High Resolution IBM compatible RGB color monitor. The other choice to be made is the keyboard. Viasyn recommends only that the keyboard be IBM-PC plug-compatible. I chose the Keytronic model KB5150 IBM plug-compatible keyboard and a DB-9 cable. The video card has a DIN socket and DB-9 female connector terminated cable with the necessary hardware to mount in the S-100 chassis included.

DOCUMENTATION

Before installing the card, I studied the Viasyn documentation. Contrary to past experiences with Viasyn documentation, I was pleasantly surprised to find two separate manuals. The PC VIDEO Technical Manual and the PC VIDEO Installation Manual are informative and detailed.

The technical manual contains hardware and software sections in addition to a section on the Theory of Operation. The Hardware section describes how to choose the devices to be connected to the board and explains the switch settings, operating modes, and capabilities of the card. The software section provides the user with equate values, storage variables, and example driver routines. The information is sufficient for a programmer to write interface routines, should the board be used with an operating system which does not already contain support for the card. The section on Theory of Operations is very detailed, informative, and should be of aid in case trouble shooting the hardware becomes necessary. The CRT controller data sheets and detailed timing diagrams are included.

The Installation Manual briefly explains how to set the switches and jumpers on the card to run with Concurrent CP/M 3.1. The major consideration is whether the card is running in monochrome or color mode. The cable installation and adapter plates for the S-100 enclosure are also briefly described. The manual describes how to set up the Concurrent CP/M 3.1 operating system to run with the PC VIDEO card. CP/M-86 and CP/M 8-16 are not mentioned. However, BIOS updates are available from Viasyn to use these operating systems with the PC Video Card. The rest of the manual explains how to use Concurrent CP/M window utilities.

THE HARDWARE

The card is well designed and built. All IC's are socketed. Two rows of Dip switches are used to select the read/write mode, the base address of the display memory, and I/O port addresses of the CRT controller and Keyboard ports. Two connectors provide input/output to the card. A 3-pin connector provides an RS-170 output (monochrome composite video). A 26-pin connector provides output to the RGB monitor and input from an IBM compatible keyboard and an optional light pen. An adapter cable is provided to convert the 26-pin connector to a DB-9 female connector for the monitor and a DIN-5 female connector for the keyboard.

The card meets all IEEE 696/S-100 bus specifications. It contains 16Kbytes of CMOS static display memory and a Motorola 6845 CRT controller chip. The address bus is 24-bits wide allowing the card to be addressed within a 1Megabyte address space. The Dip switches allow the card's display memory to be located at multiples of 16K. The Input/Output ports are decoded by 16-bit addressing and can be located in blocks of 16 port locations. The hardware contains provisions for up to eight PC-VIDEO cards to be present simultaneously. A bank-select register selects which card responds to commands, allowing a multi-user system to run several IBM-PC compatible display terminals. Even though the card can be addressed at virtually any location, for IBM compatibility the selected addresses would be at port 03Dx hex and memory location 0B8000 hex to run in color mode or at port 03Bx hex and memory location 0B0000 hex to run in monochrome mode.

The board generates wait states automatically to synchronize access by the processor. A character generator PROM provides the IBM-PC display character set.

As already mentioned the Viasyn PC video card has a light pen input. The documentation does not recommend any particular manufacturer's light pen, but describes the interface. The board has two input lines in addition to Ground, +5 Volts and +12 Volts power lines for use by a light pen. The two input lines are LS-TTL (Low power Schotky Transistor Transistor Logic) level inputs. One line is used to generate a data available status signal for polled environments or an interrupt for interrupt driven systems. The other line is passed directly to a status port without any latching or conditioning from where it can be read by the software. Sample drivers for the light pen input software are included.

SOFTWARE

No matter how good the hardware, it is not useful without the proper software to drive it. Viasyn provides a disk containing several preconfigured XIOS (eXtended Input Output Subroutines) modules, several loaders, partial source files to configure a personal XIOS module, and various utilities to make use of the Con-
GETTING IT UP

After following the instructions in the manual on how to set the various switches it was finally time for me to install the card. The installation was straightforward. It did, however, require moving several boards in my S-100 chassis to different slots to avoid a cable mess. With the card in place I followed the instructions and assembled a new XIOS conforming to my system setup. Now the time came to boot my new operating system with the PC-VIDEO card. I waited until the familiar noise which the floppy disk makes while booting stopped. Nothing happened. The system seemed to have crashed while booting. I booted the old operating system (When configuring new versions of the operating system, always keep a bootable copy as backup!) and repeated the configuration procedure. I noticed that one of the files I used to generate the new operating system was from the original disk rather than the disk supplied with the PC-VIDEO card. Unfortunately the new file in question contained the same version number and same revision dates as the older version. Only after looking at the content of this file did I notice differences. The next time I booted the system everything seemed to work just fine.

DISPLAY QUALITY

The Display quality is nearly identical to that of an IBM-PC. The display is rock steady and very clear. The AMDEK 700 monitor performs well with the PC-VIDEO card. I personally found it hard to get used to seeing the individual pixels, which make up the characters, after using conventional terminals for most of my computer work. This was most disturbing when using white letters on black background. Choosing colored characters on black background improved the readability of the screen. The phenomena of pixels being visible is not unique to the PC-VIDEO card by Viasyn but also appears on normal IBM-PC color displays. After working with the display for some time I got used to seeing the individual pixels, which make up the characters, and am no longer bothered by them. Graphic images appear clean and the colors are brilliant. The resolutions supported are identical to those of the IBM-PC computer. The most common screen formats are 640 x 200 high resolution monochrome and 320 x 200 medium resolution color. The low resolution color graphics mode offers a resolution of 160 x 100 pixels. In alphanumeric mode the screen contains 80 columns x 25 lines or 40 columns x 25 lines in low resolution mode. Sixteen foreground and background colors can be generated in addition to the usual reverse video and blinking character attributes.

A pleasant difference between the IBM and Viasyn PC-VIDEO display is the way the screen scrolls. On an IBM-PC a scroll is accompanied by a very annoying flashing of the screen. This is not so on the Viasyn PC-VIDEO card. The scroll is rather smooth and without any annoying flashes making work much more pleasant.

PROBLEMS

As I reconfigured my favorite programs to make use of the PC-VIDEO card characteristics I noticed a strange symbol (It looks like a solid ball) appear on the screen regularly. The symbol appeared most often while using the Spellbinder word processor by Lexisoft. This was very annoying as the symbol would appear in the middle of text being edited. Investigating the problem it turned out that the bell character (Control-G) was the culprit. Viasyn does not filter out this character as there is no bell circuitry on the PC-VIDEO card. I could live without a bell, but not with this character appearing on the screen every time a program wants to make noise.

I also set up Borland's Turbo Pascal to run on the PC-VIDEO card by choosing an IBM-PC color terminal from the Turbo installation menu. At first everything seemed to work just fine. As I did some programming in PASCAL I noticed that the ' key would not work. This prompted me to try out all the different key combinations. One more key was found not to function properly. The tilde key would generate a Ctrl-DELETE rather than the expected tilde character. I sent a message to Viasyn stating the problems and was told that an update to correct them was in the works. I subsequently received a software update which fixed the problems.

IBM COMPATIBILITY

The card's IBM compatibility appears adequate. Any CP/M-86 program that uses the IBM Video characteristics seems to work without any problems. Programs such as Wordstar (MicroPro), Spellbinder (Lexisoft), and Turbo Pascal (Borland), work as expected. However, MSDOS programs do not seem to perform too well. Viasyn states that only well behaved MSDOS version 1.1 programs will work correctly. To evaluate the IBM compatibility of the card, one must consider two factors. One is the PC-VIDEO card itself, the other is Concurrent CP/M 3.1 which is supposed to emulate most of the MsDOS version 1.1 functions. Simple MSDOS programs such as DIR, DEL, TIME, and DATE, work without any problems. Many graphics demo programs also work fine. Problems appear with most public domain programs which are written specifically for the IBM-PC hardware and also rely on many MSDOS internals to use short cuts and decrease programming efforts. Many MSDOS programs will start running correctly but do not respond to keyboard input. There seems to be an incompatibil-
CUSTOM PRODUCTS
DESIGN • LAYOUT MANUFACTURING

ECT-100-F
RACKMOUNT CARD CAGES

8080 CPU
CENTRAL PROCESSING UNITS

CCMB-10-F MIN
6,10 OR 20 SLOT CARD CAGES

BUILDING BLOCKS FOR
MICROCOMPUTER SYSTEMS,
DEDICATED CONTROLLERS
AND TEST EQUIPMENT
CARD CAGES, POWER SUPPLIES
MAINFRAMES, CPU'S, MEMORY
I/O, OEM VARIATIONS

RM-10
CARD CAGE & POWER SUPPLY

64K RAM
FULLY STATIC MEMORY

TT-10
TABLE TOP MAINFRAMES

ELECTRONIC CONTROL TECHNOLOGY, INC.
10 Cottage St., Berkeley Heights, NJ 07922 (201) 464-8086

SPECIALIZING IN
QUALITY
MICRO COMPUTER
HARDWARE

MULTIBUS®
PRODUCTS
MULTIBUS IS A TRADEMARK OF INTEL CORP.

PS-30 A
POWER SUPPLIES
Micro/Systems Journal March/April 1986

Concurrent CP/M 3.1 include Wordstar correctly with the PC-VIDEO card under which programs run correctly. MSDOS is a matter of experimenting to determine CP/M 3.1 with the PC-VIDEO card and it grams known to run under Concurrent loaded to execute.

Most of the SDOS 2.0 function calls are implemented including support for subdirectories and MSDOS formatted media. A demanding program such as GEM ran with only minor problems and performed much faster than on the IBM-PC. A major problem occurs with copys protected software, which talks directly to the floppy disk controller, and programs which contain their own operating system, such as the Microsoft Flight simulator. These programs will not run as they can never be loaded to execute.

Viasyn does not publish a list of programs known to run under Concurrent CP/M 3.1 with the PC-VIDEO card and it is a matter of experimenting to determine which programs run correctly. MSDOS application programs which seem to work correctly with the PC-VIDEO card under Concurrent CP/M 3.1 include Wordstar (Micropro), Newword (Newstar Software), Wordstar Tutor (Micropro), DBASE II (Ashton Tate), SuperCalc II and III (Sorcim). I have not tested the above programs extensively in every day use but found them to work correctly as a casual user. In addition, Viasyn claims that LOTUS 123 (Lotus) will work properly, however I was unable to obtain a copy to test.

To obtain more MSDOS compatibility, one could also run MSDOS as implemented by Computer House. Computer House wrote a set of device drivers to adapt IBM PCDOS to CompuPro S-100 systems. The latest version, based on PCDOS Version 3.1, contains support for the PC-VIDEO card and seems to perform very well. As I require my system to be multi-tasking, I cannot make use of single tasking operating systems, such as IBM PCDOS, however, if extensive PCDOS compatibility is a must, then the Computer House solution may be of advantage.

**SUMMARY**

The PC-VIDEO card by Viasyn introduces IBM display compatibility to the S-100 market. The card is technically sound and with the proper software allows S-100 systems to run many IBM PC-DOS application programs. As several programs will not perform as expected, a potential user of the PC-VIDEO card should test the MSDOS software he wants to use before purchasing the card. For my personal requirements, I found the MSDOS compatibility of Concurrent CP/M 3.1 with the PC-VIDEO card to be inadequate, but expect much better MSDOS compatibility with the release of Concurrent CP/M 4.1 on the Viasyn system. A sound generator would be a welcome addition in future releases of the PC-VIDEO board. Perhaps a separate sound generator board would also fill this gap.

I found the Concurrent CP/M window support increased my productivity tremendously after I learned how to make use of this new feature. I can also monitor the activities of users on my Concurrent RCPM system by setting up a small window which displays the remote console while using the system to edit files and compile programs simultaneously in the other windows. The PC-VIDEO card is certainly a welcome addition to my computer system.

I wish to express my thanks to Bill Carter at Concurrent Research Inc. (My local systems center) for making his systems available to test the PC-VIDEO card with IBM-PC software.

**Alex Soya has been involved with CP/M for over 8 years. He is currently a computer science senior at Florida Institute of Technology. His interests include Operating Systems, Data Communications, System Utilities, Real Time and Scientific Programming.**

---

**TRUE MULTI-TASKING!**

**TASKMASTER** is high tech, available now, and it works with virtually all DOS software. Give Lotus, Sidekick, Multimate or most any DOS program the advantages of real multi-tasking. It's simple to use, compatible, bulletproof and most of all, it won't slow you down. That's because TASKMASTER only shares your computer when YOU want it shared. At other times, your visible program runs at full speed, waiting for you to easily switch from program to program at the touch of a key. Compatible with most DOS computers including the IBM PC/XT/AT/Jr. series, you can order TASKMASTER today for only $69.95 + 5.00 Shipping and Handling, VISA and Mastercard.

**ORDER LINE**

(206)367-0650

Sunny Hill Software
13732 Midvale North Suite 206
Seattle, Washington 98133

---

Sidekick trademark Borland Int.
Multimate trademark Ashton Tate

---

**Micro/Systems Journal March/April 1986** 63
G

All advantage of LATI is yours now.!

LATI-K

Distributors

Australia-LAMRON PTY. Ltd.

England-Quanta Systems

Finland-BB. Soft

India-Betarnatix PVT Ltd.


Expand Your System with a 68000 CoProcessor

Peak Electronics' 68K8-CP is a high performance 68000 software development package designed to easily integrate into your existing 8-100 system. The package consists of the 68K8-CP co-processor card, CP/M-68K, and a software toolkit that includes a UNIX V7 compatible floating point C compiler and a symbolic debugger.

Any system running CP/M-86 can be expanded by inserting the CP/M-68K, within minutes without any change in existing hardware or software. This card does not replace your current processor. All of the original system's devices (RAM, disks, and other peripherals) are immediately available to the user of CP/M-68K. All files can be accessed by whichever operating system is currently active. Control is transferred between operating systems with a single simple command.

Features:

- Does not replace your current CPU card or software.
- Includes CP/M-68K with UNIX® V7 compatible floating point C compiler and a symbolic debugger.
- All developed C code and assembly code is fully relocatable and ROMable.
- 8 or 10MHz CPU with no wait state RAM.
- 128k bytes of RAM expandable to 512K.
- 2 serial and 1 parallel ports.
- IEEE-686-1983, 8-100 compatible.
- 30 day money back guarantee
- 1 year parts and labor warranty

Complete Package: $995.00

VISA or MasterCard Accepted

WORLD SMALLEST COMPUTER

ISO: CP/M plus manual $50

BiOS source code available

$199

499

MSC-MTC

MSC-ICO

MSC-LAT1

Write-Hand Man

“Almost a Sidekick for CP/M”

Ted Silveira—Computer Currents, Aug. 27, 1985

“WHM is ingenious and works as intended”


Now available for CP/M 2.2, CP/M 3.0 and ZRDOS!

The convenience of Sidekick on your CP/M machine! Trigger Write-Hand-Man with a single keystroke and a window pops open to run desk accessories. Exit Write-Hand-Man, and both the screen and program are restored. Use with any CP/M program and most any CP/M machine. Takes only 5K of memory.

FEATURES

Notepad for quick notes

File and Directory viewer

Appointment calendar

Hex calculator

Quick access phonebook

14 digit decimal calculator

BONUS

Add applications written by you or others! No other “Sidekick” lets you add applications. Dump screens, setup printers, communicate with other computers, display the date and time. Let your imagination run wild!

$49.95

California residents add tax, shipping included. COD add $2. Sorry, no credit cards or purchase orders. 30 day guarantee. Formats: 8 inch IBM, Northstar and most 5 inch (please specify).

Write-Hand-Man only works with CP/M 2.2, ZRDOS and CP/M 3.0 (please specify). Simple terminal configuration required. Not available for TurboDOS. Compatible with keyboard extenders, hard disks, and other accessories.

Poor Person Software

3721 Starr King Circle

Palo Alto, CA 94306

415-493-3735

P.O. Box 70012, Salt Lake City, UT 84170-0112
Turn your personal computer into a digital oscilloscope/spectrum analyzer peripheral for most PCS.

Finally, a high performance, low cost Digital Oscilloscope/Spectrum Analyzer Peripheral for your PC.

Until now, the idea of using your PC as a digital oscilloscope or spectrum analyzer was a great idea, but involved a lot of programming or special hardware—and was expensive! Rapid Systems has changed all that.

Introducing the Rapid Systems Digital Oscilloscope/Spectrum Analyzer Peripheral for most PCs.

Plug the Rapid Systems Peripheral into your PC, slip in the disk, touch one button and you’re ready to work. It’s that simple and easy to use. Plus, all the post processing capabilities of your PC are at your fingertips. Store and retrieve wave forms from disk.

Analyze and process the information. And your PC is available for complex mathematical computations and word processing.

You get the performance of more expensive digital oscilloscopes and spectrum analyzers, at a fraction of the cost, while your PC provides the flexibility, intelligent control, and analysis.

The Peripheral also provides users with the performance capabilities required for Digital Signal Processing—at a very low cost!

RAPID SYSTEMS DIGITAL OSCILLOSCOPE/SPECTRUM ANALYZER

DIGITAL OSCILLOSCOPE

- 4-channel Digital Oscilloscope
- with a 2 MHz sampling rate, 500 KHz analog bandwidth and diode protection on all inputs
- Graphics display is color enhanced, using up to 160 x 260 pixels for data display (up to four traces) and 4 lines of text for the scope’s parameters
- A fast, informative menu-driven operation provides keyboard control of gain parameters for channels A, B, C, and D.
- time base values, channel selection, and trigger mode.

SPECTRUM ANALYZER

- A variable order of Fast Fourier Transform, with up to 1024 points
- Features a selectable rectangular or Hanning time window
- Either baseband or Vernier band operation is available using your analog anti-aliasing filters
- Power spectrum computation and spectrum analyzing
- High resolution spectral display formats

$798!

RAPID SYSTEMS

To order or for further information, call or write Rapid Systems, 619 North 34th Street, Seattle, WA 98103. (206) 547-8311.
Rolling Your Own
PC/XT/AT Clone
Part II

by Sol Libes

This article is an update on what is happening in the PC-clone marketplace. Earlier discussions on building PC, XT and AT clones appeared in earlier issues of M/SJ (Jan/Feb '86 and May/Jun '85).

GETTING YOUR CLONE PARTS FROM THE SOURCE

Many M/SJ readers are systems houses who put together a large number of systems every month. Invariably each system is configured differently with many being networked or multi-user systems. These readers, for the most part, are using PC, XT or AT compatible equipment and usually buy their components from distributors or mail-order houses.

However, if they are buying a significant number of components they may wish to buy direct from Far East manufacturers. Most of these components are made today in Taiwan, Hong Kong, Singapore, South Korea and Japan. It is not necessary to travel to the Far East to find these companies and importing components is usually easier than you might think.

You can locate these manufacturers and exporters by subscribing to a monthly magazine that carries advertisements from these companies. You will find the larger companies (e.g. Samsung of Korea) maintain an office here in the U.S. making it easier to deal with them. The magazine you should subscribe to is: Asian Sources Computer Products, published by Trade Media Ltd. G.P.O. Box 9929, Hong Kong. A year's subscription is $40 surface, $98 air. When requesting a subscription tell them you are either a wholesaler, retailer/mail order, manufacturer or agent, as they do not allow subscriptions to others.

Also, if you are going to buy components directly from Hong Kong you should get a copy of the book titled Importing From Hong Kong, Wordright Enterprises Inc., Dept 9MV, Box 359, Winnetka IL 60093. The price is $19.95. Wordright is also the U.S. representative for Asian Sources Computer Products magazine.

A recent issue of Asian Sources Computer Products magazine I looked at was 228 pages and contained ads from well over a hundred and fifty vendors of PC-compatible components. There were also a few ads for Apple II clone components and one ad for multi-bus components. There were no ads for S-100 components. It is apparent the PC/XT hardware configuration and bus have become a generic hardware standard with far greater acceptance than has been achieved by any other bus (e.g. S-100). Further, it is apparent many of the PC/XT-compatibles have improved upon the IBM products with such features as 640K of RAM on the motherboard, dual speed clocks, etc.

FCC REGULATIONS & UL LABELS

Federal law requires all computer manufacturers to comply with Federal Communications Commission regulations on radio frequency radiation. This insures that RF radiation is below a certain prescribed level that does not interfere with other electronic equipment such as TV receivers. Thus, most PC clone systems (e.g. Compaq, ITT, etc.) carry labels certifying that they have been tested and comply with the regulations. Further, these systems bear UL labels certifying that they have been tested by UL and pass their standards for electrical safety.

I have yet to see a clone system made up of separate components by a local dealer or mail-order house that bears FCC or UL labels. The question is what are the ramifications of this lack of FCC certification and UL listing?

As far as I know, FCC certification applies only to equipment used in the home. Further, it has been my experience that a piece of equipment may have an FCC sticker but after one connects up cabling to modems, printers, external disk drives, etc., these cables radiate interfering signals so that the FCC label becomes meaningless.

I do not see how a systems house, which assembles custom systems from components, can comply with FCC regulations, without submitting each individual system sold for testing and certification.

Lack of UL listing means that if such a piece of equipment caused a fire, or was suspected of causing a fire, it gives the insurance company a justification for refusing to pay for the loss. Fire insurance policies generally require that the insured protect against potential electrical fires by using only UL listed electrical equipment.

An AT versus a Turbo-XT

The AT's main claim to fame is that it provides increased speed over an XT. This is due to the 80286 microprocessor, the full 16-bit wide data path, more memory and faster hard disk system. Generally speaking, the current AT provides a speed improvement of three to four times that of an XT. However, many users have found that certain tasks are no faster and in some cases are slower than the XT.

For example, tasks which use the math coprocessor chip or make heavy use of the floppy disk drives generally run at about the same speed or even a little slower.

It is possible to increase the AT's speed by replacing the microprocessor's...
clock crystal with one of a higher speed. However, some readers report that doing this causes the 80286 chip to overheat and fail, particularly when increasing the clock from 6Mhz to 10Mhz. Thus, it is advisable when doing this to replace the 80286 with a unit rated at a higher speed. IBM now discourages changing the crystal by using a new BIOS ROM that will not work properly above 6Mhz.

An alternative is to plug a processor card that uses the 80268 (generally called a "Turbo" card) into the XT. These cards generally use a 186 or 286 running at 8 or 10Mhz, contain their own local memory and provide caching to improve throughput. The XT motherboard now acts merely as an I/O processor. The result can be faster performance than that provided by an AT. Readers considering this approach might investigate the turbo boards made by Phoenix and Orchid. I have received good reports on these products.

Another approach is to replace the PC/XT motherboard with a 186- or 286-based motherboard that mounts in the same physical space. Such a board is made by Wavemate and Holliston Computer (see ad this issue). Also, consider a Turbo XT board; these contain dual clocks for the 80286. One runs at the standard speed and another that will run the system 1.5 times normal speed. For example, Atlay (see ad this issue) sells such a card (with 0K RAM) for $195. Pull out your old board, pop in the new one and move the 640K of memory chips from the old board to the new one. If you need it, 640K of RAM for the board will set you back another $72.

Still a third approach to speeding up a PC/XT is to provide a separate clock for the 80286 that runs at a faster rate than the standard clock. One such product sold by Microspeed Inc., Freemont CA, is a low-cost ($129 list) speedup for the PC/XT and compatibles. It consists of a small board containing dual clocks, a 8088-2 running at 8Mhz, and some support circuitry. Unplug the low-speed 80286 from the motherboard, and plug this into the socket. It works works essentially the same as the AT, one clock for the processor and another for the circuitry. And, it has a switch so you can switch back to 4.7Mhz for those programs that have critical timing loops. We expect to review this product shortly.

The cost of an XT-clone with a Turbo card is a little less than the cost of an AT-clone. This is due in large part to the fact that hard and floppy disks for the XT cost less than the drives for the AT. However, the standard XT hard disk drives are typically slower than those available for the AT. One can purchase a faster hard disk drive (e.g. the Seagate hard disk drive) and improve the XT performance even more.

Currently AT users are running Versions 2.1 or 3.1 of PC/MS-DOS. This is the same operating system used on 8088 and 8086 based systems. The result is that there is really no difference in operation, other than speed, when using an AT machine. However, this situation will change (probably in the fall) when Microsoft releases Version 5 of PC/MS-DOS. Version 5 is expected to be designed specifically to run on an 80286-based machine and take advantage of the turbo boards (see News column for more details on Version 5). Until Version 5 is released, most users will no doubt be very satisfied with a souped up XT machine.

**At Disk Drives**

If you are assembling an AT clone from parts (we will have an article on this in the next issue) then note the following. Most AT users don’t use 1.2Mbyte floppy drives preferring use the old 360K drives to maintain compatibility. However, these drives will not work with an AT disk controller unless they are modified. The modification is simple. Pin 34 (the pin furthest from the keyway slit) is used to determine if the drive is a 1.2M or 360K drive. All you have to do is put some tape over the contact, on the drives PC board, so that the pin does not contact the cable.

Vendors of “AT compatible” 360K drives
usually cut, or notch the board, to remove the contact.

Also, when buying hard disk drives be sure they are rated for 30msec access time not the 65msec access time used on the XT machines. This will make a big difference when doing sorts and compiles.

IBM equipment. I note that most of the components in the IBM systems also are made in the Far East. One could almost say that the IBM systems are clone systems.

One chronic source of problems with clone systems appear to be the power supplies. Thus, if you are experiencing problems with your PC/XT/AT clone the first thing to check is your power supply. Check the output voltages. They should be within 1-2% of their rated values with all components plugged in and operating. Also check these values while some other piece of electrical equipment, which draws a significant amount of current on the same electrical circuit, is being switched on and off. If the voltage (e.g. the +5V lines) drops by more than 10% it can cause problems.

If you can, check the power supply voltages with an oscilloscope to determine the ripple and noise (particularly due to surges on the AC line). The hard disk systems appear to be the most sensitive to power supply problems. If you have a system that will not boot off the hard disk, check the power supply first before sending the drive back to the supplier. Maybe it’s the power supply that has to be replaced instead.

Another source of problems appears to be EPROM circuits that after a period of time drop a bit here and there. Also, check the connectors for the boards and plug-in components. Frequently just reseating a component in its socket will clear up a bad connector problem.

The IBM-ATs with 20byte CMI hard disk drives have proven to be unreliable. All three of our systems have gone back to the dealer for new hard disk controller cards and drives. Fortunately IBM warranties the AT for a year.

usually cut, or notch the board, to remove the contact.

Also, when buying hard disk drives be sure they are rated for 30msec access time not the 65msec access time used on the XT machines. This will make a big difference when doing sorts and compiles.

IBM equipment. I note that most of the components in the IBM systems also are made in the Far East. One could almost say that the IBM systems are clone systems.

One chronic source of problems with clone systems appear to be the power supplies. Thus, if you are experiencing problems with your PC/XT/AT clone the first thing to check is your power supply. Check the output voltages. They should be within 1-2% of their rated values with all components plugged in and operating. Also check these values while some other piece of electrical equipment, which draws a significant amount of current on the same electrical circuit, is being switched on and off. If the voltage (e.g. the +5V lines) drops by more than 10% it can cause problems.

If you can, check the power supply voltages with an oscilloscope to determine the ripple and noise (particularly due to surges on the AC line). The hard disk systems appear to be the most sensitive to power supply problems. If you have a system that will not boot off the hard disk, check the power supply first before sending the drive back to the supplier. Maybe it’s the power supply that has to be replaced instead.

Another source of problems appears to be EPROM circuits that after a period of time drop a bit here and there. Also, check the connectors for the boards and plug-in components. Frequently just reseating a component in its socket will clear up a bad connector problem.

The IBM-ATs with 20byte CMI hard disk drives have proven to be unreliable. All three of our systems have gone back to the dealer for new hard disk controller cards and drives. Fortunately IBM warranties the AT for a year.

AT QUALITY CONTROL PROBLEMS

Many quality control problems, with clone components, have been reported to me and I have experienced a few myself. However, I must say that at the school where I teach we have a large number of new IBM PC and AT systems and we have had a large number of problems with these systems also. Thus, I cannot say that the Far East clones are less reliable than the

IBM equipment. I note that most of the components in the IBM systems also are made in the Far East. One could almost say that the IBM systems are clone systems.

One chronic source of problems with clone systems appear to be the power supplies. Thus, if you are experiencing problems with your PC/XT/AT clone the first thing to check is your power supply. Check the output voltages. They should be within 1-2% of their rated values with all components plugged in and operating. Also check these values while some other piece of electrical equipment, which draws a significant amount of current on the same electrical circuit, is being switched on and off. If the voltage (e.g. the +5V lines) drops by more than 10% it can cause problems.

If you can, check the power supply voltages with an oscilloscope to determine the ripple and noise (particularly due to surges on the AC line). The hard disk systems appear to be the most sensitive to power supply problems. If you have a system that will not boot off the hard disk, check the power supply first before sending the drive back to the supplier. Maybe it’s the power supply that has to be replaced instead.

Another source of problems appears to be EPROM circuits that after a period of time drop a bit here and there. Also, check the connectors for the boards and plug-in components. Frequently just reseating a component in its socket will clear up a bad connector problem.

The IBM-ATs with 20byte CMI hard disk drives have proven to be unreliable. All three of our systems have gone back to the dealer for new hard disk controller cards and drives. Fortunately IBM warranties the AT for a year.

AT QUALITY CONTROL PROBLEMS

Many quality control problems, with clone components, have been reported to me and I have experienced a few myself. However, I must say that at the school where I teach we have a large number of new IBM PC and AT systems and we have had a large number of problems with these systems also. Thus, I cannot say that the Far East clones are less reliable than the

IBM equipment. I note that most of the components in the IBM systems also are made in the Far East. One could almost say that the IBM systems are clone systems.

One chronic source of problems with clone systems appear to be the power supplies. Thus, if you are experiencing problems with your PC/XT/AT clone the first thing to check is your power supply. Check the output voltages. They should be within 1-2% of their rated values with all components plugged in and operating. Also check these values while some other piece of electrical equipment, which draws a significant amount of current on the same electrical circuit, is being switched on and off. If the voltage (e.g. the +5V lines) drops by more than 10% it can cause problems.

If you can, check the power supply voltages with an oscilloscope to determine the ripple and noise (particularly due to surges on the AC line). The hard disk systems appear to be the most sensitive to power supply problems. If you have a system that will not boot off the hard disk, check the power supply first before sending the drive back to the supplier. Maybe it’s the power supply that has to be replaced instead.

Another source of problems appears to be EPROM circuits that after a period of time drop a bit here and there. Also, check the connectors for the boards and plug-in components. Frequently just reseating a component in its socket will clear up a bad connector problem.

The IBM-ATs with 20byte CMI hard disk drives have proven to be unreliable. All three of our systems have gone back to the dealer for new hard disk controller cards and drives. Fortunately IBM warranties the AT for a year.

AS WE GO TO PRESS

AT clone prices are dropping quickly. Advertisements in publications such as PC WEEK and COMPUTER SHOPPER indicate that an AT with a 20Mbyte drive can now be assembled from under $2,400. This is about the same price as an XT-compatible with 20Mbyte drive and a plug-in 286 card. Also several vendors are now offering AT-clone motherboards in the $900-1,250 range.

PC/XT Far East clone prices are also dropping. At a recent flea market I attended, a basic machine (256K RAM, 2 drives, 135W power supply, case, keyboard and graphics controller card) were going for $650. Adding a display, six function card with memory to bring the system up to 640K RAM and a 10M hard disk brings a total system cost up to about $1,300.

It was also good to see that the documentation provided with the Far East-clone products has improved from virtually none to manuals comparable to what the old S-100 vendors used to provide. In other words you get a complete schematic, a brief circuit description and instructions on how to set switches and use the interfaces. The manuals are still on the advanced user level and not intended for the inexperienced user.

The flea market had well over 100 dealers. About 40 of them were selling computer systems and in virtually every case they were selling Far East PC/XT clones. I did not see a single vendor selling IBM systems! It is apparent that IBM is rapidly losing its dominant position in the PC/XT marketplace and, I suspect their AT market share is also eroding as well.

(For a listing of some flea markets occurring during the next months see my News, Views & Gossip column.)
SLICER—THE SYSTEM THAT GROWS TO FIT YOUR NEEDS

THE SLICER
Real 16 Bit Power on a Single Board—
Featuring the Intel 80186 (C) Step CPU
• Complete 8 MHz 16-bit microprocessor on a 6" x 12" board
• 256K RAM, plus up to 64K EPROM
• SASI port for hard disk controller
• Two full function RS232C serial ports with individually programmed transmission rates—50 to 38.4K baud
• Software compatibility with the 8086 and 8088.
• 8K of EPROM contains drivers for peripherals, commands for hardware checkout and software testing
• Source for monitor included on disk
• Bios supports Xebec 1410 and Western Digital WD 1002 SHD controller for hard disks
Fully assembled and tested only $895

THE SLICER 1-MByte EXPANSION BOARD
For expanded memory, additional ports, and real time clock
• 1-Mbyte additional dynamic RAM
• 2 RS232C asynchronous ports with baud rates to 38.4K for serial communication
• 2 additional serial ports for async (RS 232) or synch (Zilog 8530 SCC) communication
• Real Time Clock with battery backup
• Centronics type parallel printer port
Fully assembled and tested only $750

SLICER/1MByte EXPANSION COMBO
The Slicer (without RAM or RAM controllers) with Full 1-Mbyte Memory Expansion
Kit form only $1295

THE SLICER PC EXPANSION BOARD
Gives your Slicer high performance video capability
• IBM compatible monochrome video
• Video memory provides 8 pages of text or special graphics capability
• 2 IBM type card slots for color video, I/O expansion, etc.
• IBM type keyboard port
Fully assembled and tested only $600
All boards available in kit forms
The SLICER Bulletin Board (300/1200 baud) 612/788-5909
Runs MS DOS generic software; PC DOS program operation not guaranteed
Also available: The µSlicer $700; 8087 Math Co-Processor Bd. (call); 10 MB Hard Disk $700; W.D. 1002-SHD H.D.C. Bd. $200; Enclosures, Power Supply, and Support Hardware.
CP/M 86 $85, CCP/M $250 (Digital Research, Inc.); MS DOS $175 (Microsoft Corp.)
MasterCard, Visa, Check, Money Order, or C.O.D. Allow four weeks for delivery. Prices subject to change without notice.
QUALIFIED DEALER INQUIRIES INVITED
Slicer Computers Inc.
2543 Marshall S.I.E.
Minneapolis, MN 55418
612/788-9481
Telex 501357

DATESTAMPER™
Now! Automatic time and datestamping for CP/M® 2.2

Avoid erasing the wrong files!
Back up files by time and date!

"DateStamper...is a real winner."
Bruce Morgen, Users Guide, July-Aug. 1985
Write or call for further information (714) 655-4432

SERVO INDUSTRIAL PROCESS CONTROL BOARD
14 Bit Lab Accuracy
Industrial Durability
The Features of 5 Boards in One.

The Servo Process Control Board is a general purpose multi-channel analog and digital input/output controller which can communicate with and control most medium-scale industrial processes. Designed to work with the Servo Industrial Microcomputer, (or other computers which support the SASI interface), it offers great accuracy at prices starting as low as $495.

- American made
- MILSPEC components
- 1 year warranty
Maximum configuration includes: 192 analog inputs 512 digital outputs 64 analog outputs 128 digital outputs Based on the INTERSIL 14 Bit A to D converter Communicates with any micro or mainframe computer Easily programmed in high level languages (Turbo Pascal, Microsoft Basic, Fortran, etc.) Features a complete multipurpose, labor-saving data acquisition/analysis system that combines high level programming with fast turn-around times.

SERVO COMPUTER CORPORATION
360-B N. Ellensburg St.
Gold Beach, OR. 97444
(503) 247-2021

Micro/Systems Journal March/April 1986
The CP/M Bus

by Bob Blum

Starting a new column for a magazine I have never written for is a little unnerving. For almost three years I wrote a CP/M column in Dr. Dobbs Journal and as you might expect, in that length of time I became very comfortable doing it. The primary reason for my peace of mind, though, was the responsiveness of the readers. I depended heavily on them to provide me with their feedback on how I was doing and most importantly to tell me what type of material they wanted to read. These ideas, many times, became the subjects of columns. As you can see, my job wasn’t very difficult, all I had to do was listen.

HELP.....

To get this column started on the right foot I need your help. The more quickly I get to know you and your interests the faster I can begin to cover the subjects most important to you. Drop me a note or leave a message on my Bulletin Board System describing your interests. Or maybe you have a nagging problem that seems to be insolvable. I may not be able to help, but I'm sure some readers can. Have you run into a particularly good program lately? Tell me about it. No matter whether it came from the public domain or you purchased it commercially, personal recommendation is always the best reason to investigate a software package for potential review. And while you’re in a giving mood don’t forget to send along those special programs or subroutines that you worked so hard to develop.

If you still aren’t moved to write, do it as a favor to me, just to impress my editor. After all, I'm the new kid on the block and need all the help I can get.

DON'T FENCE ME IN

There are, of course, some guidelines that I must follow when deciding what material to work with. The border of my columnistic territory is the world of CP/M compatible 8-bit machines, not including the IBM-PC or PC compatibles. The IBM-PC is a 16-bit machine, you say? Bear with me, I will dispel that myth in a moment. These bounds may at first seem to limit severely the amount of material worthy of coverage, but let me assure you that as glamorous as they may seem, there is a lot of useful life left in those 8-bit work horses.

Rather than limiting the editorial content of this column to just the highly technical issues surrounding CP/M I hope to give equal time to new products as well. Many companies, mainly the smaller one and two man shops, continue to produce an amazing assortment of new software packages. But again, the direction I take will be based on your guidance. So, let me hear from you.

IN THE QUEUE

I always have a seemingly endless list of projects in one state of completion or another. Mine is a problem of priority, not one of too little to do. Nonetheless, as they are finished I will make the source code, if any, available on my BBS and space permitting, run the listings here as well.

The projects that I am currently involved with include both hardware and software items. Here are a few:

I’ve spent some time with the latest single board computer being produced by Micro Mint. This little barn burner, smaller than a mini-floppy disk drive, sports the HR64180, the newest 8 bit chip being produced by Hitachi. I’m told that this device is at least as powerful as an 8 MHz Z80 while offering a much higher level of integration that includes I/O ports and other features that normally require many external devices. The most exciting in its long list of extended capabilities is its ability to address 512K of memory. My plans call for a review and then to port CP/M+ over to it taking fullest advantage of its advanced features. I think in a short time that a new level of performance will be established.

I have been using DSD80, a DDT compatible debugger with many new and useful added functions, for a while. It's a very solid package that turns the drudgery of debugging into an art form.

Outside of porting CP/M+ to different machines my favorite project is comparing CP/M compatible operating systems. I have successfully implemented three out of the four packages that I have been able to find. I think you will be just as excited by the results as I am.

SOURCES MENTIONED IN THIS COLUMN

SB-180
Micromint, Inc.
25 Terrace Drive
Vernon CT 06066; (800)635-3355

Intercontinental Micro
4015 Leaverton Court
Anaheim CA 92807; (714)630-0964

DateStamper
Plu+Perfect Systems
54310 N. Circle Drive
Idyllwild CA 92349; (714)659-4432

Ztime-l
Kenmore Computer Technology
20 Landers Road
Kenmore NY 14217; (716)877-0617

Z80ASM
SLR Systems
1622 N. Main Street
Butler PA 16001; (800)833-3061

DSD80
Soft Advances
Box 49473
Austin TX 78765; (512)478-4763
A MYTH DISPELLED

I don't usually go out of my way to harass a person or to intentionally belabor a subject, but when just the right situation presents itself, I can't resist quoting the following passage from the introduction of the Intel "iAPX 88 Book." It clearly sets the record straight on how the manufacturer intended the 8088 to be classified and summons some interesting facial expressions followed by sputtering from those who would like to believe otherwise.

"This book describes the unique Intel 8088 microprocessor, the outstanding choice for 8-bit microcomputer applications requiring both high performance and low cost."

"The Intel 8088 is the most powerful 8-bit microprocessor available today, yet as easy to use as other 8-bit microprocessors designers have used for years."

Outside of the large amount of marketing rhetoric, these two paragraphs contain the phrase 8-bit often enough to dispel any doubt that the 8088 was designed as an 8-bit processor.

The CP/M Bus Bulletin Board System, operated by Bob Blum, is available for your use 7 days a week, 24 hours a day at 1200 baud. Reach it by calling (404) 449-6588.

S100

The P&T-488 interface package

- can control 15 IEEE-488 devices
- works with 8 operating systems
- works with Pascal, Fortran, Basic, C or assembler
- includes sample programs and GPIB monitor

Call or write:

PICKLES & TROUT®
PO. Box 1206
Goleta, CA 93116
(805) 685-4641

Z SETS YOU FREE!

Z Operating System, an 8-bit OS that flies! Optimized HD64180/Z80 assembly language code — full software development system with proven linkable libraries of productive subroutines — relocating (ROM and RAM) macro assembler, linker, librarian, cross-reference table generator, debuggers, translators and disassemblers — ready to free you!

High performance and flexibility! Productivity results from dynamically customized OS environment, matching operator, tasks and machine.

Real-time control kernel option allows quick software development for industrial control applications, other tools and utilities for office desk-top personal computing functions, local area networks to Ethernet, AppleTalk, Omnimint, ArcNet, PC-Net (Systek) — from micro to mainframe command, control and communications. Distributed processing application programs are easily developed.

- Extreme organizational flexibility, each directory another environment
- Multiple Commands per line
- Aliases (complex series of commands known by simple names) with variable passing
- Named Directories with absolute password security
- Full-screen command line editing with previous command recall and execution
- Shells and Menu Generators, with shell variables
- Command-file search paths, dynamically alterable
- Screen-oriented file manipulation and automatic archiving and backup
- 512 megabyte file sizes, 8 gigabyte disks handled
- Auto disk reset when changing floppy
- TCAP database handles characteristics of over 50 computers and terminals, more easily added
- Tree-structured online help and documentation subsystem
- 76 syntax-compatible support utilities

Your missing link has been found — Z! Now fly with eagles! Fast response, efficient resource utilization, link to rest of computing world — shop floor to executive suite, micro to corporate mainframe. Call 415/946-3820 for literature.

Echelon, Inc.
101 First Street • Suite 427 • Los Altos, CA 94022 • 415/946-3820

PC SPEEDUP

V20 REPLACES 8088, V30 REPLACES 8086

90 DAY WARRANTY, HONEST PRICES, NO HIDDEN CHARGES

V20 KIT, V30 KIT: Speed up any 8088 or 8086 based PC. Includes warranty, tool, V20/V30 processor, user guide, BIJS access to 3200 free PC programs.

TECHNICAL INFO: 100% compatible, 110 instruction superset, 8088 mode, CMOS, dedicated addl. and math hvw, dual bus, pre-fetch pointer, hi-speed block move.

PRODUCTS AND PRICES: V20/V30 kit in 5 or 8 mhz from $9.50 to $29.95 TURBO SEVEN kit, switchable to 7 mhz in standard IBM PC. Under $100, CALL VP/M the V20 CP/M emulator — CALL for details. "AT" crystal kits $2 to $8.

Exec-PC, Inc.
P.0. BOX 11191
SHOREWOOD, WI 53211

ORDER HOTLINE
(414) 242-2173

TECHNICAL INFO
(414) 242-2165

ORDER BY MODEM
(414) 964-5160

Micro/Systems Journal March/April 1986
This column discusses the UNIX operating system. If you have comments or questions about UNIX or this column, please write to Ian Darwin at Box 603, Station F, Toronto, Ontario, Canada M4Y 2L8. If you have access to the uucp network, mail "tlnp4kdarwinlIan". I can't always answer immediately, but I will get back to you; electronic mail gets answered first.

NEXT YEAR'S SYSTEM V - THROUGH THE KIMONO

Now that AT&T sells computers, they are trying to get makers of UNIX software to move to the 3B2 computer for development. So System V Release 3 (due mid-1986) will be based on the 3B2. An interim release (System V Release 2.1) will be available soon to source licensees. Dubbed an "interim porting base product" in a recent letter to source licensees, SVR2.1 will be upwards-compatible to SVR3. The interim SV will include the "Stream Input/Output System" described by Dennis Ritchie in the October 1984 Bell Laboratories Technical Journal, page 1897, as well as a "transparent remote file access" scheme that is probably the "V8 Network File System" described by Peter Weinberger in the Summer 1984 USENIX proceedings, page 86. However, an article in $ echo, AT&T's Software sales and licensing glossy newsletter, does not mention streams or the remote file system. These two packages are major innovations in the UNIX operating system; if they make it into System V without substantial change during their installation, then SVR3 will be worthwhile. Read the papers cited and see if you agree.

SVR2.1/SVR3 also include demand paging for the 3B family, as already implemented in SVR2 Version 2 for the VAX. There's also a facility for loadable device drivers; this could be a boon for driver writers. For database use, SVR3 will also include mandatory record and file locking, which should be upwards compatible from the John Bass advisory record locking scheme. There's something called "file system hardening", which sounds like they're putting files in an underground bunker. One part of File System Hardening is an automatic periodic sync() as was done by update in V6 and later systems as far back as 1973; it's not clear why this needs to be added to UNIX at this stage. There are alternate interfaces for end-users and system administrators. The "Basic Networking Utilities," known outside AT&T as the "honey danber" version of uucp, is also included. "Honey DanBer" is named after P. Honeyman, D.A. Nowitz and B. E. Redman, its developers; AT&T is too corporate, too official, too stuffy to allow anything to be named after authors. Honey DanBer previously sold separately.

However, some useful features of Seventh Edition Bell Labs UNIX are still missing from System V Release 2; it would be nice if they could make it into SVR3. I refer to the refer program, the dbm library, ranlib, learn, a full-function mv, and struct. These could still be added to SVR3 to make it a more comprehensive release of UNIX and to make software yet more portable. AT&T is obviously trying to pack as many features as they can into the system. Let's hope they can get the significant features from other UNIXes but not make a package with so many features that the essential simplicity of the system gets lost in the shuffle. Many would argue that System V has already lost the original clean design; perhaps in this release AT&T will remove some little-used features to make room for the good stuff they are adding. In fairness to AT&T, the System V Interface Definition does make some "features" optional; my complaint with the SVID (pronounced as a monosyllable by AT&T people) is that it makes optional far too much of the system. One could nominate some of the System V shared memory facilities for the optional or even removable category, but somebody will no doubt claim they are "essential." Or does the need for "backwards compatibility across the ages" prevent AT&T from ever removing a feature?

USENET UNDERGOING EVOLUTION

All things must change, especially things that are kept online, and USENET is no exception. USENET is the network of computers that exchanged electronic news by the USENET protocol documented in "RFC850", a standard for the interchange of news. Most of these systems run the UNIX system, and most use uucp to transfer data. But with the growing popularity of UNIX, the number of sites connected to USENET has mushroomed. This network was designed and built when there were only a few sites, and most of the people using UNIX were knowledgeable, responsible individuals. To judge by the quality of some postings seen recently on USENET, one could judge that the majority of people on USENET are neither knowledgeable, nor responsible, nor even particularly mature. To do so would, however, be to underestimate the large silent majority who read news but seldom posts it, and who speak with a calmer, more reasoned voice when they say anything.

But the volume continues to grow. And that means the phone bills continue to rise. Some of the large "backbone" sites, in the name of corporate philanthropy, pay phenomenal phone bills to support USENET. Others pay the phone bills by passing the hat to those sites that they pass news on to. And all these sites are attempting to cope with the phone bills. There are many people who feel that USENET cannot be saved, that it has already passed the point of no return, like a ship that has taken on too much water. But others continue to work to keeping the net running.

The simplest way to reduce phone bills is to reduce the number of newsfeeds transmitted. USENET news is organised into newsgroups, or interest topics. Some of the backbone sites have dropped some of the newsgroups with the lowest signal-to-noise ratio - discussion groups where emotions speak louder than facts, and meaningless chit-chat clogs the network, much like the worst of Citizen's Band Radio in a large city. These groups are being terminated, in hopes that the discussions they unleashed will continue as private mail, being sent only to the sites of those who are interested.

Technological means of reducing the costs include compression and higher baud rates. Compression of news reduces its volume by 50 or 60 per cent, at the cost of a small amount of CPU time. Since the compression can usually be done overnight, when the machines are least busy, the CPU time is readily available. Thus compression can cut almost half the phone bill, and is used on most (probably all) major news feeds. Dial-up modems running at 2400 baud cut the transmission time in half (more or less, given turnaround delays and the like). Speeds of 2400 are now common for long-distance news feeds. And 9600-baud dialup modems are appearing on the horizon; I'd expect to see the backbone sites using them within the year (aha! My one new
year's prediction for 1986) if they can agree on one of the incompatible 9600-baud protocols. European sites tend to use lower-cost X.25 packet transmission, and they subscribe to a subset of the news. They are tangentially involved in one of several efforts underway to write a far more efficient version of the news software. I hope to have more to say about this in the near future.

But the volume continues to grow.

Additional solutions include moderated newsgroups and satellite transmission. Moderated newsgroups are controlled by a single moderator (see the discussion of "mod.sources" in the last issue's UNIX File). These provide a valuable service to USENET in reducing the volume of inept postings, filtering out duplicate postings, and in generally sorting the wheat from the chaff. Satellite transmission (pioneered by Lauren Weinstein with support from USENIX and others) will, if and when it gets off the ground, provide for economical distribution of a totally moderated USENET-like service piggybacked on satellite television transmissions.

But the volume continues to grow.

Additional solutions are required. Much of the problem of too much traffic is due to inept or inappropriate postings. Each site is given a series of files to give new users, providing instruction in use of the software. Every month, an introduction for new sites is posted to all sites. But it sometimes seems that people would rather write than read, since every month a number of new users joins the network and posts something stupid, or asks the same questions that are asked all the time (so often that they are summarised in the introductory documents). Please, if you are a new user of the net, make sure you learn from your site administrator the difference between mail and news. Make sure you know the difference between posting to a local group (that only affects people on your machine, or in your city), and posting to a North-America-wide or worldwide newsgroup. You may think that the 1977 Ford or Chevy you're trying to sell is important, but be assured that people in the Netherlands or Korea really don't want to read about it. Please read the introductory documents. Please read others' postings for a month or two before you post anything.

People occasionally defend their mistakes by referring to some implied "right to post", as though it were the same as the right to free speech. Free speech is a political concept, and a good one, but it is not the same as the right to force another person to distribute your words. USENET is a volunteer organization, maintained by volunteers, system administrators and UNIX experts, many of whom work on USENET outside their regular assigned job duties just to keep the net running. The telephone bills are often paid for by organisations far from where the article originated. I'd like to express my thanks to all of these people. You can show your thanks by using the net intelligently. Intelligently use of USENET requires following a number of rules; perhaps the most general formula is "Stop and think before you post."

**ETHICS & ETIQUETTE FOR ELECTRONIC MAIL?**

Most early uses of computers involved scientific computation, but electronic mail has been in use for at least 15 years, longer than those raised on IBM PC's knew that computers existed. Two people who have been using computer mail for 15 years have written a short booklet titled *Towards and Ethics and Etiquette for Electronic Mail*. Some of it overlaps with the USENET introduction, but not everybody has a copy of that, and it covers some other aspects. If you're using electronic mail or USENET or the ARPA Net or any other major electronic mail network, or a public access bulletin board system, or planning to use electronic mail, you should read *Ethics and Etiquette*. If it's not in your computer library, send U.S. $4.00 with your name and address and the name of the report, *Ethics and Etiquette for Electronic Mail*, to Rand Publications Department, 1700 Main Street, Santa Monica, CA 90406, U.S.A.

**ERRATA**

Last issue's discussion of *join* failed to make explicit one important fact. The input files have to be sorted. If you read the manual page, you'd know this. It was noted implicitly, and pre-sorted my sample texts. But the *whopays* shell script was flawed, and works erratically; it had given me output just by chance when I first wrote it. Here is the exact version I am currently using:

```bash
#!/bin/sh
# whopays - who is on as a paying customer (system specific)
# $S = /tmp/whop2.$
# $G = /tmp/whop1.$
trap "rm -f $F $G; exit" 0 1 2 15
who | sort >$F
pwent "cut -f1 -d' ' $F | grep -v '' | sort -s" >$G
join $F $G
```

The *pwent* program is a local system program that prints password file entries. The ",'z" is a local convention for internal (non-paying) users.

That's all for this month. I welcome letters and electronic mail on these and other topics, especially suggestions for future columns. Cheers!

---

**The SB180 Computer/Controller**

**NEW**

**COORD180-M S**

optional peripheral board adds 1200 bps modem and SCI hard disk interface.

**TO ORDER**

**CALL TOLL FREE**

1-800-635-3355

**TELEX**

643331

**Micromint, Inc.**

25 Terrace Drive

Vernon, CT 06066

**BYTE Magazine called it.**

"CIARCIA'S SUPER SYSTEM"
The Data Base Forum

by Nelson T. Dinerstein

This column will be a regular feature in M/SJ. It will discuss problems associated with the application of database managers such as dBase-II/III, Framework, and Rbase 5000. Suggestions, comments and questions are welcomed.

ARITHMETIC ABERRATIONS WITH dBase III

You may occasionally find that arithmetic operations do not work as expected in dBASE III. Take, as an example, the following situation. A database file contains an integer field named TNUMBER. Append a record to this database and REPLACE the value of TNUMBER with 10/3 (ostensibly the value 3). When you examine the content of the field TNUMBER with LIST or with EDIT, the value is 3 displayed, but the value actually stored in TNUMBER is not exactly 3. As a result, both

? TNUMBER = 3

and

? TNUMBER = 10/3

yield the result,

.F.

Thus, when you test the value of TNUMBER against the expected value in a program, the test always fails. If you REPLACE the value of TNUMBER with 10/2, the value stored in TNUMBER really is 5, so the test for equality does work correctly when an integer is placed in the storage location. To overcome this type of problem, you may wish to use the old FORTRAN trick of testing for equality by seeing if the value in the database record is "close" to the desired value. For example, instead of using the test,

TNUMBER = 3

use the test,

ABS(TNUMBER-3) < .00001

In this case, the result of the test is,

.T.

Note that ABS is a function not available in dBASE III, but is available in DEVELOPER'S RELEASE of dBASE III.

Another possible solution to this problem is to use a combination of the VAL and the STR functions. When you store a real number in a database field, dBASE III may need to truncate it so that it will have the correct length. You can perform a similar truncation in the following manner:

1. Assume that the definition of the field NUMB is N,5,2.
2. Replace NUMB with 10/3.
3. ? NUMB = 10/3 returns the value .F., but
4. ? NUMB = VAL(STR(NUMB,5,2)) returns the value .T.

DEVELOPER'S RELEASE

Developer's Release from Ashton-Tate contains a number of "goodies" especially for the systems developer. Some of these appear to be additions that should have been in the original version, e.g. the ABS function. Some of the more useful features of the Developer's Release are summarized in the following sections.

DEBUGGING: Two that can help you debug a program are the HISTORY mode and the ability to resume the execution of an interrupted program. Use the HISTORY mode to collect a copy of the commands executed in your program. Once the collection has been created, you can edit it and resume execution from that point. You may also display the HISTORY file to see the order of execution of the statements in your program. When you halt the execution of a program by pressing the ESC escape key, dBASE asks whether you wish to cancel, ignore, or suspend. Use CANCEL to abort execution of the program, IGNORE to continue execution of the program as if it had never been interrupted, and SUSPEND to save enough program information to restart the program from the point of the interruption (RESUME). If the program is cancelled, LIST MEMORY shows 0 active memory variables. After a program is suspended, you may perform a number of operations and then resume execution of the program from the point of interruption. In particular, you may display the names and values of the memory variables, as well as list the structure of a database. Since a cancel deletes all information concerning the memory variables, the option to suspend a program is particularly useful when interactively debugging a program.

Note that dBASE III will also ask if you wish to cancel, ignore, or suspend the execution of a program if an error is encountered during the execution of a program.

ASSEMBLY-LANGUAGE INTERFACE: You can call assembly-language routines from your dBASE III program. If you are building a system that uses, for example, a nonstandard input device (like a magnetic-card reader), you will find this feature particularly attractive.

MEMO FIELDS: Use the SET MEMOWIDTH command to set the width of each line when the contents of the field are being printed (or listed on the screen). In this manner, you can control the width of the printed output if you are using a memo field to hold the text of a letter.

ERROR AND KEYSTROKE TRAPPING: The ON ERROR, ON ESCAPE, and ON KEY commands can be used to execute a command file (program) if either a dBASE III error occurs, the escape key is pressed, or some other key is pressed. After the ON KEY command has been used, you can determine which key was pressed by examining the command buffer with either the INKEY or READ commands.

CHARACTER-STRING MANIPULATION: New character-string manipulation functions allow you to perform operations such as:

1. Substring search from the left-hand-end of the string.
2. Substring search from the right-hand-end of the string.
3. Remove leading or trailing blanks.
4. Insert a substring into a string (without rebuilding the entire string), and
5. Use PICTURE clauses in output statements other than the "@ ... SAY."
MATHEMATICAL FUNCTIONS: The new mathematical functions are,
1. ABS - absolute value
2. MAX - larger of two values
3. MIN - smaller of two values
4. MOD - Modulus

SED - THE SMART SCREEN EDITOR: Developer’s Release comes with the SED editor. This editor is useful for creating screen displays that may need to use @ ... SAY’s for input and/or output. After you have completed “drawing” the document or report on the screen, you can save the screen image and create the dBASE III program needed to display the same image on your screen or printer during the program run. SED is smarter than ZIP, which is the 8-bit version of SED, since it can generate wide output for reports. Unfortunately, SED cannot handle graphics characters, but I expect that you will find this program helpful anyway. The documentation for SED in the Developer’s Release manual is essentially nonexistent, but there is an on-line help function which provides a full set of documentation. Indeed, you can create a manual just by printing this function.

THE COMPILER: One of the nicest features of Developer’s Release is its ability to compile your dBASE III programs. The product of the compiler is not a .COM file, but something like P-code. All of the programs in your application are collected into one large file and simplified in a number of ways. The result executes faster than the original (ASCII) code and is not readable by the user. Unfortunately, a special runtime system is required to execute this code. The Developer’s Release comes with the compiler, but your client will need to purchase the runtime system separately.

Nelson Dinerstein is an Associate Professor of Computer Science at Utah State University and an active consultant in database applications on micros. He has a Ph.D. in mathematics from the University of Utah. And, he is the author of 8 books on dBase-III/III, Framework, and Rbase 5000 applications.

GRAF 3.0

$49.95 $69.95

Full Screen Editor for MS-DOS (PC-DOS)

Looking for an Ultra-Powerful Full-Screen editor for your MS-DOS or PC-DOS system? Are you looking for an editor FULLY COMPATIBLE with the UNIX® VI editor. Are you looking for an editor which not only runs on IBM-PC’s and compatibles, but ANY MS-DOS system? Are you looking for an editor which provides power and flexibility for both programming and text editing? If you are, then look no further because PC/VI IS HERE!

The following is only a hint of the power behind PC/VI: English-like syntax in command mode; mnemonic control sequences in visual mode; full undo capability; deletions, changes and cursor positioning on character, word, line, sentence, paragraph or global basis; editing of files larger than available memory; powerful pattern matching capability for searches and substitutions; ability to invoke other programs from within PC/VI; macro capability; location marking; joining multiple lines; auto-indentation; word abbreviations and MUCH, MUCH MORE!

The PC/VI editor is available for IBM-PC’s and generic MS-DOS based systems for only $149. Available in 5¼", 8" and 3½" disk formats Minimal System Requirements: MS-DOS Version 2.00, 256KB, 1 disk drive. Recommended system: 512KB and hard disk. Quantity and dealer discounts available. For more information call or write:

Custom Software Systems
P.O. Box 551 MA
Shrewsbury, MA 01545
617-842-1712

The UNIX community has been using the VI editor for years. Now you can run an implementation of the same editor under MS-DOS. Don’t miss out on the power of PC/VI!

*UNIX is a trademark of AT&T Bell Laboratories.
ATTENTION

C-PROGRAMMERS

File System Utility Libraries

All products are written entirely in K&R C. Source code included, No Royalties, Powerful & Portable.

BTREE Library
- High-speed random and sequential access.
- Multiple keys per data file with up to 16 million records per file.
- Duplicate keys, variable length data records.

Price: 75.00

ISAM Driver
- Greatly speeds application development.
- Combines ease of use of database manager with flexibility of programming language.
- Supports multi-key files and dynamic index definition.
- Very easy to use.

Price: 40.00

MAKE
- Patterned after the UNIX utility.
- Works for programs written in every language.
- Full macros, File name expansion and built-in rules.

Price: 59.00

Full Documentation and Example Programs Included.

ALL THREE PRODUCTS FOR 149.00

For more information call or write:
softfocus
1343 Stambaugh Drive
Oakville, Ontario, Canada
L6L 2J5
(416) 825-0903

Credit cards accepted. Dealer inquiries invited.

S-100 BOARDS

DUPLEX 816: 8 Mhz, 80B08 & Z80H CPUs, 2 RS232 Serial Ports, 5 & 8-inch Floppy Interface, 8 kbyte ROM, Memory Management to 16 Mbytes & Interrupt Handler. Runs PC-DOS, CP/M-80, CP/M-86, and Concurrent CP/M-86. CP/M-80 vs 2.2 included. Price: $995.

CPU2O: 4 or 6 Mhz Z80, 2 RS232 Serial Ports, Memory Management to 1 Byte, Programmable Timer, Vectorized Interrupt. Price: $316.

DD-ASM: Double Density Floppy Disk Interface, including boot ROM, Direct Memory Access, CP/M 2.2 operating system. Price: $316.


SOFTWARE

DB-3: The Tarbell Database System, for PC-DOS, CP/M-80, CP/M-86, or Concurrent CP/M-86. Multi-User File Locking, Interactive Program Generator, Up to 16 Files Open at Once, Extensive HELP system, Multi-Field Sort, and Multi-Line Field Type. Price: $95.


INV: Manufacturing Inventory System, written in dBASE-II. Items may consist of as many levels of other items as desired. Menu includes buying, receiving, packaging, shipping, listing, totaling, and others. Price of source: $80.


TBAS: Tarbell Disk BASIC Interpreter. Has many extra functions, such as high-speed file search, I/O re-assignment, procedures, and alphanumeric labels. Price: $49.

PCPROM-SRC: Assembly-Language source for our own ROM-BIOS that's used on the Duplex 816 to boot up PC-DOS directly. Price: $150.

TARBERELL ELECTRONICS

1082 E. Artesia Blvd., Suite C
Long Beach, CA 90805, (213) 422-7081

Micro/Systems Journal March/April 1986
Now Available! FULCRUM'S New...

256K STATIC RAM

- 8/16 Bit Transfers
- 24 Bit Extended Addressing
- Battery Back-Up

$495

Designed For Speed & Flexibility.

MPUZ CPU

This NEW MPUZ CPU utilizes the Z-80 8MHz uP as a basis for its 8MHz CPU for S-100 systems, and has been carefully designed to meet the requirements of the IEEE - 696 standard. The quality and performance this CPU provides is rarely found in S-100 products, and you can see why... only $299

- 4 or 8MHz clock rate
- Two RS-232 serial ports
- Centronics printer ports
- Real time clock with battery back-up
- Vectored interrups to any block location in memory
- Programmable timer
- ROM monitor
- Power on Jump
- On board wait states
- 2K of RAM space
- 24-bit extended addressing
- Latched Status
- Front panel compatibility
- MPM support

Best Value In Disk Controllers.

OMNIDISK

Now the FULCRUM OMNIDISK offers S-100 systems users a unique marriage of component compatibility and technological innovation. These together produce features not found in any conventional disk controllers made today. See for yourself what tomorrow looks like... only $299

- Simultaneous support of both 5½" and 8" floppy disks and hard disks
- Complete 24 bit DMA
- Power on boot for 5½" and 8" floppy and hard disks
- Power on boot PROM
- On board de-blocking to save RAM space over BIOS
- Interfaces with the WD 1001 hard disk controller
- Supports 13 devices simultaneously
- Full track buffer allows controller to recall entire track
- DMA's at 10 MHz
- Supports MS DOS
- 10K on board buffer saves two K of TPA

So before you buy another S-100 component, call or write for our FREE catalog. And see how your system can benefit from the FULCRUM difference.

*CP/M 2.2 configured for OMNIDISK $60. *Trade mark of Digital Research. FREE UPS ground shipping on prepaid orders. Shipping is added to VISA, M/C, and C.O.D. orders. CA residents, please add sales tax.

FULCRUM COMPUTER PRODUCTS

64K memory board, Serial I/O 2.2 & Video I/O Interface boards, Relay board, I-8080, 8015 and 8035 main frames with 21 slot mother boards, CPA front panel and A/D board.
The Scientific Computer User
by A. G. W. Cameron

\textsc{\TeX} DEVELOPMENTS

I described the \TeX text formatting language in the September-October, 1985, issue of \textsc{Micro}Society, in an article which was a precursor to this column. There have been a number of interesting developments between last summer and now (November), and so \TeX-related matters will occupy most of the column this time.

During the month of August I had an interesting time participating in the scientific word processing project of the Technical Special Interest Group of the IBM PC Users Group of the Boston Computer Society. A fairly large number of word processors, claimed by their vendors to support equations and other requirements of scientific word processing, were reviewed, and the whole effort culminated in a scientific word processing fair during the month of September, at which several of the vendors exhibited, including both Personal \TeX (with \textsc{PCTeX}) and Addison-Wesley with \textsc{MicroTeX}. The final report will be published by the American Mathematical Society in the January, 1986, issue of their Notices. Reprints of the report are scheduled to be available from Carl A. Hein (Dunster House Apt. 7, Swan son Road, Boxborough, MA 01719) for $8.

The principal challenge to each of the programs was the reproduction of benchmarks of several different kinds, many of these being complicated equations, matrices, and other mathematical expressions which \TeX does very well. Three of them could not be done by most of the tested programs. These included an electronic circuit diagram, a Feynman diagram (which includes wiggly lines at various angles) and used in high energy physics), and organic chemical structural formulas. I succeeded in doing all of these using just plain \TeX. But I had to use \TeX as a plotting device, a task for which it was never intended. It is a tribute to the versatility of \TeX that it was possible to do this. I wrote a note for \textsc{TUG}boat, the newsletter of TUG, the \TeX Users Group, explaining how I made the wiggly lines; this was published together with a separate account of this project.

\TeX PRINTER DRIVERS

Since I wrote my last article on \TeX, my usage of this text formatting program has become more efficient and effective, primarily due to the availability of new \TeX drivers for various output devices. I am grateful to Lance Carnes of Personal \TeX for review copies of the Textset drivers that I will describe below.

\textbf{The Marriage of \TeX and PostScript}

In my \TeX article I complained about the painfully slow output using the Epson FX-80 printer. I was therefore very thankful when Personal \TeX came out with a driver for the Epson LQ-1800 ($100). This printer uses a head with 24 striking pins, and so it does in one pass what the FX-80 does in 12 passes. The resolution of the printer is not as good, just 180 by 180 dots per inch, and so the output does not have quite as good a quality as that from the FX-80, but in view of the excellent speed of the printer it immediately became my preferred output device, initially for the preparation of papers, and later for preparation of drafts. This paragraph has been prepared using the LQ-1800, so that you may have an opportunity to judge the output. We are using nine point type here, which severely strains the capability of any dot matrix printer; the output looks better for 12 point type.

The most important \TeX news is the availability of drivers for laser printers and for screen preview on PCs and compatibles. The least expensive laser printer is currently the Corona, where an insert card in the PC sends the image dot pattern to the printer. Personal \TeX now has a driver for this (at $200) which requires a RAM disk with a little more than a megabyte of storage for a full page image. There is still fine tuning to be done, however, since the kerning information is only approximate. Kerning refers to the fine adjustments in horizontal position needed to fit the shapes of two adjacent letters neatly together. Ligatures are supported, however. These are letter combinations treated as a single unit; see for example the "fi" which is printed as "fi" in this column's title.

In addition to this Times Roman, one can use Times Italic, Times Bold, and the combination Times Bold Italic. This is Helvetica, part of a sans-serif family, which includes Helvetica Oblique, Helvetica Bold, and the combination Helvetica Bold Oblique. This Courier font has uniform spacing and is intended to appear like typesetter output; also available are Courier Oblique, Courier Bold, and Courier Bold Oblique. An internal Symbol font has Greek and math symbols; this can be accessed but there is ordinarily no reason to
do so. The MacIntosh and the LaserWriter are being used in a whole new activity called desktop publishing; the combination of the PC, \TeX, and the LaserWriter can also be used for this purpose.

**POSTSCRIPT**

Of particular importance to the scientist is the use of the LaserWriter as a plotting device. It is the best such device that I have ever used. The PostScript language is somewhat like Forth in using reverse Polish notation in combination with stacks (apparently it has been written in Forth). To add 1 and 2 you say "1 2 add". To plot a line from points (2,3) to (5,6) you say "2 inch 3 inch moveto" followed by "5 inch 6 inch lineto". You can vary the widths of lines and the shape of the line ends. You can fill areas with any shade of grey between white and black. You can draw arcs, circles, ellipses, or spline fits. You can draw lines with any chosen pattern of dashes in any combination of lengths. You can place text where you want and make it follow arbitrary paths. You can translate, scale, and rotate any or all of the above.

PostScript is thus a language devoted to page description. In order to learn the language the PostScript user should obtain two books recently been published by Addison-Wesley. One is PostScript Language Reference Manual (at $22.95) and the other is PostScript Language Tutorial and Cookbook (at $16.95); both give as author only Adobe Systems, the Palo Alto firm that developed PostScript. The second book is very well done and is essential to getting started, and possibly you could do without the other, but not if you want to do serious programming in PostScript.

I rate myself in the novice class in making use of PostScript for plotting. I have typically done the following with some numbers that I want to plot. I will write a Fortran program to read in these numbers and to write out a PostScript program to do the plotting. This program is then wrapped in a \TeX shell, \TeX'ed to produce a DVI, or device independent, file, run through the Textset driver to produce a PS, or PostScript, file, and then shipped to the LaserWriter for output. This may sound like a complicated procedure, but it is actually straightforward.

The good news about this procedure is that it allows the merging of graphics and text, using \TeX. I have been able to produce preprints with my figures inserted on the current page (if I have not already placed too much text on the page) or on the first available page following. I give here an example of a recent plot which I made for a paper; it is inserted, reduced in scale by a factor three, at the top of one of these columns, using the \TeX "topinsert" procedure. Note how well the features of the plot are reproduced by the LaserWriter, despite the reduction in size.

**SCREEN PREVIEW**

The screen preview driver (at $250) was also developed by Textset. Presently the LaserWriter is supported, and shortly the IBM Enhanced Graphics and Tecmar graphics boards will also be supported. You \TeX a file to get the DVI output, and then Preview will show you on screen a portion of a selected page. You must enter into hard disk storage three sets of font files, at 80, 118, and 300 dots per inch (dp), and at least four megabytes will be required unless you discard some of the fonts (the Textset font files are stored more efficiently than standard \TeX font files). With these font sets you can see how the pages will look subject to the limitations of the screen resolution. With the 80 dpi fonts the image is too small to be read reliably, but positioning information is clear. The standard page width fits well within the screen width, but the full vertical extent of the page is not visible. With keyboard keys the image may be shifted in any direction, but typically three or four seconds is required between shifts. With the 118 dpi fonts the width of a standard page is greater than the screen width, but I was able to change the default font size to match these two widths. These fonts can be read with difficulty. Finally, the 300 dpi fonts may show you about one-quarter of a line width, but the symbols are extremely clear and this is very good for checking equations. Keyboard commands to magnify or shrink switch between font sets. If you want to use internal LaserWriter fonts in your document, then you have to tell Preview what fonts to substitute for them. In that case the positioning of the characters will be correct but the substituted font may look a little strange. You can also ask Preview to display the attributes of any selected character.

Preview will be extremely valuable for someone who is using a slow output device such as the FX-80 printer. With a fast output device such as the LaserWriter handy it can still be highly useful, because you may only want to check one small point on one page. And, of course, Preview does not understand PostScript.

**MISCELLANEOUS**

I expect important new developments for \TeX users to occur during the next few months. Version 1.5 of the \TeX program at Stanford University should be officially released shortly, and both of the \TeX vendors are expected to come out with this version by the end of 1985 or early 1986. Many new technology printers are under development, including light emitting diode (LED) 300 dot per inch machines which should sell to end users for about $1000. These will put desktop publishing within the reach of nearly everyone. There are sure to be \TeX drivers promptly produced for these. It is likely that you will need to install one of the new enhanced memory cards which will allow a full page image to be established before it is sent to the printer. This is how Personal \TeX has implemented their Corona driver, and how they will implement the driver for the Hewlett-Packard Laserjet using the Tall Tree LaserJet card.

Apparently PostScript is about to be adopted widely. I have heard from two sources that Adobe Systems' biggest customer is as yet unannounced; could this be a company with three well known initials? I have space only to mention some products received for review that I will address more fully later. MATRIX 100 is a product in interpreter and compiler form that allows you to add many operations to your Basic programs (from Stanford Business Software). PMATE version 4.0 is now released from Phoenix Software Associates; this is my favorite editor and the new version has customized versions for word processing and Fortran and C development. There is now available a plotting program which makes use of the full resolution of the Epson FX-80 printer; it is Sciplot from MicroGlyph Systems.

A. G. W. Cameron is Professor of Astronomy at the Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138.
Converting From CP/M To MS-DOS On The PC

by Robert J. Stek, Ph.D.

Readers of Micro/Systems have generally worshipped at the altars (Altairs?) of S-100, CP/M, and 8" disks. And while these bastions are still alive and strong, nonetheless, subtle influences of the Force are being felt by those among us for whom BASIC-E, paper-tape readers, and the Kansas City Standard were daily invocations. I am referring to the potentially important phenomena MS-DOS, BASICA, and PC compatibility. While I have lingered at some great addresses such as 100H, E800H, and C000H, I must admit that I have entered Chapel Perilous and am the owner of (dare I say it?) an IBM PC. But this transition has been fraught with frustration and a great gnashing of teeth. With over 50MB of CP/M programs and data on 81/2 disks, I could not abandon my Z80 world completely and suddenly. This article explores some products and services which have helped ease my conversion hysteria over the last year or so.

BABY BLUE

By reading the IBM bulletin board on the SOURCE, I was able to purchase a used Baby Blue I (Xedex Corp., 222 Rt. 59, Suffern, NY, 10901, (914) 368-0353), a Z80 coprocessor board for the IBM, for a very reasonable price. For the IBM PC (and compatibles), Baby Blue (and its successor, Baby Blue II) adds the ability to run almost all CP/M-80 programs. It will run plain-vanilla, no-tricks, maximally-portable, hardware-independent CP/M programs. It supports BDOS functions, the BIOS jump table (but don't use the disk primitives!), and file extents. It does not implement I/OBYTE, user areas (everyone is always user 0), file attributes, or software write-protection of disks. Certain CP/M disk utilities run, but produce incorrect information (e.g. STAT) and certain other utilities (e.g. DUU) can really create havoc. But most commercial applications work fine with the exception of communication programs which are hardware specific and do their own direct I/O. When not in use by the Z80B, the 64K of on-board memory can be used by MS-DOS (or mapped out of memory if desired). Baby Blue II offers 256K of memory plus other features, making it a possible alternative to add-on memory cards for the PC.

Baby Blue does not actually implement CP/M per se, but rather lets you convert a CP/M-80 program to run in the MS-DOS environment. Assuming that you have transported a CP/M .COM file over to MS-DOS format (we'll get to that later), you "attach" a 4K header to the CP/M program with utilities provided by Xedex. This header allows operation of the on-board Z80B and 64K memory with the CP/M program and translates the appropriate I/O requests from CP/M calls to make use of the IBM PC resources - video, keyboard, disks, printer, etc. - mediated by the 8088 and PC-DOS operating system calls. You get the equivalent of a 63.5K TPA - large enough for the most memory hungry programs. And since you are essentially running under MS-DOS, any files created by your CP/M program are automatically "translated" into MS-DOS files which can be TYPEd or used by MS-DOS programs. For example, files created by CP/M-dBASE or CP/M-WordStar are ready to use with the MS-DOS versions of the same program. The Z80B runs at 4.77 MHz, so most programs run a little faster than on a standard Z80A. And of course you can access any MS-DOS devices from within your CP/M program just as if they were CP/M devices, i.e. you can use an MS-DOS hard disk or RAM disk.

Baby Blue is supplied with a CONVERT utility which allows your PC to read 5 types of CP/M formatted disks - NEC PC-8001, IMS 5000, DEC VT-18, Heath-Zenith, or CP/M-86. This utility will be discussed later in this article.

I have "converted" many CP/M programs to run under Baby Blue, including dBASE II, MBASIC, and the BDS compiler. Since I am more pragmatic than adventurous, I have not tried to deliberately find out which CP/M programs could possibly trash my directory when run with Baby Blue. The "plain vanilla" programs I have converted have all worked well. If you want to run CP/M programs on your PC at full speed, Baby Blue is the way to go.

TURBOSLAVE-PC

If the old technology of the Baby Blue does not appeal to you, then perhaps the TurboSlave-PC will (from Earth Computers, Box 8067, Fountain Valley, CA, 92728, (714) 964-5784). The TurboSlave-PC is also a Z-80 based IBM-compatible co-processor card, but it uses a Z-80/8 operating at 8 MHz with 128K of high speed RAM (with interrupt generating parity error detection), two RS-232 serial ports (software programmable baud rates from 50 to 38.4K baud), and an internal
timer capable of generating real time clock interrupts. The TurboSlave-PC is I/O mapped instead of memory mapped, so it is possible to install up to 16 TurboSlave-PC’s in an IBM-compatible system. Multiple TurboSlave-PC’s with dumb terminals attached can be used to run CP/M and MP/M applications when used with the TurboDOS operating system for the IBM PC.

For the purposes of this article, however, the TurboSlave-PC can be used with the “CEPM” emulator software included with the board. The CPEM emulator is identical in concept to the software provided with the Baby Blue card. After porting CP/M software to MS-DOS, you must use the BUILD.COM utility to add a header to a CP/M.COM file (not necessary for overlay files) which provides the interface between MS-DOS and the CP/M program’s need for BDOS and BIOS calls. As with the Baby Blue software, plain vanilla CP/M programs which do not rely on the very lowest level of CP/M support (such as STAT, XDIR, DU) will work fine.

Although the Baby Blue’s clock speed of 4.77 MHz made it run a shade faster than a stock 4 MHz Z-80, a significant speed increase was noticed with the TurboSlave-PC. Table 1 shows the results of some timing comparisons running the BYTE Sieve program as a benchmark. Microsoft MBASIC-80 was used for the Z-80 processors, and IBM BASIC was used on a stock IBM PC running DOS 2.1, and IBM BASIC on the IBM AT under DOS 3.1 with an 8 MHz clock as well as with the standard 6 MHz clock. As you can see, the TurboSlave-PC wins hands down over a stock PC, and even gives the AT a run for the money. Of course, one benchmark is not enough to make final judgements, but it can give you some idea of the relative performance.

The Baby Blue card can be used as a 64K block of memory for your PC while the TurboSlave-PC’s 128K RAM is not accessible to the PC. On the other hand, the TurboSlave-PC does have two serial ports which the Baby Blue does not. And since the TurboSlave-PC is I/O mapped, it lends itself to some truly exciting applications which would be impossible on the Baby Blue. Its port mapped FIFO buffer facilitates high speed communications with the IBM PC’s processor on the PC bus; it can accept data up to 1 megabyte per second from the host. For example, it would be possible to write a program to use the TurboSlave-PC as a dedicated printer buffer, or for data encryption, or as a communications controller, operating independently of the IBM’s 8088 CPU. An even more interesting application would be to adapt CP/M (or better yet, Echelon’s Z-System with ZCP/R3) to the board so it could run independently of MS-DOS. Imagine being able to switch from MS-DOS over to CP/M-80, start running an application, detach your console from the running application, and return to MS-DOS to perform some other function concurrently. When done, you could reattach the console to the TurboSlave-PC, any messages from the running CP/M program would have been stored in the upper 64K bank of RAM for replay before interacting with the applications program again. That is true multi-processor, multi-programming concurrency!

By the way, the TurboSlave-PC board operates correctly in both 8-bit and 16-bit modes, and IBM BASICA on the IBM AT under DOS 2.1, and IBM BASICA, DOS 2.1 under DOS 3.0 and IBM AT under DOS 3.0 or higher.

Since Earth Computers did not supply a copy of TurboDOS with their board, I cannot comment upon the use of the TurboSlave-PC as a slave processor under those conditions. However, on the face of it, a few TurboSlave-PC’s in an IBM XT or AT might prove to be an acceptable alternative to a higher priced local area network if the application only requires CP/M compatible programs. If TurboDOS can handle the operating system requirements as well as the TurboSlave-PC can handle CP/M application programs, it should be a very good combination.

### TABLE 1

<table>
<thead>
<tr>
<th>Processor</th>
<th>Time (sec.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.0 MHz Z80, NorthStar Horizon</td>
<td>MBASIC 5.21</td>
</tr>
<tr>
<td>4.77 MHz Z80B, Baby Blue I</td>
<td>MBASIC 5.21</td>
</tr>
<tr>
<td>8.0 MHz Z80H, TurboSlave-P.C.</td>
<td>MBASIC 5.21</td>
</tr>
<tr>
<td>6.1 MHz HD64180, Micromint SB180</td>
<td>MBASIC 5.21</td>
</tr>
<tr>
<td>CP/EMUulator II, 6.5 MHz 80286 IBM AT</td>
<td>MBASIC 5.21</td>
</tr>
<tr>
<td>4.77 MHz 8088, IBM PC</td>
<td>BASIC, DOS 2.1</td>
</tr>
<tr>
<td>6 MHz 80286, IBM AT</td>
<td>BASIC, DOS 3.0</td>
</tr>
</tbody>
</table>

**The WORLD’S FASTEST Z-80 COMPUTER IS NOW A PC**

Earth Computer’s TurboSlave-PC™ is the world’s fastest Z-80 Coprocessor. Running at 8MHz, it was designed to permit operation of thousands of CP/M application programs on your IBM-PC, XT, AT™, or compatible computer system.

The TurboSlave-PC supports the TurboDOS™ multi-user operating system which allows up to 16 users on your PC. It is the only IBM-PC/Z-80 system that is MP/M™ compatible and allows TRUE multi-user, multi-process operations, including full record locking and security.

Discover a whole new world of high-speed (8MHz) single and multi-user applications for your personal computer. Discover the TurboSlave-PC™, the world’s fastest Z-80 Coprocessor, with such outstanding features as:

- 128K RAM with parity
- 2 Serial ports
- On-board Counter Timer
- S.L.R. Z-80 assembler included

**To order your TURBOSLAVE-PC, call or write to:**

EARTH COMPUTERS
P.O. Box 8067, Fountain Valley, CA 92728
TELEX: 910997 6120 EARTH FV
(714) 964-5784

Ask about EARTH COMPUTERS’ other fine PC and S-100 compatible products.

IBM-PC, XT, AT are trademarks of International Business Machines, Inc.; CP/M and MP/M are trademarks of Digital Research; TurboDOS is a trademark of Software 2000; TurboSlave-PC is a trademark of Eart Computers
Lattice Products Are Your Best Investment

Lattice Screen Editor $125.00
[LESE]—Designed as a programmer’s editor. LESE is fast, flexible and easy to learn, LESE’s multi-window environment provides all the editor functions you need including block moves, pattern searches, and “cut and paste”. LESE also offers special features for programmers such as its error tracking mode and three assembly language input modes. You can create macros to customize keystrokes, menu, and prompts to your style and preferences.

Lattice TopView Toolbasket $250.00
Provides more than seventy C functions for creating programs to take advantage of the IBM TopView environment. Speed TopView-specific program development with window, cursor, pointer, and printer control functions. Expedite program development with the debugging utilities included.

LMK*—Automated product generation utility for MS-DOS, similar to UNIX “Make”.

C-Spite*—Symbolic debugger for programs written in Lattice C or assembly language.

C Compilers—MS-DOS $500.00
and PC-DOS—The industry standard.

Panel**—High performance screen design and screen management system. Available for MS-DOS, PC-DOS, and UNIX systems.

dBC II or dBC III**—$250.00
C function libraries supporting indexed files that are compatible with dBASE II or dBASE III*

C Food Smorgasbord**—$150.00
Includes a BDC decimal arithmetic package, I/O functions, IBM-PC BIOS interface, terminal independence package, plus many other utility functions.

With Lattice products you get Lattice Service including telephone support, free updates during the warranty period, notice of new products and enhancements when you register, and a money-back guarantee.

Call us today for further information on these, or our many other C programs, utilities, and tools! Corporate site license agreements are also available.

Lattice, Inc.
PO. Box 3072
Glen Ellyn, IL 60138
Phone (312) 858-7950
TWX 910-291-2190

International Sales Offices
Benchux, De Volpi, Phone (312) 520-5123
England: Rondell, Phone (0872) 54275
Japan: Lifeboat Inc, Phone (03) 293-4711

CPM2.DOC—CP/Emulator II instructions.
CPM2.ASM—CP/Emulator II source code.
COMD.SYS—A system-command processor for CP/Emulator II that provides the usual CP/M commands such as DIR, ERA, SAVE, etc.

COMD.ASM—8088 Source code for COMD.SYS.

CPM2.DOC—CP/Emulator II instructions.
CPM2.ASM—CP/Emulator II source code.
COMD.SYS—A system-command processor for CP/Emulator II that provides the usual CP/M commands such as DIR, ERA, SAVE, etc.

Yes, it really works, and yes, it runs slowly. Assuming you have moved your CP/M files over to MS-DOS format, you need only rename any.COM files to .CPM. Enter “CPM2 *” and voila! You are now running a CP/M system. CPM2 provides a pseudo-CP/M environment within MS-DOS in which it is possible to run many programs originally designed to run under CP/M. Using CP/Emulator II, the 8080 code in the CP/M program is interpreted by CP/Emulator II, but the 8088 processor along with MS-DOS does all I/O. The CP/Emulator II acts as a program loader, an instruction translator, and a system-call translator to convert system calls from the 8080 CP/M program to a format which can be processed by the 8088 MS-DOS system. CP/Emulator II can run with any MS-DOS system having at least 128K. A 64K bank of memory following the program is used for the simulated CP/M environment. The simulated BDOS and BIOS start at 0FE00, giving the CP/M user program over 63K of TPA.

A few simple benchmark tests I performed with MBASIC indicated that a CP/M program takes from 4 to 5 times longer to run than an equivalent program run under BASIC. However, some COMP programs were only 3 to 4 times slower than when run with the Baby Blue card. When run on an AT or another faster processor, execution speed should approach that of a 2.5-MHz Z80 system! Not exactly as fast as lightning, but acceptable for running a few CP/M programs occasionally, and certainly the price is right. Since the source code is included, you can learn a lot about CP/M, MS-DOS, and 8088 programming in the process. Note, however, that it does not emulate Z80 opcodes, just 8080 instructions. Again, when sticking to “plain vanilla” CP/M programs I have had no problems with CP/Emulator II.

TRYING TO GET FROM 8 TO 5 DURING 9 TO 5

Both Baby Blue and CP/Emulator II depend upon having CP/M programs already available on MS-DOS formatted disks. Xedex does provide a CONVERT program to allow your PC to read, and therefore transfer from five different 5" CP/M soft-sectored formats. With over 100 different 5" formats available, however, it is obvious that a better solution must be found. And since I had 8" disks on my Morrow Decision I, I wanted the ability to read these CP/M formats on my PC as well. Since my faith in microcomputer technology is without bounds, I also had hopes of someday being able to read my 5" NorthStar hard-sectored disks, although I wasn’t too optimistic about a quick solution.

When I purchased my PC, I acted as my own systems integrator. Being “slot conscious”, I ordered an LNW Bus Board (LNW, Inc. -R.I.P.) enabling me to use their disk controller which could control both 5" and 8" disk drives under MS-DOS. A device driver provided the software necessary for integrating my 8" DSDD drive into MS-DOS 2.x. The format was of course MS-DOS, but I was halfway there (or so I thought). The company which sold me the 8" drive (Floppy Disk Services, Inc., 741 Alexander Road, Princeton, NJ, 08540) also sold me software from Maynard Electronics (430 E. Semoran Blvd., Casselberry, FL, 32707) which supposedly would enable me to read SSSD 8" CP/M format, but only when using JFORMAT 1.x (Tall Tree Systems, 1036 Los Altos Ave., Los Altos, CA, 94022). I carefully assembled all the software, spent many hours patching in the operating system, and finally tried to read a CP/M disk. No soap. It just wouldn’t work. So Floppy Disk Services took back the Maynard software (for a 10% restocking
I got CrossData. I tried it on my KayPro disk. It worked fine. I went to the menu from where I could enter the 8" disk parameter file-transfer systems were popping out of the woodwork. I called them all. One "guaranteed" that his program would work but would not refund my money if it didn't. Software, Inc. (3545 Chain Bridge Rd., Rte. #3, Fairfax, VA, 22030) told me that their program would not currently work, but that they could make a special version for me when they had time. Although they never did, they actually called me a month later and told me that they hadn't forgotten about my request. They didn't solve my problem, but they seemed to be decent human beings. Others might have given up at this point, or taken the coward's way out (physically joining my PC with a Morrow via a serial cable and using a modem-transfer program). Disheartened though I was, I would never let my unwavering faith in systems' programmers die. I saw an announcement in the Computer Shopper about a new version of Uniform for the PC. I had heard of Uniform for the KayPro and had even seen it in operation. MicroSolutions (125 South Fourth St., Dekalb, IL, 60115) was advertising that their PC version could handle transfers between MS-DOS and 8" formats, as well as 5" formats. Not only that, their program was implemented as a device driver which means that Uniform would work. I was amazed at the amount of support they have given me. At their own expense, they have shipped to me three times via UPS Blue Label and returned numerous phone calls. And they have never asked for one additional penny from me. Their program retails for just $69, and I originally purchased it through one of their retailers, not from them directly.

In speaking with Ron, he mentioned two other items which may be of interest to others. He has devised a way of adding an 8" drive to an IBM AT. Uniform already has support for the AT's 96-TPI, high-capacity disk drive. Anyone who sends me a SASE will receive the wiring changes necessary to hang an 8" drive on their AT. This will allow Uniform to access the 8" drive, but will not allow the use of the 8" drive as an MS-DOS drive. If there are any bored hackers out there who wish to write a device driver to allow this, let me know!

By the time you read this, MicroSolutions will be offering a disk-controller card for the PC and AT which will allow a version of Uniform to read from and write on Apple disks, NorthStar 10-hole, hard-sectored disks, and Vector Graphic 16-hole, hard-sectored disks. If that doesn't cover all the bases, I don't know what does! Even without this capability, Uniform already supports over 130, 8", and 48- and 96-TPI 5", soft-sectored formats.
For Programming Professionals: an expanding family of compatible, high-performance, Forth-83 Standard compilers for microcomputers

For Development:
Interactive Forth-83 Interpreter/Compilers
- 16-bit and 32-bit implementations
- Full screen editor and assembler
- Uses standard operating system files
- 400 page manual written in plain English
- Options include software floating point, arithmetic coprocessor support, symbolic debugger, native code compilers, and graphics support

For Applications: Forth-83 Metacompiler
- Unique table-driven multi-pass Forth compiler
- Compiles compact ROMable or disk-based applications
- Excellent error handling
- Produces headerless code, compiles from intermediate states, and performs conditional compilation
- Cross-compiles to 8080, Z-80, 8086, 68000, and 6502
- No license fee or royalty for compiled applications

Support Services for registered users:
- Technical Assistance Hotline
- Periodic newsletters and low-cost updates
- Bulletin Board System

Call or write for detailed product information and prices. Consulting and Educational Services available by special arrangement.

Laboratory Microsystems Incorporated
Post Office Box 10430, Marina del Rey, CA 90295
Phone credit card orders to: (213) 306-7412

Overseas Distributors:
Germany: Forth-Systeme Angelika Fleisch, D-7820 Titisee-Neustadt
UK: System Science Ltd., London EC1A 9JX
France: Micro-Sigma S.A.R.L., 75006 Paris
Japan: Southern Pacific Ltd., Yokohama 222
Australia: Wave-onic Associates, 6107 Wilson, W.A.

Micro/Systems Journal Software
Software appearing in Micro/Systems Journal is released into the public domain via the SIG/M and PC/BLUE Public Domain Software Libraries. It may thus be copied at many computer club meetings and downloaded from many RBBS bulletin board systems.

The Software may also be obtained directly from us. We currently have two disks of software available:

Disk #1 - Software from 1985 issues
Disk #2 - Software from 1986 issues
$12/disk (includes shipping and handling). Outside North America add $5 for shipping (via air). Ordering both disks deduct 10%. Send check (drawn on U.S. bank) or postal money order to: Micro/Systems Journal, Box 1192, Mountainside NJ 07092. Specify disk format.

Robert E. Lee would have been very fond of GENRAL. GENRAL simulates the anxiety, uncertainty, and despair felt by the commanders of armies in an imaginary war taking place a century or so ago. GENRAL is...

... a Two-Player game. It requires two IBM or compatible computers (286 or 80386) communicating via modem or cable at 300 baud. The computers are non-playing "umpires"; they produce statistical reports and animated displays of the battle situation, and relay the players' commands between the machines...

... a Real-Time game. It is always "your turn". The video display changes continually as the passes.

... a Complex game. Each player controls an army of twenty-six units. There can be action in several places at once, and the decision which to attend to first can be critical...

... a Serious game. It has had over five years of development and testing. A typical game lasts about two hours and requires constant, intense concentration. The game has an immense variety of possible situations, and does not grow stale with repeated playing.

GENRAL is available from:
Two-Kay Software
P.O. Box 1277
Columbus, Ohio 43207
Diskette and User's Manual: $ 50.00
User's Manual only: $ 15.00
Serial I/O Software Listings: $ 2.00

A variety of 5" disk formats is available (including Apple), as well as standard 8" SSSD. Please specify desired format when ordering.

GENRAL is licensed to the user and not to the software. It may not be used except on personal computers for which the licensing fee has been paid.

GENRAL simulates the anxiety, uncertainty, and despair felt by the commanders of armies in an imaginary war taking place a century or so ago. GENRAL is a Two-Player game. It requires two IBM or compatible computers (286 or 80386) communicating via modem or cable at 300 baud. The computers are non-playing "umpires"; they produce statistical reports and animated displays of the battle situation, and relay the players' commands between the machines...

... a Real-Time game. It is always "your turn". The video display changes continually as the passes.

... a Complex game. Each player controls an army of twenty-six units. There can be action in several places at once, and the decision which to attend to first can be critical...

... a Serious game. It has had over five years of development and testing. A typical game lasts about two hours and requires constant, intense concentration. The game has an immense variety of possible situations, and does not grow stale with repeated playing.

Robert E. Lee would have been very fond of GENRAL. GENRAL simulates the anxiety, uncertainty, and despair felt by the commanders of armies in an imaginary war taking place a century or so ago. GENRAL is a Two-Player game. It requires two IBM or compatible computers (286 or 80386) communicating via modem or cable at 300 baud. The computers are non-playing "umpires"; they produce statistical reports and animated displays of the battle situation, and relay the players' commands between the machines...

... a Real-Time game. It is always "your turn". The video display changes continually as the passes.

... a Complex game. Each player controls an army of twenty-six units. There can be action in several places at once, and the decision which to attend to first can be critical...

... a Serious game. It has had over five years of development and testing. A typical game lasts about two hours and requires constant, intense concentration. The game has an immense variety of possible situations, and does not grow stale with repeated playing.

Robert E. Lee would have been very fond of GENRAL. GENRAL simulates the anxiety, uncertainty, and despair felt by the commanders of armies in an imaginary war taking place a century or so ago. GENRAL is a Two-Player game. It requires two IBM or compatible computers (286 or 80386) communicating via modem or cable at 300 baud. The computers are non-playing "umpires"; they produce statistical reports and animated displays of the battle situation, and relay the players' commands between the machines...

... a Real-Time game. It is always "your turn". The video display changes continually as the passes.

... a Complex game. Each player controls an army of twenty-six units. There can be action in several places at once, and the decision which to attend to first can be critical...

... a Serious game. It has had over five years of development and testing. A typical game lasts about two hours and requires constant, intense concentration. The game has an immense variety of possible situations, and does not grow stale with repeated playing.

Robert E. Lee would have been very fond of GENRAL. GENRAL simulates the anxiety, uncertainty, and despair felt by the commanders of armies in an imaginary war taking place a century or so ago. GENRAL is a Two-Player game. It requires two IBM or compatible computers (286 or 80386) communicating via modem or cable at 300 baud. The computers are non-playing "umpires"; they produce statistical reports and animated displays of the battle situation, and relay the players' commands between the machines...

... a Real-Time game. It is always "your turn". The video display changes continually as the passes.

... a Complex game. Each player controls an army of twenty-six units. There can be action in several places at once, and the decision which to attend to first can be critical...

... a Serious game. It has had over five years of development and testing. A typical game lasts about two hours and requires constant, intense concentration. The game has an immense variety of possible situations, and does not grow stale with repeated playing.

Robert E. Lee would have been very fond of GENRAL. GENRAL simulates the anxiety, uncertainty, and despair felt by the commanders of armies in an imaginary war taking place a century or so ago. GENRAL is a Two-Player game. It requires two IBM or compatible computers (286 or 80386) communicating via modem or cable at 300 baud. The computers are non-playing "umpires"; they produce statistical reports and animated displays of the battle situation, and relay the players' commands between the machines...

... a Real-Time game. It is always "your turn". The video display changes continually as the passes.

... a Complex game. Each player controls an army of twenty-six units. There can be action in several places at once, and the decision which to attend to first can be critical...

... a Serious game. It has had over five years of development and testing. A typical game lasts about two hours and requires constant, intense concentration. The game has an immense variety of possible situations, and does not grow stale with repeated playing.

Robert E. Lee would have been very fond of GENRAL. GENRAL simulates the anxiety, uncertainty, and despair felt by the commanders of armies in an imaginary war taking place a century or so ago. GENRAL is a Two-Player game. It requires two IBM or compatible computers (286 or 80386) communicating via modem or cable at 300 baud. The computers are non-playing "umpires"; they produce statistical reports and animated displays of the battle situation, and relay the players' commands between the machines...

... a Real-Time game. It is always "your turn". The video display changes continually as the passes.

... a Complex game. Each player controls an army of twenty-six units. There can be action in several places at once, and the decision which to attend to first can be critical...

... a Serious game. It has had over five years of development and testing. A typical game lasts about two hours and requires constant, intense concentration. The game has an immense variety of possible situations, and does not grow stale with repeated playing.
NOW AT THE SBC MART

**HARD DISKS**
- complete 10MB Kit
- special, only $460
- complete internal 1/2-high 10MB kit, incl. controller and cables, special $460
- complete 10MB kit with low-power 3-1/2" half-high drive, fits 5-1/4" slots, $495
- 3-1/2" 10MB Winchester drive alone HD-3 just $395
- 20MB half-high drive HD-2 now $455

**ADD-ON CARDS**
- multifunction 384K, elk/cal, S, P, with OK save $50 Model MFC-4 $145
- monochrome graphics card runs 1-2-3 graphics, w/printer port, 720 x 348, hi-res monochrome TTL output Model MGC-1 now $145
- floppy controller for 1-4 48 or 96tpi drives, w/cable save $25 Model FDC-2 now $74
- color adapter w/light pen port, RGB and composite outputs reg $140 Model CC-1 now just $116
- hard disk controller for 1-2 ST-506/412 drives reg $220 Model HDC-1 only $160

**SOFTWARE SPECIALS**
- Microsoft Macro assembler BEST PRICE $107; MS BASIC interpreter regularly $340, now $280; BASIC compiler reg $386, just $285
- Ellis/Utah COBOL or PASCAL compilers, BASIC interpreter, or EDIT each with bound tutorial textbook only $37 each
- Open Systems Business BASIC interpreter, reg $180, Sale $155
- Lattice C compiler (from Lattice) regularly $475, $349
- Borland Turbo Pascal (3.0) list $70, reg $49, now $42

**SPECIAL BONUS** Norton Utilities Ver 3.0 Reg $90, only $60 w/purchase of any disk drive. IBM PC-DOS 3.1 (the real thing) Reg $65, only $40, w/purchase of motherboard.

**MOTHERBOARDS**
- full IBM PC/XT compatibility
- 8 I/O slots
- runs IBM's PC-DOS 3.1
- BASIC interpreter available
- great foundation for business or personal system
- 1 year warranty

The ideal foundation for complete business, personal, and workbench PC's. Complete with a manual that will please novice thru expert.

**POWER SUPPLY**
- 135 Watts
- side switch
- top quality
- one year warranty
- standard cables for 4 disk drives
- Model PS-135 power supply regularly $129, now only $95

Shipping and handling: drives/motherboards/cases/power supplies $4.50 ea, software $2.50 ea, keyboards $4. CA residents add 6% sales tax.

The SBC Mart, 821 Commercial St., P.O. Box 1296, Ridgecrest, CA 93555

**ICX TOOLKIT**

**CP/M**
**MS-DOS**

**ISIS**

New Release for PDS & MDS

ICXv.4 eXchanger now supports BOTH 8” MDS and 5-1/4” iPDS formats. Manipulation of ISIS-II files using your computer system was never easier.

ISEv.6 Emulator gives the CP/M 80 user access to all the ISIS-II languages and utilities.

Complete source (C and MAC asm) included.

ICXMDS..................$89
ICXPDS..................$89
ISE.....................$89
ICX Toolkit (all 3)........$250

**ZAS DEVELOPMENT PACKAGES**

ZAS is a full-featured relocatable macro assembler which includes multi-pass object linker, downloader, and run-time monitor. Supports Z-8 and Z-8000 for CP/M and MS-DOS. Request catalog of products.

Copyrights:CP/M Digital Research, Inc. ISIS-II and iPDS Intel Corp. - MS-DOS Microsoft

Western Wares 303-327-4898 Box C - Norwood, CO 81423

**Power Tools for power users™**

Call today for our free catalog of design aids, compilers, libraries, debuggers, and support tools for Apple and IBM micro computers. The Power Tools catalog includes product descriptions, warranty and license terms, and all the information you need to make an intelligent purchase decision.

TSF offers competitive pricing, free UPS shipping on orders over $100, and a reasonable return policy. Visa, MasterCard, and American Express accepted without surcharge. TSF helps you get your job done.

Sample Prices:
- Microsoft C $259
- MASM 4.0 $109
- Turbo Pascal $45
- Mark Williams C $375
- Lets C $59
- Wendin OS Toolbox $69
- Blaise Async Manager $137

Call Toll Free (24 hrs/7 days)
Ask For Operator 2053
1-800-543-6277
Calif: 1-800-368-7600

TSF The Software Family™
Welcome to the Age of Reason

PC/PROFILER™
It's 3 a.m. - do you know where your program is? Determine in less than five minutes where your program is offending functions are located and can be turned on or off during program execution. Typically execution speed goes up 50 to 100 percent once the offending functions are located and improved. Works with any compiled language system compatible with LINK.EXE or LINK(TM)-86. $150.

Price: $95 plus $35 for each format purchased
Publisher: Software House, 1227 Goler House, Rochester NY 14620; (716)454-3188

Program Name: SciPlot Graphics Library
Requirements: PC/XT/AT or compatible, Microsoft C,tran-77 V3.2 or IBM Professional Fortran, and IBM/MX/FX compatible printer
Description: Produces presentation quality, high resolution (240x216) graphics, or can be viewed on color monitor. Hershey character sets (14) included to produce high definition fonts and proportional spacing.
Price: $59.95
Publisher: MicroGlyh Systems, Box 1066, East Arlington MA 02174

PC/MAKE™
End program recolilation busy work! MAKE calculates which modules need to be recreated based on file creation times. This product is a must for programmers developing with multiple modules. Command line flags allow forced recreation of a single file, files, or file named in a common file. No execute flag allows preview of actions MAKE will take. Features with C-like arguments simplify MAKE script changes. Many examples and an instructive manual included. $75.

Special
PC/MAKE + PC/PROFILER: $175 — a $50 savings

RUN/C--The C Interpreter™
Full K&R C interpreter with integrated full screen editor. Quick to learn and use. Ideal for learning C, mastering functions, working with interrupts, and debug. Compiles at over 100 statements/second and generates code that executes about 50 times faster than interpreted Basic code. Maintains 18 decimal digit accuracy over range from 10^-308 to 10^308. Trig functions more accurate than those in standard math tables. Supports up to 10 Basic programs, or tasks, run concurrently in separate windows and true interrupt drive device I/O. Compiles to directly executable object code which can be put into a ROM.
Price: $79.95 plus $3.50 S/H ($10 overseas). MD residents include 5% sales tax
Publisher: Softaid, Inc., Box 2412, Columbia MD 21045; (301)792-8096

Program Name: MTBASIC*ROM
Requirements: MS/PC-DOS system with 8087 or 80287 coprocessor
Description: Compiles at over 100 statements/second and generates code that executes about 50 times faster than interpreted Basic code. Maintains 18 decimal digit accuracy over range from 10^-308 to 10^308. Trig functions more accurate than those in standard math tables. Supports up to 10 Basic programs, or tasks, run concurrently in separate windows and true interrupt drive device I/O. Compiles to directly executable object code which can be put into a ROM.
Price: $79.95 plus $3.50 S/H ($10 overseas). MD residents include 5% sales tax
Publisher: Softaid, Inc., Box 2412, Columbia MD 21045; (301)792-8096

Program Name: F77L Version 2.00 Fortran Compiler
Requirements: MS/PC-DOS, 256K memory, and 8087 or 80287 coprocessor
Description: A complete implementation of ANSI(X3.9-1978) Fortran 77 Standard. Version 2.00 adds following features: Source On-line Debugger; Interface with Lattice C, MS-Fortran, assembly language and other software packages; No limit on size of common and arrays (greater than 64K); Long Names (up to 31 characters); Boolean functions; DOS and 8087 system interface; source file can be either Standard or Free Format.
Price: $477, includes telephone support and newsletter
Publisher: Lahey Computer Systems, Inc., 3,1244 Palos Verdes Drive West, Suite #243, Rancho Palos Verdes CA 90274, (213)541-1200

Program Name: MT8087 BASIC Compiler
Requirements: MS/PC-DOS system with 8087 or 80287 coprocessor
Description: Compiles at over 100 statements/second and generates code that executes about 50 times faster than interpreted Basic code. Maintains 18 decimal digit accuracy over range from 10^-308 to 10^308. Trig functions more accurate than those in standard math tables. Supports up to 10 Basic programs, or tasks, run concurrently in separate windows and true interrupt drive device I/O. Compiles to directly executable object code which can be put into a ROM.
Price: $79.95 plus $3.50 S/H ($10 overseas). MD residents include 5% sales tax
Publisher: Softaid, Inc., Box 2412, Columbia MD 21045; (301)792-8096

Program Name: F77L Version 2.00 Fortran Compiler
Requirements: MS/PC-DOS, 256K memory and 8087 or 80287 coprocessor
Description: A complete implementation of ANSI(X3.9-1978) Fortran 77 Standard. Version 2.00 adds following features: Source On-line Debugger; Interface with Lattice C, MS-Fortran, assembly language and other software packages; No limit on size of common and arrays (greater than 64K); Long Names (up to 31 characters); Boolean functions; DOS and 8087 system interface; source file can be either Standard or Free Format.
Price: $477, includes telephone support and newsletter
Publisher: Lahey Computer Systems, Inc., 3,1244 Palos Verdes Drive West, Suite #243, Rancho Palos Verdes CA 90274, (213)541-1200

PC/DOvar:k™
Amaze your friends. Type the Dvorak routine created with the Lattice large model C compiler. Quickly create loadable versions of the Halo C-Food™ C-Utility™ functions you use. Load and unload multiple libraries in less than a minute. Complete C source-level debugging including multiple breakpoints, single stepping, etc. Interrupt program execution and determine/change the value of any variable. $250.

PC/DOvar:k™
Amaze your friends. Type the Dvorak routine created with the Lattice large model C compiler. Quickly create loadable versions of the Halo C-Food™ C-Utility™ functions you use. Load and unload multiple libraries in less than a minute. Complete C source-level debugging including multiple breakpoints, single stepping, etc. Interrupt program execution and determine/change the value of any variable. $250.

Age of Reason Co.
161 First Ave.
New York, NY 10003
(212) 473-2309

All products carry a 30-day money back guarantee.

Mastercard / Visa / Eurocard
Program Name: ABLE ONE MAILING LIST
Requirements: CP/M V2.2 and 132 column printer
Description: Prints mail labels in 5 different formats with optional fields for date, telephone number and two amounts.
Price: $19.95, 8" or KayPro 5" disk formats
Publisher: Able Data Software Inc
1260 Hornby St
Vancouver BC Canada V6Z 1W2

Program Name: QROFF
Requirements: PC or compatible and HP LaserJet printer
Description: Text formatter to control mixed fonts, page specifications, line manipulation, subject index generation, superscript/subscript, pagination, table format and spacing (fixed/proportional).
Price: $79.95
Publisher: QCAD Systems Inc.
1164 Hyde Ave
San Jose CA 95129
(800)538-9787 or (408)255-5574

Program Name: Jontel Business System
Requirements: CP/M System with dual 8" or 5" drives
Language: Compiled CBasic
Description: Five journal accounting package (7 disks + 100 page manual). Includes payroll, mailing and inventory programs. Allows dual-books and multiple companies.
Price: $69.95 (manual on disk $10, credited toward purchase)
Publisher: Moolite Computer
707 Edge Hill Rd.
New Bern NC 28560
(919)638-6979

PC-Lint* analyzes your C programs (one or many modules) and uncovers glitches, bugs, quirks, and inconsistencies. It will catch subtle errors before they catch you. PC-Lint resembles the Lint that runs on the UNIX* O.S., but with more features and some awareness of the 8086 environment.

- Full K&R C
- Supports Multiple Modules—finds inconsistencies between declarations and use of functions and data across a set of modules comprising a program.
- Compares function arguments with the associated parameters and complains if there is a mismatch or too many or too few arguments.
- User-modifiable library description files for most major compilers.
- All warning and information messages may be turned on and off globally or locally (via command line and comments) so that messages can be tailored to your programming style.
- All command line information can be furnished indirectly via file(s) to automate testing.

Price: $139.00 MC, VISA

Paradynamics builds a variety of modern, efficient, trouble-free expandable housing systems for most S-100 BUS configurations. Whether a rack mount, desk top, or stand alone, our patented super-efficient heat dissipation system can end your board-level failures due to high temperatures. Please call today for full details. (602) 991-1600
Paradynamics Corporation • 7895 East Acoma • Scottsdale, AZ 85260
LDP is offering a compatibility upgrade package to convert your current S100 BUS system quickly and easily to IBM-PC compatibility. This upgrade includes the high performance THUNDER 186 and COLOR MAGIC, IBM-PC compatible color graphics board. You get 10 Mhz 8086 performance, 256K bytes of no wait state RAM, two serial ports and a parallel printer port. No other S100 bus boards are required. Included with this set is the advanced CONCURRENT DOS operating system bringing PC-DOS compatibility and multitasking to the system. This board outperforms the IBM-PC by a three to one margin. Gain IBM-PC compatibility without sacrificing S100 bus compatibility.

THUNDER 186/COLOR MAGIC SET ....... $1749.00

IBM COMPATIBLE S100 BUS COLOR GRAPHICS

LOMAS DATA PRODUCTS presents COLOR MAGIC, the most complete compatibility solution for S100 bus computer products. COLOR MAGIC includes three major hardware sub-functions which allow it to emulate the IBM-PC: An entirely compatible video function, an IBM-PC keyboard interface and an IBM-PC compatible timer interface including IBM-PC sound compatibility. HOW COMPATIBLE IS IT? Currently we are running MICROSOFT’s FLIGHT SIMULATOR recognized as one of the severest tests of compatibility. We can also directly boot PC-DOS for the IBM-PC with no alterations. Other programs which have been tested and function without problems are: LOTUS 1-2-3, DATABASE III, WORDSTAR and VOLEYWRITE.

COLOR MAGIC (16K byte version) .... $959.00

THUNDER 186 single board computer provides a high performance 16 bit computer all on one board. It is an ideal companion to the COLOR MAGIC to provide a low cost, high performance IBM-PC compatible system. The 8Mhz 80186 offers 10Mhz 8086 performance. THUNDER 186 provides all the components necessary to form a complete system including: 256K bytes of no wait state RAM, 2 serial ports, a parallel printer port, high performance floppy disk controller controls both 5¼" and 8" drives simultaneously, full IEEE 696 (S100) bus for system expansion. The COLOR MAGIC and THUNDER 186 combine to provide performance you won’t find in other compatibles. The price includes the powerful Concurrent DOS operating system.

THUNDER 186 ..................... $1195.00

NV-DISK is a solid state memory with software to emulate a disk drive under MS-DOS. Concurrent DOS, and CP/M-86. NV-DISK is entirely COMPUPRO software compatible allowing COMPUPRO users to take advantage of the lower cost and battery protection support offered by NV-DISK. It offers the advantage of high speed access and no moving parts. It can be battery protected to allow data to stay even while powered down. The board is available in either 128K or 2 Megabyte configurations and multiple boards may be used to create disk drives with up to 16 Megabytes of storage.

NV-DISK 128K, $595.00 2 MBYTE, $1695.00

MEGARAM is a high density, high performance dynamic RAM board with up to two Megabytes of storage. MEGARAM offers no wait state performance in IBM-PC systems with up to 10 Mhz processors at a fraction of the cost of comparable performance static RAM.

MEGARAM ....... 1 MEGYTE, $795.00 2 MBYTE, $1095.00

IBM-PC COMPATIBLE S100-BUS SYSTEM

LOMAS DATA PRODUCTS offers IBM-PC compatible systems with performance far exceeding that available from IBM. You can purchase systems offering performance of an eight Mhz 8086 or up the performance of an 8Mhz math coprocessors. Our 8Mhz 89286 system offers IBM-PC compatibility while offering up to 2 times the performance of the IBM-PC-AT. For applications where PC compatibility is desirable but higher performance is a benefit or requirement LDP offers the only viable solution.

WHO IS LOMAS DATA PRODUCTS...

LOMAS DATA PRODUCTS has been shipping 16 bit microprocessor S100 bus products for five years. We have earned a strong reputation for reliability and performance over these five years. We were running MS-DOS (SCP-DOS/PC-DOS) before IBM knew the operating system existed. We offer a wide range of 16 bit operating systems including MS-DOS, CP/M-86, CONCURRENT CP/M-86 and CONCURRENT DOS. All our products are backed by a one year guarantee. We offer 8 bit products and concentrate entirely on high performance 16 bit systems. If you are looking for the highest performance possible on the S100 bus, you can be sure LOMAS DATA PRODUCTS offers it.

Dealer inquiries invited.

LOMAS DATA PRODUCTS, INC.
182 CEDAR HILL ROAD, MARLBORO, MASSACHUSETTS 01752  TELEPHONE: (617) 460-0333  TELEX: 4996272
For orders outside the U.S., contact our exclusive dealers:  Australia – LAMRON PTY., LTD., (02) 808-3666  Malaysia – EXA COMPUTER (m) SENDIRIAN BERHAD, 795284  England – RATIONAL SYSTEMS, 0908-613209 or 0908-611349; SHARPBORN LTD, 018764559.
New Products

When contacting vendors please mention that you read about them in Micro/Systems Journal.

S-100 HARDWARE

DUAL 16-BIT PROCESSOR CARD

InterContinental Micro has announced the CPS-216, a single card containing two 8086 16-bit slave processors, each with 256K of RAM and 2 serial ports (4 total). The CPS-216 is I/O mapped for easy integration into Z80 or 16-bit based systems. An optional Z8530 SCC chip permits IBM Bisync, HDLS, SDLC, etc. communications. Contact: Intercontinental Micro, 4015 Leaverton Ct., Anaheim CA 92807; (714)630-0964.

8MHZ Z80 PROCESSOR CARD

Earth Computer has announced what it claims is the fastest Z80 S-100 processor card available. Based on the Zilog Z-80H, 8Mhz part, the board can be configured as a TurboDOS user processor or as a coprocessor running under other operating systems. It features 128K of memory, 2 serial ports and a port-mapped FIFO for master-slave communications. Price is $595. It has a monitor ePROM containing diagnostics. Contact: Earth Computers, Box 8067, Fountain Valley CA 92728; (714)964-5784.

HEATH/ZEHNITH-100 MEMORY UPGRADE KIT

Software Wizardry has introduced the RamPal-100 memory modification for Heath/Zenith Z-100 computers. It consists of 5 plug-in PAL chips (replaces current chips) that allow the use of the new 41256, 256K RAM chips for a maximum of 768K of RAM on the motherboard. The kit is available at most Heath/Zenith Electronics centers and costs $79.95. For more info contact: Software Wizardry, 1106 First Capitol Dr, St Charles MO 63301; (314)946-1978.

PC COMPATIBLE HARDWARE

80286 PROCESSOR CARD

Earth Computer has introduced the TurboAccel-286, 8Mhz 80286-based processor card. It features 512K of memory with expansion capability, optional 80287 math coprocessor and switch to run with the system's original 8088 processor. It executes the PC's ROM BIOS insuring software compatibility and requires no special programming. Price is $995. Contact: Earth Computers, Box 8067, Fountain Valley CA 92728; (714)964-5784.

Z80 COPROCESSOR CARD

Earth Computer announced a Z80 PC-compatible coprocessor card. Based on the 8Mhz Zilog Z-80H, the board can be configured as a TurboDOS user processor (up 16 user/processors) or as a coprocessor running under other operating systems. It features 128K of memory, 2 serial ports and a port-mapped FIFO for master-slave communications. Price is $495. It has a monitor ePROM containing diagnostics. Contact: Earth Computers, Box 8067, Fountain Valley CA 92728; (714)964-5784.

Instant-C™:

The Fastest Interpreter for C

Runs your programs 50 to 500 times faster than any other C language interpreter.

A ny C interpreter can save you compile and link time when developing your programs. But only Instant-C saves your time by running your program at compiled-code speed.

Fastest Development. A program that runs in one second when compiled with an optimizing compiler runs in two or three seconds with Instant-C. Other interpreters will run the same program in two minutes. Or even ten minutes. Don't trade slow compiling and linking for slow testing and debugging. Only Instant-C will let you edit, test, and debug at the fastest possible speeds.

Fastest Testing. Instant-C immediately executes any C expression, statement, or function call, and display the results. Learn C, or test your programs faster than ever before.

Fastest Debugging. Instant-C gives you the best source-level debugger for C. Single-step by source statement, or set any number of conditional breakpoints throughout your program. Errors always show the source statements involved. Errors always show the source statements involved. Once you find the problem, test the correction in seconds.

Fastest Programming. Instant-C can directly generate executable files, supports full K & R standard C, comes with complete library source, and works under PC-DOS, MS-DOS, or CP/M-86. Instant-C gives you working, well-tested programs faster than any other programming tool. Satisfaction guaranteed, or your money back in first 31 days. Instant-C is $495.

Rational Systems, Inc.

PO. Box 480
Natick, MA 01760
(617) 653-6194
The following selected books can be ordered through Micro/Systems Journal. Prices include shipping (NJ residents add sales tax) with prices shown for U.S., Canada and Mexico. Add $5 for other countries. Send check for full amount payable in U.S. funds by a U.S. bank. We cannot bill or take credit cards. Allow 15-20 days for order to be processed. Please do not give a P.O. Box address as we ship via UPS. Send orders to: Micro/Systems Journal, Box 1192, Mountainside NJ 07082.

| C Language | | | | |
|---|---|---|---|
| **C: A Reference Manual** by S. Harbison & G. Steele. Without doubt the best reference manual for C. Don Libes (C Forum author) uses this as his reference. $20.95 |
| **C Programmer's Handbook** by AT&T. A concise reference. $15.95 |
| **Learning To Program In C** by Thomas Plum. Considered one of the best books on C language. $26.00 |
| **C Made Easy** by Herbert Schindt. For programmers looking to make the transition from Basic to C. $16.95 |
| **The C Library** by Kris Jamies. 125 routines from macros to UNIX utilities. $15.95 |

| TURBO PASCAL Language | | | |
|---|---|---|
| **Using Turbo Pascal** by Steve Wood. For new Turbo Pascal (V3.0) programmers. Contains lots of code examples. $20.95 |
| **80286/8086/8088**<br>The 8086 Book by R. Rector & G. Alexy. A guide to 8086 and 8088 hardware and software. Includes examples of interfacing and applications. $19.95 |
| **80286 Programmer's Guide** by B. Childs & S. Evanczuik. $15.95 |
| **80286 System Guide** by C. Childs & S. Evanczuik. $15.95 |
| **From Basic To 8086/8088 Assembly Language** by Templeton. $18.95 |

| 68000 | | | |
|---|---|---|
| **68000 Assembly Language Programming** by G. Kane, D. Hawkins & L. Leventhal. Covers topic in explicit detail and contains many program examples. Also useful as a reference... very complete. Even good for programmers new to assembler. $19.95 |
| **Self-Guided Tour Through The 68000** by M. Hyman. $15.95 |

| CP/M | | | | |
|---|---|---|---|
| **Programmer's Guide To CP/M** Edited by Sol Libes. Collection of all CP/M articles from Microsystems magazine (Jan 1980 to February 1982). Those wanting to customize their BIOS and add CP/M enhancements will find following books useful. $20.95 |
| **CP/M Techniques** by Barbier. $20.95 |
| **CP/M Solutions: Improving CP/M** by Barbier. $15.95 |
| **CP/M Assembly Language Programming** by Barbier. $13.95 |
| **Programmer's CP/M Handbook** by Johnson & Laird. $22.95 |
| **System Programming Under CP/M-80** by Hughes. $18.95 |
| Following books, by Dave Cortesi, are recommended for learning more about CP/M. $15.95 |
| **A Programmer's Notebook:**<br>**Utilities For CP/M Plus** $18.95<br>**Inside CP/M $27.50**<br>**Inside CP/M-86 $18.95**<br>**Inside Concurrent CP/M $18.95**<br>**The Osborne/McGraw-Hill CP/M-86 User's Guide** by Jonathan Sachs; Includes Concurrent-DOS, Concurrent CP/M-86, DR/Net, DR-EDIX, and DR/Talk. How to use these packages more effectively and troubleshoot hardware and software problems. $19.95 |
| **CP/M-86 Assembly Language** by Lindsay. $19.95 |
| **Z-80 Assembler For CP/M** by G. King. $25.95 |
| **16-Bit SIG/M Public Domain Software Directory** An index, by application, of all 16-bit CP/M-86, MP/M-86 & CP/M-68K in the SIG/M library (almost 200 programs), cross-indexed to volume number so you can locate them easily. $2 |

| IBM-PC/XT & COMPATIBLES | | | |
|---|---|---|
| **Inside IBM PC: Access to Advanced Features & Programming** by Peter Norton. Detailed analysis of MS-DOS, PC-system architecture, ROM-BIOS service routines and much more. $20.95; Companion disk $65.95 |
| **Peter Norton Programmer's Guide to IBM PC** by Peter Norton. For intermediate and advanced users. For assembly language programmer. $20.95 |
| **Complete Guide To IBM PC Graphics** by M. Hyman. $20.95 |
| **Assembly Language For IBM PC DOS** by Joe Dorner. Book $20.95; Disk $30.95 |
| **Input/Output Assembler Programming For IBM PC DOS** by Clarence Germain. $25.95 |
| **IBM PC BASIC For Scientists & Engineers** by D. Weinman & B. Kurshan. $20.95 |
| **Programming Tools For IBM PC; Screen Design, Code Generator, & High Memory Access** by J. K. Gugate. $20.95 |

| OTHER BOOKS OF INTEREST | | | |
|---|---|---|
| **Designer's Guide to Disk Drives** by Teja & Connella. $20.95 |
| **Getting The Most From Wordstar & Mailmerge** by M. David Stone. $15.95 |
| **Operating Systems Design: The XINU Approach** by Comer. How to write a Unix-like operating system with much of source code included. $34.95 (hard cover) |
**TRENTON COMPUTER FESTIVAL '86**

Eleven years in the vanguard of Computer Expos!

- The original Personal Computer Show now celebrating its eleventh anniversary at Trenton State College.
- Attendance last year exceeded 15,000.
- User Group Meetings—IBM, Apple, Macintosh, TRS, Commodore, CPM, Heath, Atari, Zenith, plus many others.
- Essay contest for junior and senior high school students. Major prize will be awarded—See local newspapers or call for information.
- Free courses for the general public and novices.
- Computer Games Contest—door prizes.
- Huge outdoor Flea Market—Software/hardware accessories, surplus computer gear, more than five acres of bargains.
- Expanded exhibition space—in the TSC Recreation Center—all exhibits, lectures and promotions conveniently located in one part of the TSC campus.
- Forums, talks and seminars held both Saturday and Sunday. Meet the leading experts and attend sessions on software/hardware applications, business applications, educational computing (special sessions for parents and teachers), robotics, music, graphics, ham radio, new languages, etc.
- Free day-care center for preschool children.
- Computer/Electronics Job Fair Sunday.
- Much, much more!

**Flea Market Spot**

(one parking lot space, no electricity available) for both days and one admission ticket $15. Spots available on first-come, first-served basis. Sold on day of show only. Flea Market held rain or shine! Sellers only will be admitted beginning at 7 a.m.

**Admission/Registration**

Registration will be at the door only. General admission, covering both days and all events except banquet $7. Students/senior citizens $3; preschool children free.

Sunday only—$5 general admission. Children under 12 accompanied by an adult will be admitted free on Sunday.


For more information contact:
Ms. Marilyn Hughes/Department of Electronics Engineering
Technology/Trenton State College/Hillwood Lakes CN 550/Trenton NJ 08625-0550/(609) 771-2487

**TCF '86**

at Trenton State College
The following back issues are available at $4.50 per copy (50 foreign, cash, Postal Order or U.S. bank check) including shipping. If ordering 3-9 copies deduct 10%, 10 or more copies deduct 15%. Orders can be combined with back issues of Microsystems for discount. Send to: M/SJ, Box 1192, Mountainside, NJ 07092.


MAY/JUNE 1985 (Vol. 1., No. 2): Build an S-100 to PC-Bus Converter, Interfacing to MS-DOS Part-I, Loadable Drivers for CP/M2.2, Roll Your Own PC-Clone, Bringing Up ZCPR-3, C & Godbout Disk-1 Controller, Writing Translation Programs in C and Turbo Pascal; REVIEWS: 16-Bit Lisp & ProLog-Part II.


Some of the issues of the old Microsystems magazine are still available in very limited quantities. They are $4 per copy ($5,50 foreign, cash, Postal Order or U.S. bank check) including shipping. If ordering 3-9 copies deduct 10%, 10 or more deduct 15%. Orders can be combined with M/SJ back issues for discount. Send to: M/SJ, Box 1192, Mountainside, NJ 07092.

1984

MARCH: MS-DOS Overview Part-I, Enhancing MP/M-II Part-2: Adding login and date and time functions, Julian Date Conversions, I/O changes for Fortran-80, CP/M Mass Renaming by Filetype, C/PM BIOS public domain enhancements, Power Failure Backup for S-100 systems; REVIEWS: MS-DOS for CompuPro From Computer House, Lomas Lightning One, Dual Systems SIO4, MagicBind, SAL/80K

JANUARY: Enhancing MP/M - Part 1; Installing MP/M; Add Concurrency to MP/M; Two Users on CP/M; Relocating Assemblers & Linkage Editors - Part 3; S-100 Wait States; REVIEWS: MP/M-8/16, ProComp-8, Paragraphics Game Board, ProLog.

1983

NOVEMBER: Intro to 80286, 68000, and 16032 Microprocessors; Intro to Local Area Networks - Part 2; Extended Memory Management for older S-100 Systems; Notes on Microsoft Fortran-80; Building S-100 Parallel Ports; REVIEWS: CompuPro CPU-68K, System 8/16, Zenith Z-100, Nevada & Ellis Computing Fortran.

OCTOBER: Intro to Local Area Networks, Part-1; Build Low-Cost LAN; Build S-100 Bubble Memory Card; Use Radio Shack Model 100 portable with a CP/M system; Write Menu-Driven Utility for Setting Printer Options; North Star Improvement; True Z-80 Random Number Function; Hide Code in Basic REM statements; Machine Code loader for MBasic; Increase Single-Density Disk Formatting; Relocating Assembler & Linkage Editors, Part-2; Run MX-80 with North Star; User Group Directory; CP/M-86 Versus CP/M-80; REVIEWS: CP/NET, QBAX, S-Basic.

AUGUST: XERA Program; Logging-On CP/M; WordStar Date/Time Patch; Find Location of Variable in NorthStar Basic; Prevent System Crashes During Warm Boot; Enhance Spreadsheet Print Files; Plotting Package-Part 3; Run WordStar under TP/M; 50-line Text Formatter; Using the LU Utility; User Areas under CP/M; REVIEWS: Stiff Upper Lisp, MuLisp-80, Supersoft Lisp, Cromenco C-10, Access Manager, Fancy Font, Computine SBC-880 S-100 card.

JULY: Using RCPMs; RCPM Directory; PIP Data Between Computers; Toward Smarter Modem Programs; Interface MX-80 via Parallel Interface; Digital Audio On CP/M System; Customize CP/M BIOS; Plotting Package Part-2; REVIEWS: DRI PL/I-86 and PL/I-80, S-100 PMMI MM-VT1.

JUNE: Plotting Package Part 1; Drive HP Plotter; Laboratory Graphics Applications; Console Keypressed interrupts; Cutomize Wordprocessor Keyboard; WordStar Patch for H-19/Z-19 Terminal; Relocatable Code; REVIEWS: Graftalk, JES S-100 Graphics Controller, ZCPR2.
Programmer's Reference Cards

IBM/GW Basic Card
C Language Card
UNIX Shell Card
8086/8088 Card
WordStar Card
Z80 Card

Concise comprehensive reference cards that save time and avoid cumbersome manuals. Organized to keep train of thought while programming and enhance productivity. All are 8½"x11" laminated plastic cards printed in two colors, both sides.

$5.95 + $1 each (U.S., Canada & Mexico; Foreign $3) Shipping & Handling; ordering 3 or more cards $5.50 each S&H/$1.50 each Foreign). Send check (drawn on U.S. bank) or postal money order to: Micro/Systems Journal, Box 1192, Mountainside NJ 07092.

Pocket Reference Cards

CP/M Programmer's Reference Card - $2, includes postage (U.S., Canada & Mexico; $3 foreign)

WordStar Reference Card - $1, includes postage (Foreign $2)

Microsystems Back Issues continued

APRIL: IEEE-488 Tutorial; Interfacing to Lab Instruments; CP/M-86 System in Lab; Implementing CP/M + Part II; Build Simple S-100 Card Extractor; Macros & Macro-Assemblers; REVIEWS: Pickles & Trout S-100 488 Controller; CP/M Utilities; Morrow Decision I.

1982

NOVEMBER/DECEMBER: CP/M Vs MS/DOS; CP/M-86 Vs MS-DOS; Intro to ADA Part 2; Virtual Disk for NorthStar; CP/M Program Auto-execute; Macros & Macro-Assemblers; REVIEWS: Janus, Aztec-C, C/80, Morrow S-100 M36 Hard Disk System, Teleram S-100 Bubble Memory Card, Jade S-100 Bus Probe.

1981

JULY/AUGUST: 16-Bit Disk Operating Systems; Input Queuing For NorthStar; Variable Speed Automatic Slow Step; Build S-100 Clock/Calendar Card; REVIEWS: TEC-86 System, Seattle Computer 8086 System, AlphaMicro, Godbout Dual Processor, CP/M-86, Televideo 920-C Terminal.

$–100
BARE BOARDS
8086/8087 CPU – plus
2764 or 27128, 8253, 8259
8088 Auxiliary Processor
I/O mapped, 4K EPROM,
4K RAM, prototype area
$45.00
Each
Call or write for brochure.
Terms: Check or money order only. CA residents add sales tax. Prices include
UPS shipping.
Applied Innovations
3000 Scott Blvd. Suite 106
Santa Clara, CA 95054
(408) 748-1875

C CODE FOR THE PC
source code, of course
Concurrent C ............... $45
LEX ..................... $25
YACC & PREP ........... $25
Small-C compiler for 8086/88 . $20
tiny-c interpreter & shell ....... $20
Xlisp 1.4 & tiny-Prolog .... $20
C Tools .................. $15

The Austin Code Works
11100 Leafwood Lane
Austin, Texas 78750-3409
(512) 258-0785

Users’ Group
Over 75 volumes of public
domain software including:
• compilers
• editors
• text formatters
• communications
packages
• many UNIX-like tools
Write or call for more details
The C Users’ Group
Post Office Box 97
McPherson, KS 67480
(316) 241-1065

FREE SOFTWARE
FROM THE PUBLIC DOMAIN
User Group. Software isn’t copyrighted, so no fees
to pay! 100’s of CP/M and IBM software
programs in .COM and source code to copy your­
self. Games, business, utilities! All FREE!

19MBPC-SIG 1-390
IBMPC-Blue 1-540
SIG/M 1-92
Disks
15MPC-SIG 1-230
IPA-C 1-255
First Class
Send your check & specify computer format.
Rental is for 7 days after receipt, 3 days grace to
return. Use credit card, no disk deposit.
Shipping: Handling & Insurance $9.50 per library.
(619) 941-0925
Orders & Technical
(9 to 5)
(619) 727-1015 24 Hr. 3 Min. into Recording
Have your credit card ready!
National Public Domain Software
1533 Avohill Dr.
Vista, CA 92084
1-800-621-5640

PC-PRO
is
PC-DOS
for
CompumPro/Viasyn
• PC DOS Ver 3.1
• PC Graphics Support
• All Viasyn Hardware
Supported
for information write
Computer House, Inc.
P.O. Box 709 Woodacre, CA 94973
(415) 453-0865
Trademarks: Viasyn Corp.,
PC-PRO - Computer House.

MS-DOS II Portable
Computer
Includes 2-drives
80 x 16 line LCD Display
128K RAM $895
512K RAM $995
Optional 80 x 25 line
Monitor Driver
Word Processor
Vixen System
$895

Public Domain Software
Copying Company
38 Gold St. L3M NY, NY 10038
(212) 632-2258

Newsi AFFORDABLE
ENGINEERING
SOFTWARE

d/MULTI
MULTIUSER dBASE
true
for
TurboDOS
TRUE File and Record Locking as easy as
dBASE II. Unlimited users can perform the
magic of dBASE in the program or
interactive mode
• TurboDOS 1.3 or 1.4
• No Peeks or Pokes
• System Date and Time Functions
• Printer Controls up to 16 printers
Martian Technologies .
CREATEing Multi-users from
Single-users around the world

CALL FOR DETAILS
Martian Technologies
6346 Center Dr., Ste.F, La Mesa, CA 92041
(619) 464-2924

11 Pound
PORTABLE COMPUTER
Includes 2-drives
TFT 6 line LCD Display
128K RAM $895
512K RAM $995
Optional 80 x 25 line
Monitor Driver
Word Processor
Vixen System
$895

Micro/Systems Journal March/April 1986
The only magazine by and for advanced micro users.

Micro/Systems Journal is the independent magazine for advanced software and hardware hackers who use MS/DOS, CP/M, MP/M, TurboDOS, Concurrent-DOS and Xenix. An important resource for programmers who use C, Turbo Pascal, Forth, Lisp and Assembler. It also covers hardware based on the S-100, PC and AT busses, as well as powerful single board and multi-user systems. Its name — MICRO/SYSTEMS JOURNAL!

Each issue is packed with practical articles...in depth tutorials, reviews, hints...the latest information on SIG/M, PC/Blue, C-User Group and PC-SIG Public Domain Software. Advanced topics such as 16-bit and 32-bit microprocessors, high performance data acquisition systems, interfacing to peripherals, patching application software packages for improved performance...and lots more! Strictly technical info...no fluff...stuff to keep every hacker up-to-date on the ever-changing micro technology.

Save Up To 27% Off Newsstand Price

TAKE ADVANTAGE OF SPECIAL LIMITED TIME OFFER

Offer expires June 31, 1986 so hurry and mail your subscription now.

[ ] YES! Start my subscription!
[ ] 1 YEAR* ................................ $20.00
[ ] 2 YEARS** ................................ 35.00
[ ] 1 YEAR (Canada & Mexico)* .... 28.00
[ ] 2 YEARS (Canada & Mexico)** . 52.00
[ ] 1 YEAR (other foreign)* ........ 35.00
[ ] 2 YEARS (other foreign)** .... 64.00

*6 issues **12 issues

Checks must be payable in U.S. funds by a U.S. bank

Name: ____________________________
Address: ___________________________
City: ____________________ State: ______ Zip: ______

make check payable to: MICRO/SYSTEMS JOURNAL
Box 1192
Mountainside, NJ 07092
We Call It TurboLAN.

Imagine IBM PCs, intelligent workstations and S-100 BUS multiuser systems all on the same local area network. Impossible?
Not with TurboLAN, Intercontinental Micro's networking solution.
The key is a unique hardware and software approach to local area networks.
You get the flexibility of 8-bit and 16-bit processors on the same network, the cost savings of shared peripherals, and expandability to over 4000 users.
You simply organize the network the way you want, mixing IBM PCs, S-100 BUS multi-user systems, S-100 BUS file servers, and workstations.
Intercontinental's sophisticated single board computers, 8-bit and 16-bit slaves, memory and interface boards make your job even easier.
TurboLAN will work with almost any S-100 BUS system including NORTHSTAR, IMS, Teletek, and any other S-100 master featuring phantom deselection or extended addressing capability.
The ability to run PC-DOS, MS-DOS, CP/M, MP/M, and other applications programs means whatever the future holds, TurboLAN is ready.
And so is Intercontinental Micro.
You see, our S-100 BUS products revolutionized an industry. Intercontinental's slaves, masters and memory boards introduced advanced features like Direct Memory Access and Memory Management to micro environments. TurboLAN™ The new networking solution from the company that's been building networking solutions for years. Still think TurboLAN's impossible?
Then call, write or circle the bingo number below—we'll send you complete information on TurboLAN and descriptions of all our products, including the most complete S-100 BUS product line in the business.
OUR COMPLETE TURBOLAN AND S-100 BUS PRODUCT LINE

CPS4800X-SINGLE BOARD COMPUTER.
4 or 6 MHz processor (Z80A/B), on board floppy disk controller, 64K RAM, 4 channel DMA controller, 24 line parallel I/O port. 2 serial I/O ports, real time clock. Memory mapped or I/O mapped capability.

CPS-15X-16-BIT ROM SLAVE PROCESSOR.
256K, 512K, or 1MB RAM, bank selectable, memory mapped or I/O ports, 2 serial I/O ports, 8 MHz.

CPS-BMX1 MX-Z80 SLAVE PROCESSORS
4 to 6 MHz processors, 54K RAM or 128K bank selectable memory, two serial ports, 24 line parallel I/O port.

256KMB—MEMORY BOARD.
Hard disk cache, linear addressable to two megabytes, bank selectable in 16K increments, configures for phantom deselection, parity error detection.

LANS-100—TURBOLAN FOR S-100 BUS SYSTEMS
ARCNET controller meets 696.2/D2S-100 spec, coax cable interface, 255 nodes per network segment, 2.5 megabit/sec data rate.

LANPC TURBOLAN FOR THE IBM PC
Plug-in expansion ArcNet board. Custom software drivers integrates IBM PC into TurboLAN networks. 64K or 256K RAM options available.

WS80X—DISKLESS WORKSTATION
Converts almost any dumb terminal into intelligent workstation with networking capability. Floppy and hard disk options available.

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

Intercontinental Micro Systems

495 Leaverton Ct., Anaheim, CA 92807 (714) 630-0964, TELEX: 821375 SUPPORT UD
TIME & MONEY
SemiDisk is the disk emulator that saves you more of both.

We've just done something we know you'll like. We've made the SemiDisk far more affordable than ever before. With price cuts over 25% for most of our product line. Even our new 2 megabyte units are included.

COMPARE WITH THE OTHERS.
SemiDisk Systems builds fast disk emulators for more microcomputers than anyone else. S-100, IBM-PC, Epson QX-10, TRS-80 Models II, 12, and 16. Up to 2 megabytes per board, standard. Up to 8 megabytes per computer, using only four bus slots, max! Software drivers are available for CP/M 80, MS-DOS, ZDOS, TurboDOS, VALDOCS 2, and Cromix. SemiDisk turns good computers into great computers.

GREAT NEWS FOR IBM PC AT USERS.
New MS-DOS 3.0 software drives take full advantage of the 80286's expanded instruction set, moving data four times faster than can be done on PC or XT.

BATTERY BACKUP, TOO.
At 0.7 amps per 2 megabytes, SemiDisk consumes far less power than the competition. And you don't have to worry if the lights go out. The battery backup option gives you 5-10 hours of data protection during a blackout. Nobody else has this important feature. Why risk valuable data?

IT'S EXPANDABLE TO 8 MEGABYTES.
You can start with as little as 512k bytes, and later upgrade to 2 megabytes per board. At your own pace, as your needs expand.
In an IBM PC, XT, and AT you can have multiple drives on a single system. And the SemiDisk gives you mainframe performance on the top of your desk.

AND THE BEST NEWS IS SAVED FOR LAST:

512K
$695
$1395
$1995
$1795
$1795
$1795
$150
$150

SemiDisk Systems is a trademark of SemiDisk Systems, Inc.
SemiDisk Systems, Inc.
P.O. Box GG, Beaverton, Oregon 97075
503-642-3100