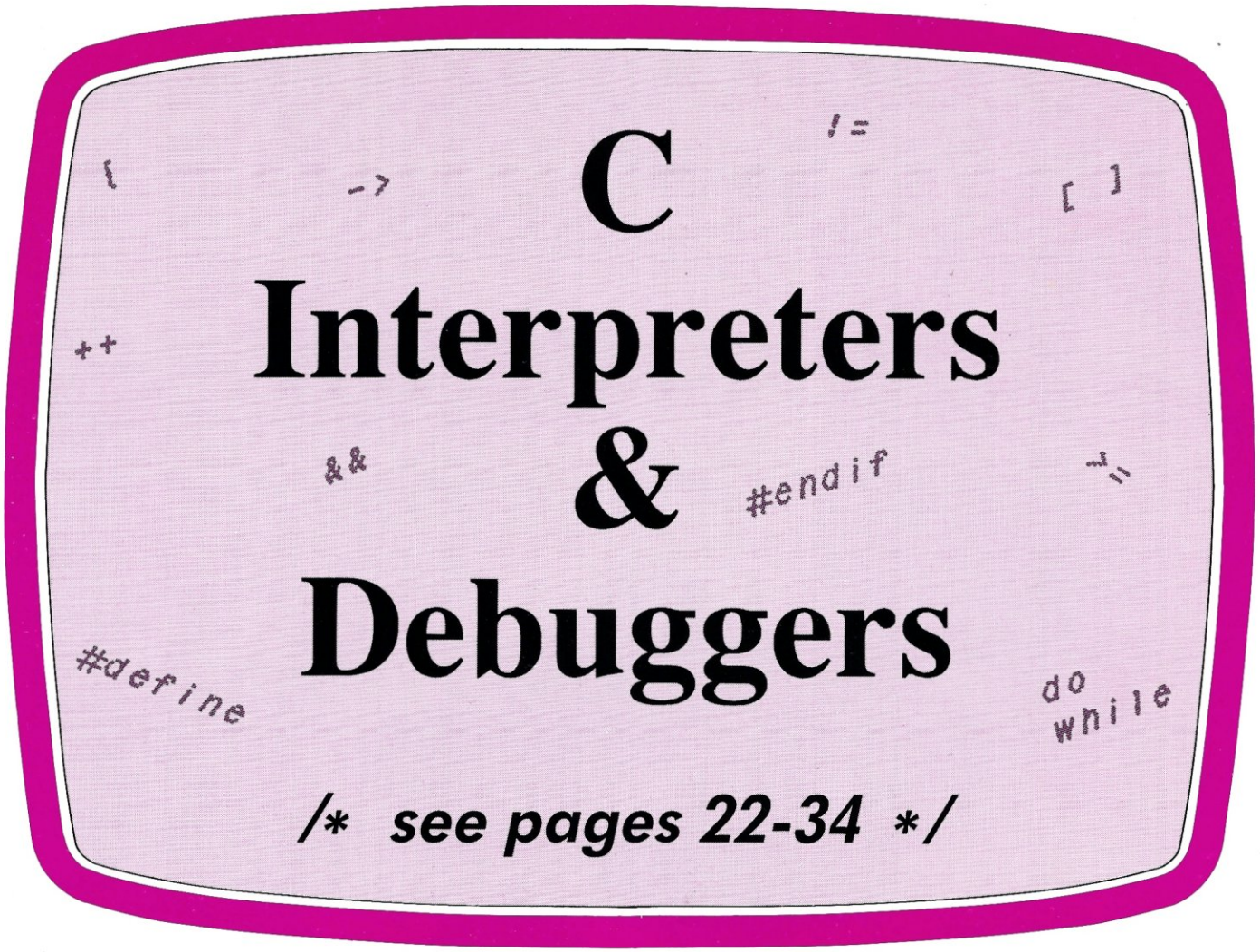
For the Advanced Computer User

Micro/Systems Journal™



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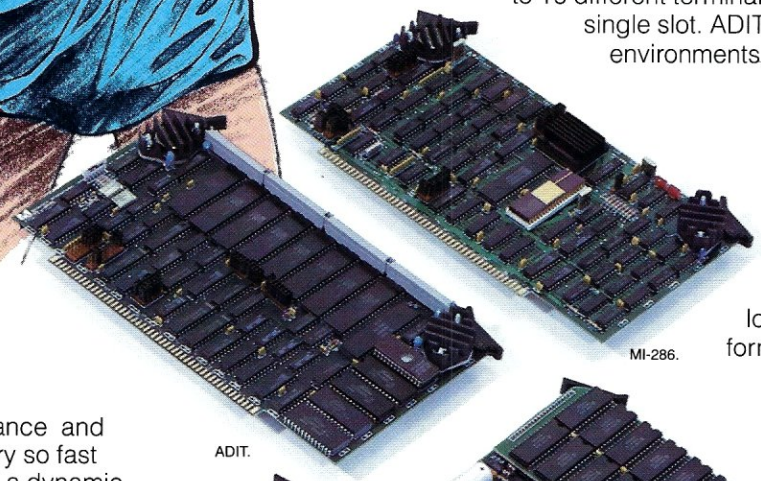

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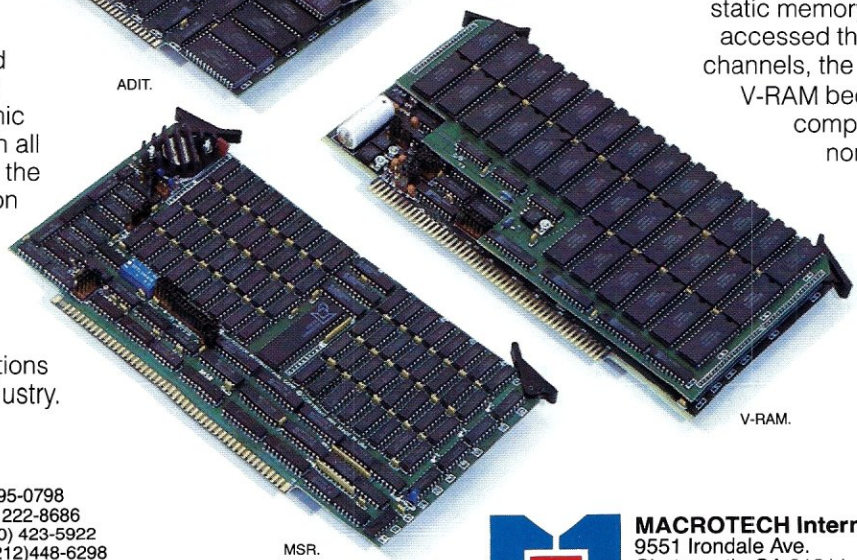

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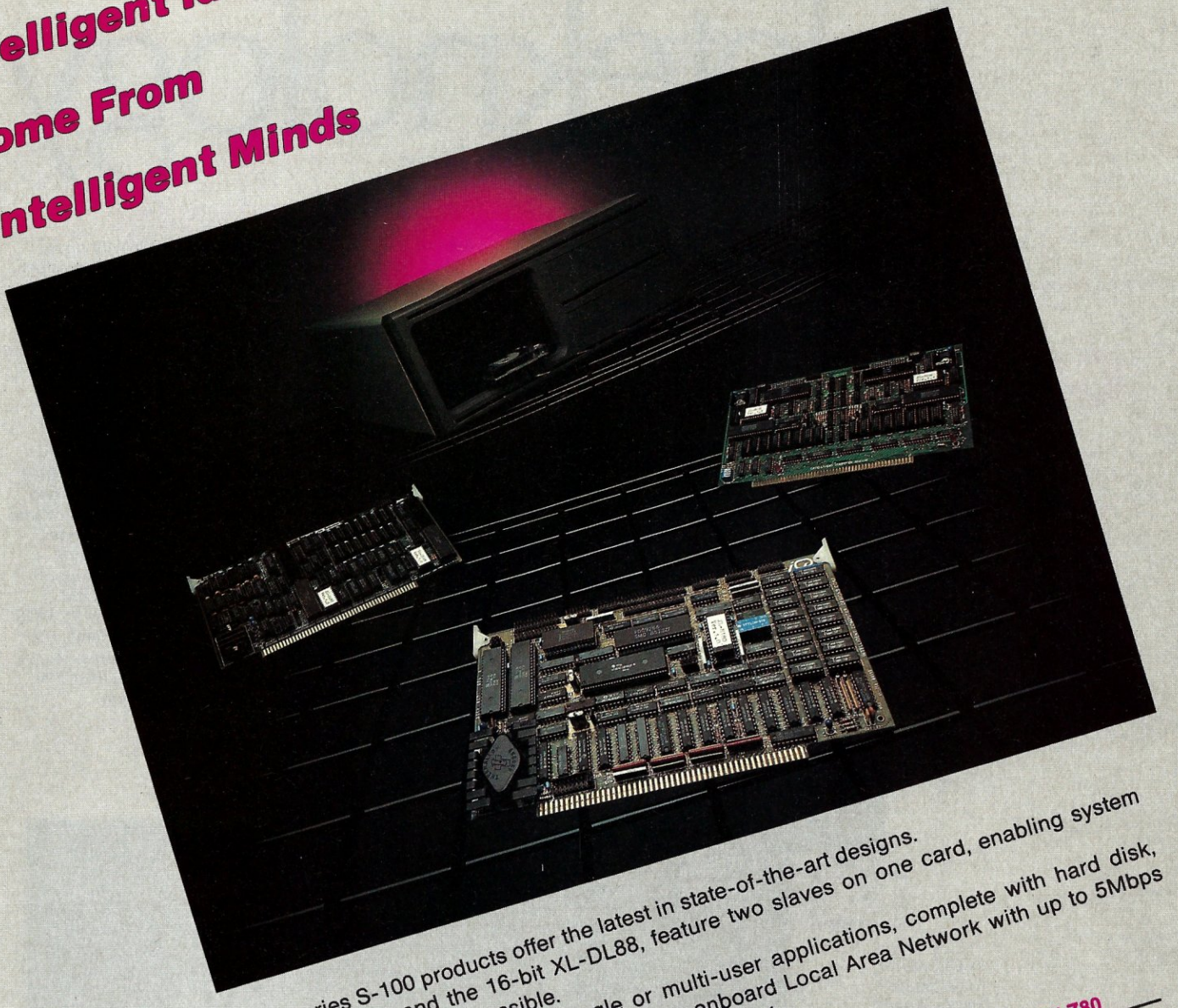

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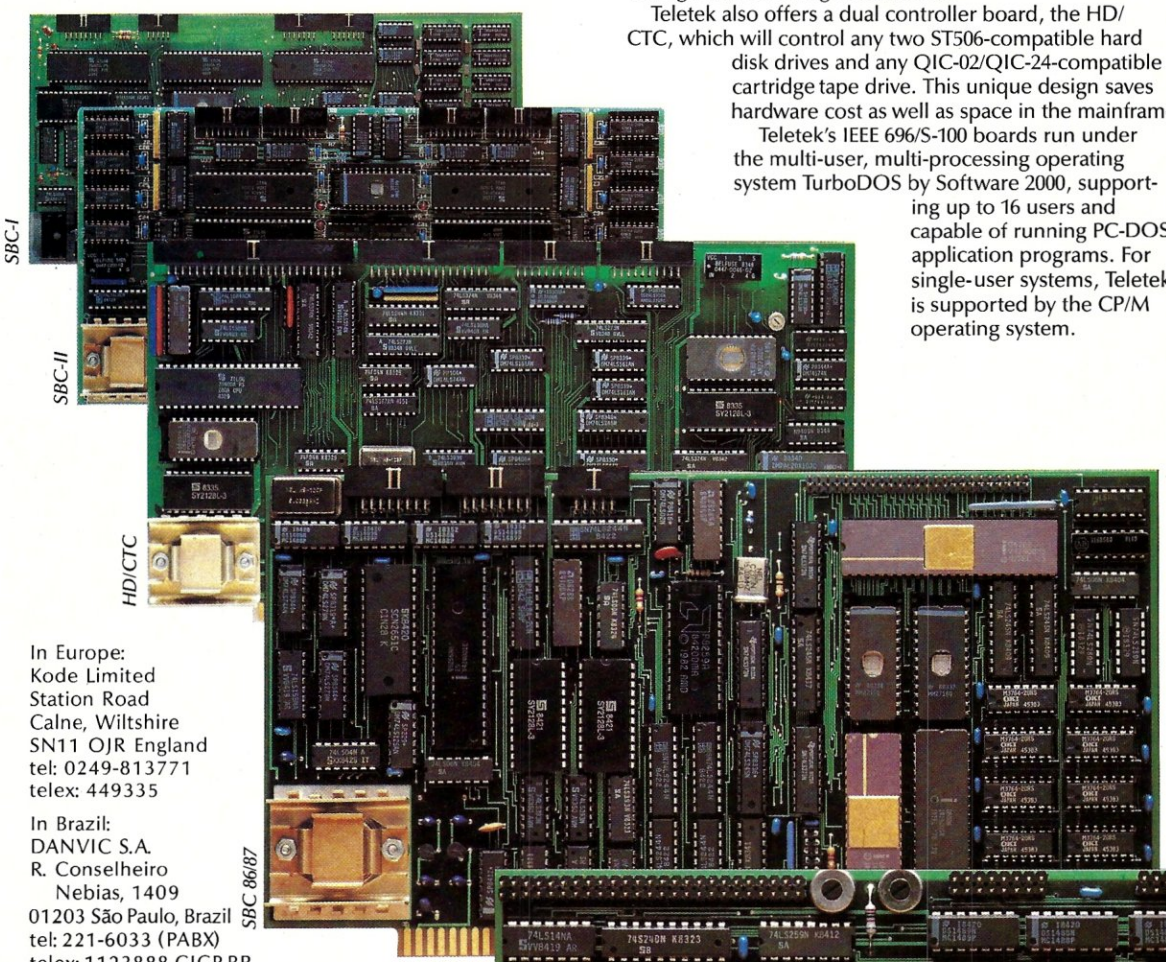

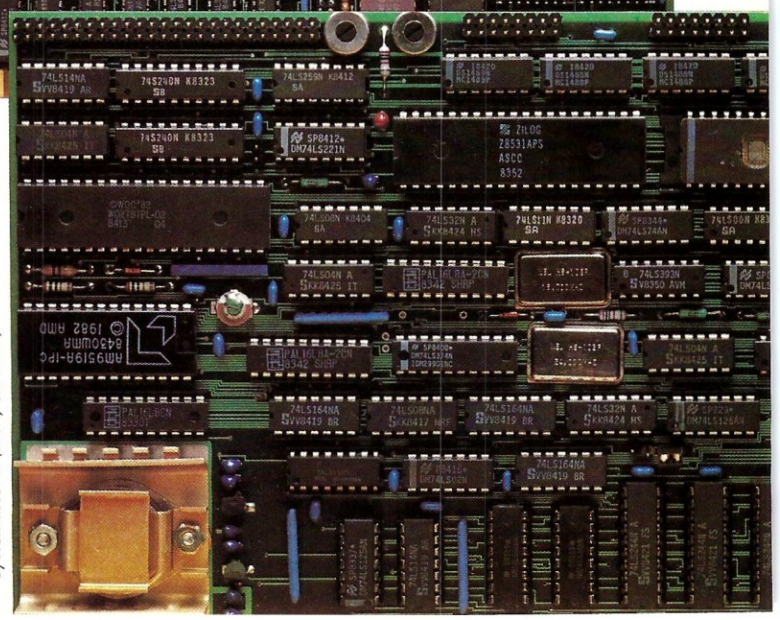

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IBM PC, PC/XT, AT	International Business Machines
MS-DOS, XENIX	Microsoft
GW Basic	Microsoft
68000, 68010,68020	Motorola

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, advertiser, 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 questionaire 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

PC/PC-Compatible Systems

IBM-PC	103
IBM-XT	78
Zenith 150/160	60
IBM-AT	50
Compaq	33
Clones	33
Sanyo	10
AT&T-6300	8
Leading Edge	8
Tandy	5
Other	17
Total	405 (81%)

S-100 Systems

CompuPro	63
Zenith Z100	35
NorthStar	33
Ithaca Intersys.	15
Ca. Comput. Sys.	10
Exidy	8
Sol	8
Morrow	8
Dynabyte	5
Teletek	5
Altair	5
Other	133
Total	328 (65%)

UNIX Systems

VAX	60
PDP-11	28
Altos	8
Sun	5
Other	14
Total	115 (23%)

Other Systems

TRS-80	63
Apple II	60
KayPro	55
Heath Z89	28
Osborne	18
Morrow MD	18
Big Board	15
Xerox 820	15
Televideo	15
Ampro	13
Commodore	13
Macintosh	10
Other	242
Total	565 (113%)

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 questionaires. We were forced to limit ourselves to only tabulating the data from the first 500 responses to the first questionaire. The following are the results of tabulating just the first question on the first questionaire.....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.

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National C User's Group provides direct access to the wealth of public-domain software written in BDS C, including text editors and formatters, BBS's, assemblers, C compliers, games and much more.

Complete package price: $150.
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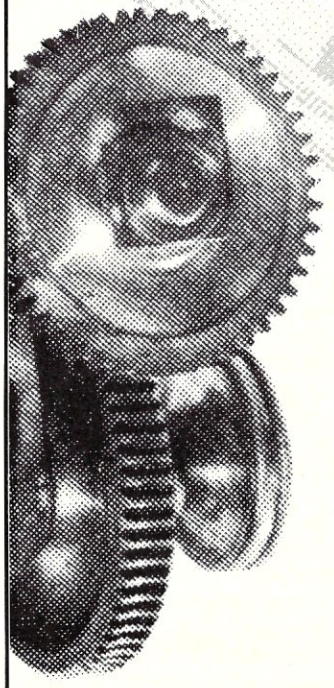

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News, Views & Gossip

by Sol Libes

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 new 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. I 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 demoed 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 bank-switches program code from conventional memory to high memory in a manner similar to that used in CP/M 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 afforable prices.

Wendin, Box 266, Cheney WA 99004, (509)235-8088, has introduced a $99 verison of UNIX called *PCUNIX* that they claim *brings the power and flexibility of UNIX to the PC* and compatibles. PCUNIX is multitasking and multiuser. 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 Soquel Dr, Aptos CA 95003, (408)688-0286, 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

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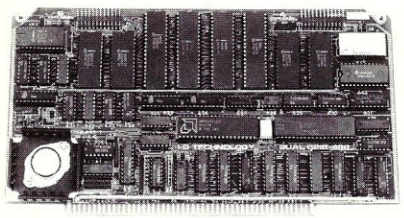

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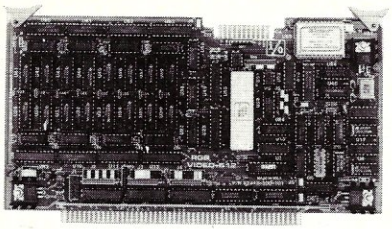

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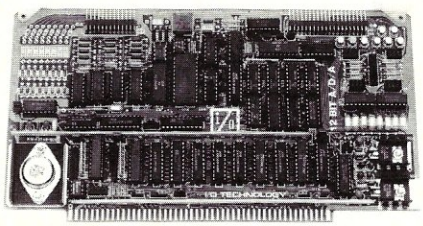

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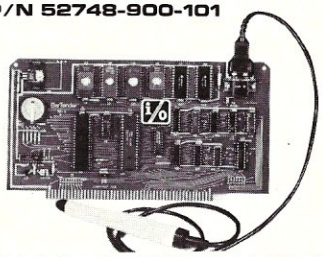

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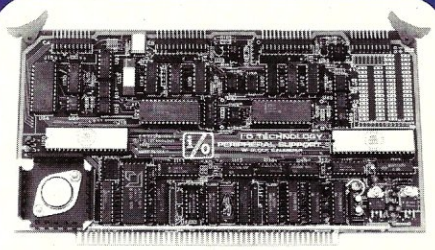

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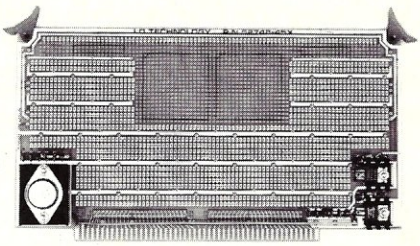

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expected to introduce a multi-processing version of MS-DOS later this year even at this low cost Unix may never achieve a significant share of the market.

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 compatiblity. 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 committment to making them better and cheaper than the likes of the IBM and Compaq machines. The Japanese are expected to captialize 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 1Mbof 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 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.) undertaken 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 megs 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 4Mhz 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 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 vailable 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-datapath 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 Carrolton 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).

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CMAUTO
Create programs to run other programs: to eliminate repetitive typing; to create short named programs for long commands. Specify command line, run disk and user area. Full-screen menu allows easy entering or editing.

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

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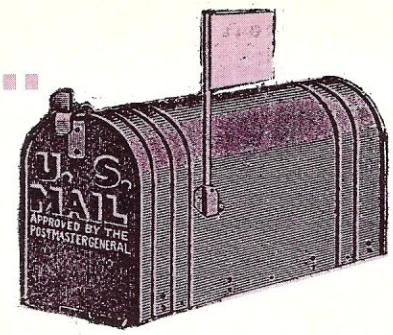

We welcome your letters with comments, compliments, criticism and suggestions. We read them all and publish the most noteworthy, even if they are critical of us. We do not have the staff to answer all letters personally. And all letters become the property of M/SJ and may be subject to editing. Further, we do not print letters that do not include a name and address.

Please send your letters to: Micro/Systems Journal, Box 1192, Mountainside NJ 07092.

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 Microsystems 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 contructing 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 "e" 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 Lempereur
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 this 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 PCs 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 M/SJ 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 M/SJ:

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, expecially in the MS-DOS and UNIX/XENIX environments.

With best wishes,
Jeffrey M. Speiser
San Diego CA

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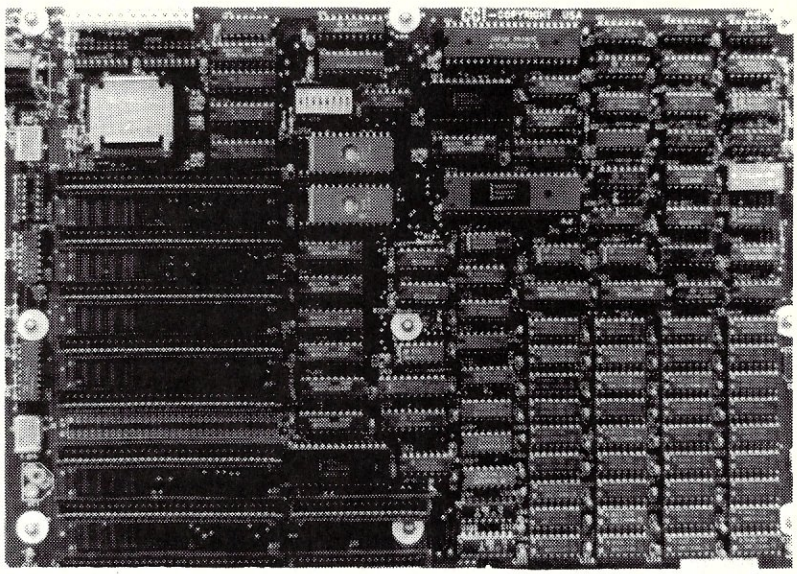

The Challenger XT-186 offers full IBM PC-XT compatibility. It supports industry standard operating systems: MS, DOS, PC-DOS, 1.0 through 3.1, UNIX and CP/M and runs all existing software with higher performance. The XT-186 mother board can directly replace any existing PC or PC-XT mother board, as it 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.

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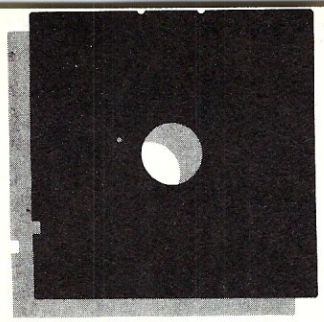

In the SIG/M Public Domain

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 indeed 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 Phillipe 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 just 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 Dugan, 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 modem 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) 398-1634. 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 the 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) 493-1495
	(805) 492-5472
Colorado:	(303) 465-1313
Georgia:	(404) 636-6130
Massachusetts:	(617) 646-3610
New York:	(718) 539-3338
	(516) 561-6590
Ohio:	(216) 645-0827
	(513) 256-7227
Oklahoma:	(918) 446-5219
Tennessee:	(615) 528-5039
Texas:	(713) 469-8893

is available for $6.00. Many bulletin boards have the software for downloading and most new releases on available on the CP/M SIG on Compuserve.

NEW SIG/M RELEASES

```
Vol 247  Concurrent CP/M Patches & Utilities
     released    November 15, 1985
CONNECT .AQ6   MCDOS virtual console
DU-75E  .AQ6   Disk Utility CCPM or CPM86
EXAMPLES.LBR   CCPM queues, etc
FKEY    .LBR   Reassign Compupro keys
GREP    .LBR   CPM86 pattern matcher
MCDOS   .EQU   MCDOS equates
NTREE   .LBR   Display CCPM or DOS dir
PASS    .AQ6   Password utility
ROUTINES.AQ6   CCPM subroutines
TACH    .LBR   Measure MCDOS idle time
TCLOCK  .AQ6   Time of day in large nos
UPSMON  .LBR   Power supply monitor
Z19-MODS.LBR   Intercept escape sequences
-------------------------------------------------
Vol 248    Dan's Information Management Sys.
     released    November 15, 1985
DIMS103A.LBR   MBASIC data management
DIMS103B.LBR   system (Updates SIG/M 61)
-------------------------------------------------
Volume 249   Remote Bulletin Board System
     (Volume 1 of 2)
     released    November 15, 1985
RBBS38A .COM   RBBS ready to run file
RBBS38A .WQ    Documentation
INSTAL38.COM   Installation program
INSTALL .HQP   Help file used by INSTAL38
UTIL38  .COM   Utility program
EXIT38  .COM   Ask for Comments on Exit
BYE     .COM   Psuedo BYE to call EXITRBBS
RBBS    .COM   Psuedo RBBS to call real RBBS
STARTUP .COM   Program start-up in BYE
RUNIT   .AQM   Psuedo program maker
BULLETIN.      RBBS38A Support Text files
ENTERCPM.
HELP    .
INFO    .
MENURBBS.
NEWCOM  .
NEWS    .
SYOPMENU.
TWIT    .
READ    .ME2   Additional information
-------------------------------------------------
Vol 250  RBBS (Vol 2 of 2)
     Micro/Systems Journal Programs
     released    November 15, 1985
RBBS38A .AQC   Source file with comments
RBBS38A .NQC   'No comments' source file
INSTAL38.AQC   Source file for install
EXIT38  .AQC   Source for Exit Comments
UTIL38  .AQC   Source for utilty program
TXT71   .LBR   Turn TEXT file into .COM
WHLCHK  .LBR   Checks WHEEL
CHGLIB22.LBR   Modify Telephone list
CPM68K  .TXT   Bringing up CP/M-68K
TRANSFER.TXT   Intersystem Processing
TURBO   .TXT   Turbo Pascal library mods
WHOPRTS .A86   Printer control in CCPM
MDCS    .TUT   Master Disk Cat. Sys Guide
-------------------------------------------------
Vol 251  ROS Turbo Pascal BBS System
     released    November 15, 1985
ROS33   .LBR   Turbo Pascal BBS System
ROSMAC  .LBR   /
```


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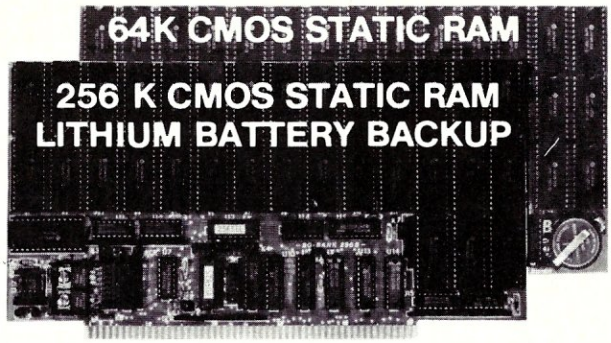

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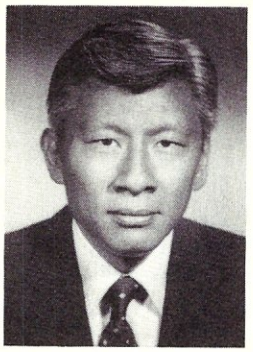
PC/Blue Report

by Hank Kee



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.

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 .?Q? in the filename suffix. If a filename had no suffix, then .QQQ would be appended to the filename. UnSQueeze, 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 denotd 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 {aumdxerplvt}[bwn] <archive>
 [<filename> . . .]
```

Where:

a,u = add files to archive
m = move files to archive
d = delete files from archive
x,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
n = 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 into BASICA to change the screen attributes, it reverts to the original color standard when you return to the command mode. There is a utility program called KOLOR which can be invoked in the AUTOEXEC.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. But each 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.

Oldtimers who have been using SD or SDIR 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.

Copies of the PC/Blue printed software directory can be ordered from Micro/Systems Journal, Box 1192, Mountainside NJ 07092 ($4 U.S, Canada & Mexico; $6 foreign).

PC/Blue disks are available from the New York Amateur Computer Club, Inc., Box 106, Church Street Station, NY NY 10008. Price is $7 per volume which includes media, postage, and handling. On foreign orders, please add $2 per disk.

NEW PC/BLUE RELEASES

VOLUME 175
QModem -version 1.12
modem communications program
author-John Friel III, Forbin Project

TRYVMSYM -version 1.1
virtual memory for Symphony 1.1
using up to 4mb on fixed disk
author-SYSCOMP

PROINDEX -version 1.2
indexing system for text files
author-Gary Elfring

VOLUME 174
ESIE -version 1.1
(E)xpert (S)ystem (I)nference (E)ngine
author-Lightwave Consultants

CRCBTOOL - CRC version 6.5/CRCB 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 Browne

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
FASTFMT -fast formatting program
author-CNA HelpWare

dBASE II screen generator
author-Jeff Newbro

Kraft Paint -painting with a joystick
authors-Bill Athing Jr/Dave Nielsen

XWORD version 2.12 -format translator
author-Ronald Gans

ECHOMODB -ECHO of blank lines in .BAT
author-Bill Norris

HOUSEKEEP -file handler w/.LBR funct
author-Don Thompson

VOLUME 171
ESCREENS -Easy Screens
facility to create interactive
color graphic screens

VOLUME 170
PIBTERM version 3.0
modem communication emulator
author-Philip R. Burns

BUTLER version 1.03
batch ModemButler
author-Andrew Brenner

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 K. Perlman Associates

VOLUME 168
pBASE version 1.02
database management system
author-4B Associates

PC-Recipe
kitchen management tool
author-PC Square

SL -dBASE SideLine version A1.0
flowcharts dBASE III command files
author-Wynn B. Rust

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

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

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

PC-GL version 2.3-General Ledger
PC-AR version 2.1-Accounts Receivable
author-Jerry Medlin

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

VOLUME 163
dGENERATE version 1.0
dBASE III screen and code generator
author-Tom Rettig Associates

VOLUME 162
OmniEdit
author-Quaid Software Ltd

DOS Assistant version 2.0
author-John Hensley

LetterFall-typing instructor
author-Frank Harris

XRay-adjustable window
author-John Ferguson, Jr.

VOLUME 161
FANSI-CONSOLE version 1.11/1.13
fast ANSI X3.64 console driver for IBM
author-Hersey Micro Consulting, Inc.

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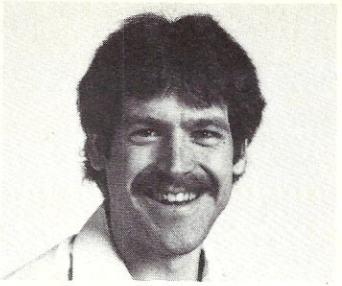
The C Forum



by Don Libes

getopt - A Subroutine For Parsing Command-Line Arguments

One of the stumbling blocks of every C programmer is figuring out how to get the command-line arguments for a C program so that they are usable inside the program.

Most MS-DOS C compilers follow the UNIX convention that the main program has the parameters *argc* and *argv*. *argc and argv* are a strange representation of what was on the command line that invoked the program.

argv is an array of string pointers, each string being one of the tokens of the command that the main was invoked with. (A token is a group of characters delimited by "white space".) Since the first token is just the name of the program, argv[0] is not usually examined (and in fact, is hard to get from MS-DOS). argc is the number of pointers in *argv*. This layout provides the ability to pass a variable number of arguments to a program.

However, this layout is unwieldy when one considers it in relation to how *command-line arguments* are used in a typical program.

Command-line arguments are usually single-character flags that may or may not have a following value which may or may not be separated by white space. Ugh. Flags with no values may appear consecutively in one *argv* string. Some programs are generous and allow all of these argument passing styles and more. Other programs are more idiosyncratic and will only accept, for example, arguments that are separated by white space. Worst of all are programs that insist on having the arguments in a particular order.

Writing argument parsing routines is always a headache because you have to think of all the ways a user could reasonably enter the input and expect it to be accepted. Archetypal argv parsing code consists of a while loop to look at each argument, enclosing a switch which actually determines what code is executed for the different argument flags. Finally, there may be a loop to pick up a number of files to be processed. (Files usually appear after flags.) Such archetypal code also usually has bugs in it, since it is confusing writing code that can handle all of these possibilities.

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″ SSSD, Osborne SSDD, Heath and North Star Formats.They are listed below:

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

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 argc/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.

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, ":" can not be used as a flag character.) For example,

```
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,

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

would be validly parsed by the above *getopt* call. 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,

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

An excerpt of the *getopt* calling code is as follows:

```
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':
              i_flag = TRUE;
              i = atoi(optarg);
              break;
          case 'n':
              n_flag = TRUE;
              n = optval;
              break;
          case 'a':
              a_flag = TRUE;
              break;
          case 'b':
              b_flag = TRUE;
              break;
      }

     /* rest of arguments are */
     /* files, so pick them up, too */
     for (;optind < argc; optind++) {
         if (stat(argv[optind]) ...
         ...
     }
}
```

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, "-f"! (It is not a very smart idea to have file names that 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 "opterr" 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.

```
/* optarg - parse command-line arguments */
/* Author: AT&T */

#define NULL    0
#define EOF     (-1)
#define ERR(s, c)       if(opterr){\
        extern int strlen(), write();\
        char errbuf[2];\
        errbuf[0] = c; errbuf[1] = '\n';\
        (void) write(2, argv[0], (unsigned)strlen(argv[0]));\
        (void) write(2, s, (unsigned)strlen(s));\
        (void) write(2, errbuf, 2);}

extern int strcmp();
extern char *strchr();

int     opterr = 1;  /* getopt prints errors if this is on */
int     optind = 1;  /* token pointer */
int     optopt;      /* option character passed back to user */
char    *optarg;     /* flag argument (or value) */

int  /* return option character, EOF if no more or ? if problem */
getopt(argc, argv, opts)
int     argc;
char    **argv;
char    *opts;              /* option string */
{
        static int sp = 1;  /* character index in current token */
        register char *cp;  /* pointer into current token */

        if(sp == 1)
             /* check for more flag-like tokens */
             if(optind >= argc ||
                argv[optind][0] != '-' || argv[optind][1] == '\0')
                     return(EOF);
             else if(strcmp(argv[optind], "--") == 0) {
                     optind++;
                     return(EOF);
                }
        optopt = argv[optind][sp];
        if(optopt == ':' || (cp=strchr(opts, optopt)) == NULL) {
                ERR(": illegal option -- ", optopt);
                /* if no chars left in this token, */
                /* move to next token */
                if(argv[optind][++sp] == '\0') {
                        optind++;
                        sp = 1;
                }
                return('?');
        }

        if(*++cp == ':') {   /* if a value is expected, get it */
                if(argv[optind][sp+1] != '\0')
                     /* flag value is rest of current token */
                     optarg = &argv[optind++][sp+1];
                else if(++optind >= argc) {
                     ERR(": option requires an argument -- ", optopt);
                     sp = 1;
                     return('?');
                } else
                     /* flag value is next token */
                     optarg = argv[optind++];
                sp = 1;
        } else {
                /* set up to look at next char in token, next time */
                if(argv[optind][++sp] == '\0') {
                        /* no more in current token, */

                        /* so setup next token */
                        sp = 1;
                        optind++;
                }
                optarg = NULL;
        }
        return(optopt); /* return current flag character found */
}
```

References:
[1] "Experiences with Electronic Software Distribution", Brooks, Catherine A., USENIX Association 1985 Summer Conference Proceedings, Portland, Oregon, pp. 433-436.

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 Lennie and Sol Libes.

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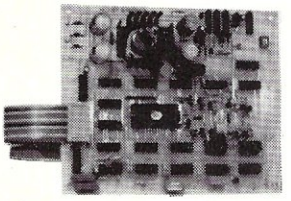

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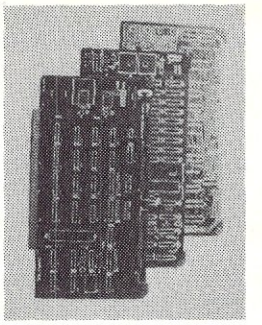

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Working with a debugger:

```
A>DEBUG
-N PROGRAM.EXE
-L
-D 10D 127
4D48:0100                                               50 B4 30                P4O
4D48:0110  CD 21 86 E0 3D 36 01 72-05 3D 0A 02 76 09 BA CB   M!.`=6.r.=..v.:K
4D48:0120  03 B4 09 CD 21 CD 20 58                          .4.M!M X
-U 10D 127
4D48:010D 50            PUSH    AX
4D48:010E B430          MOV     AH,30
4D48:0110 CD21          INT     21
4D48:0112 86E0          XCHG    AL,AH
4D48:0114 3D3601        CMP     AX,0136
4D48:0117 7205          JB      011E
4D48:0119 3D0A02        CMP     AX,020A
4D48:011C 7609          JBE     0127
4D48:011E BACB03        MOV     DX,03CB
4D48:0121 B409          MOV     AH,09
4D48:0123 CD21          INT     21
4D48:0125 CD20          INT     20
4D48:0127 58            POP     AX
```

Working with MASTER*KEY:

```
 1: 0010D P     50          H0010D: PUSH   AX
 2: 0010E  0    B430                MOV    AH,30h
 3: 00110  !    CD21                INT    21h             ;DOS Version#
 4: 00112       86E0                XCHG   AH,AL
 5: 00114 =6    3D3601              CMP    AX,0136h
 6: 00117 r     7205                JB     H0011E          ; . . . . . .
 7: 00119 =     3D0A02              CMP    AX,020Ah
 8: 0011C v     7609                JBE    H00127          ; . . . . . .
 9: 0011E       BACB03      H0011E: MOV    DX,03CBh
10: 00121       B409                MOV    AH,09h
11: 00123  !    CD21                INT    21h             ;Display String
12: 00125       CD20                INT    20h             ;TERMINATE normally
13:                                 ;-----------------------------------------
14: 00127 X     58          H00127: POP    AX


          PROGRAM.EXE - ASSEMBLY SOURCE CODE CROSS REFERENCE - PAGE: 1

0136h                    5
020Ah                    7
03CBh                    9
09h                     10
20h                     12
21h                      3   11
30h                      2
AH                       2    4   10
AL                       4
AX                       1    5    7   14
DOS Version#             3
DX                       9
Display String          11
H0010D                   1
H0011E                   6    9
H00127                   8   14
TERMINATE normally      12
```

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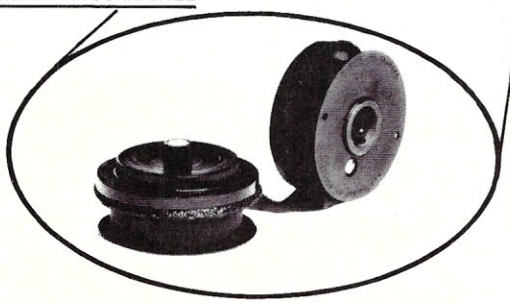

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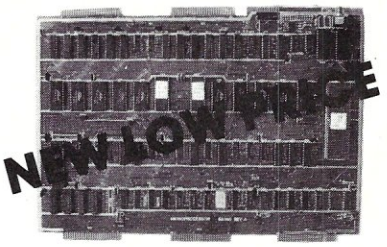

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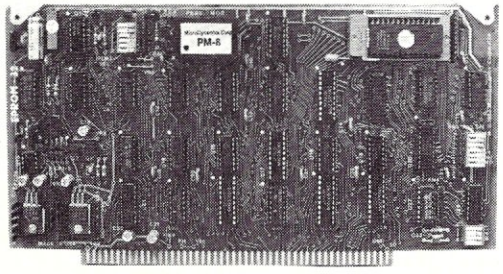

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See Dec. 1983 **Microsystems** for a review of the EPROM-32.

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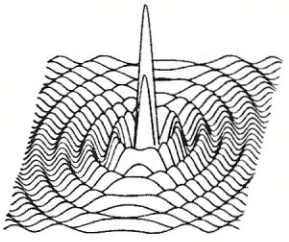

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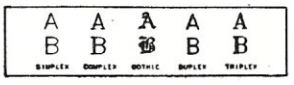

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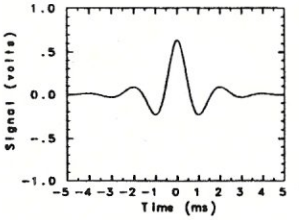

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C Interpreters

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 override 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 Teletypes 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 excrutiatingly 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 nonplussed 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 then 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 terminates 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 whatever 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 executing. 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 editing.

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 crlf 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 Lattice C, Computer Innovations C86, Microsoft C 3.0, Mark Williams C or Aztec C. Thus, if the user wants to use their own math library, it 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 for 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 cozy 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 a 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 C 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 typechecking 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 anyway. 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.

Type	Brand	Seconds
C	Aztec C	3.5
I	Instant C	16
P	P-system	56
I	C-terp	1100
I	Run/C	5400

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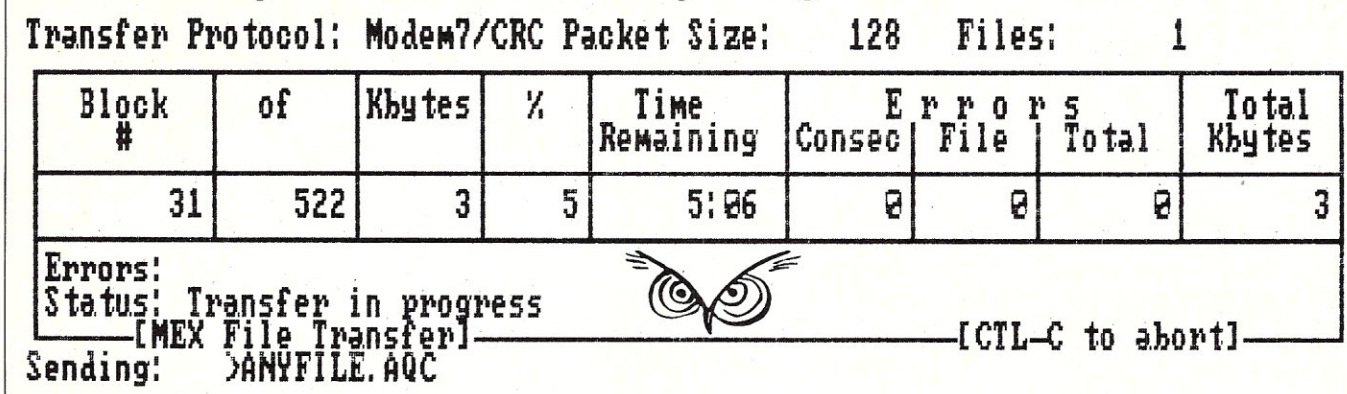

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We were quite surprised that IC is several times faster than the P-system. (The P-system semi-compiles code, producing P-codes that are opcodes for an ideal Pascal machine. The P-codes are interpreted at runtime.) Obviously, the IC writers put a lot of work into optimizing the interpreter itself. At the other end, CT was very slow and RC was very, 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 from putting it in the compiler, thereby leading to faster compilation times and runtimes.

IC, alone, has the ability to produce EXE or COM files. At first we didn't think this would be very useful, so we assumed that everyone using a C interpreter would have a compiler, but by buying IC, you in effect, get a compiler (albeit a slow one). Perhaps this justifies its higher price.

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.

C Interpreter Vendors

Instant-C
Rational Systems, Inc
P.O. Box 480
Natick, MA 01760
(617) 653-6194

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Lifeboat Associates
1651 Third Avenue
New York, NY 10128
(212) 860-0300

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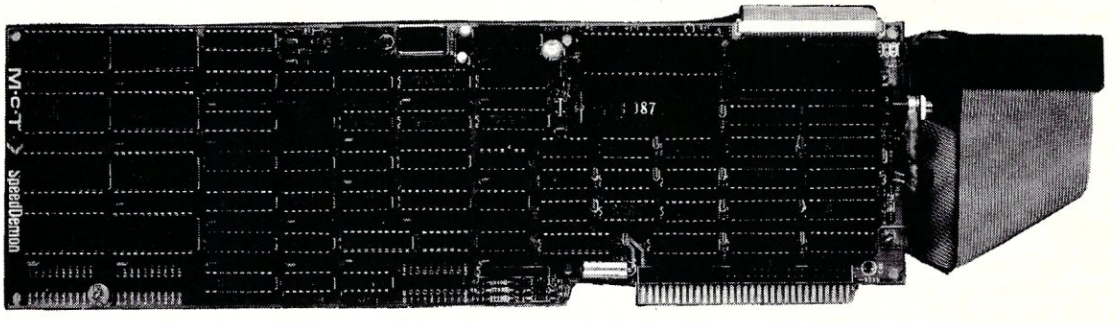

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C Source-Level Debuggers

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.
   c. C syntax for calling a function. The debugger should be able to call any function defined in the program being debugged.

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 disasterously. 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 'fputc(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,

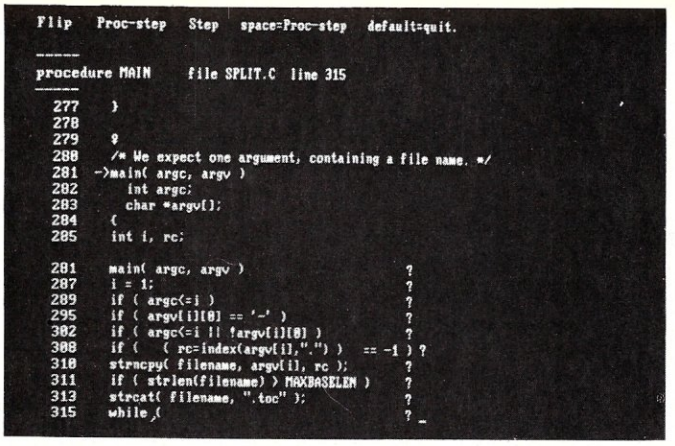


Figure 1. The de Smet C debugger's debugging screen. Prompt line, context line, and source code window are shown.

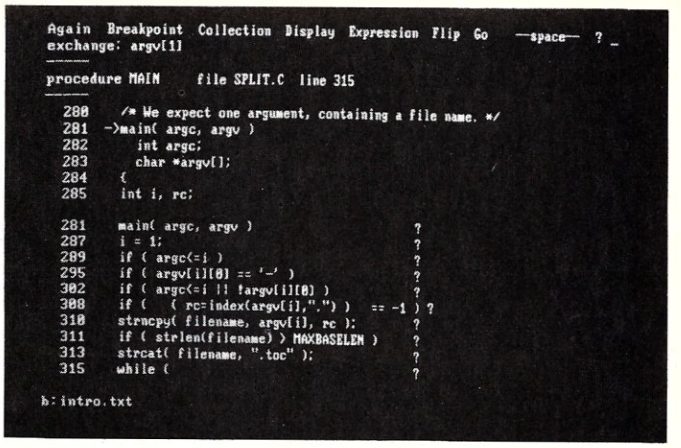


Figure 2. The 'E' command prompts you to enter an expression, then displays its value at the bottom of the screen.

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 on machine Address'), 'L' ('break on source Line number'), 'P' ('break at start of a named Procedure'), or 'F' ('run Forever' or until a numbered breakpoint is found). If you enter 'A', 'L', or 'P', 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++' 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

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

it compiles code as though you wrote

```
struct etab xyz;
function(&etab);
```

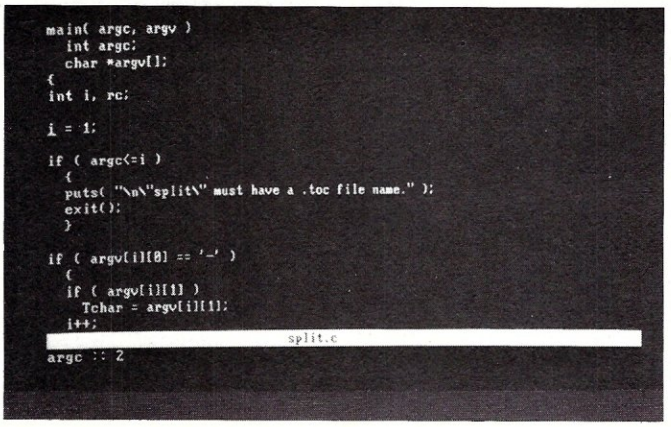


Figure 3. The Mark Williams C debugger's debugging screen: source code window (above) and evaluation window (below).

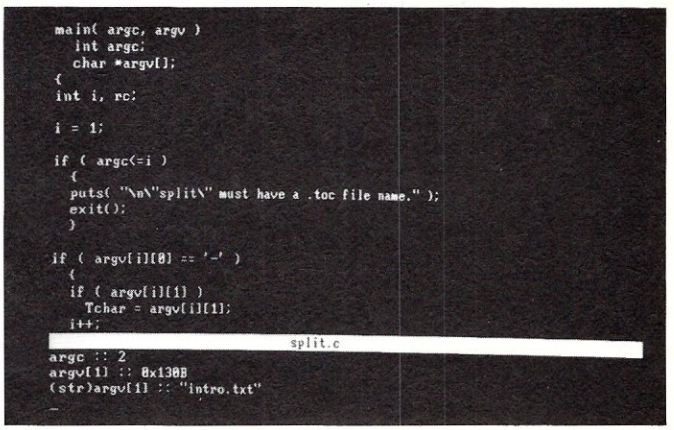


Figure 4. Evaluating expressions. The pseudo-cast '(str)' displays a character array as a string.

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.

How to Use It: To prepare a program for debugging, you must compile and link it with the '-VCSD' option. Modules compiled with and without this option may be linked together, but only modules compiled with the option may be debugged.

The debugger divides the screen vertically into two parts (see Figure 3). The upper part is a source code window. The lower part is an "evaluation window" where you can enter C expressions for the debugger to evaluate.

When you start the debugger, the cursor appears at the beginning of the first line of source code for the first module compiled with '-VCSD'. To make your program start running, you enter the 'step' command, which consists of two keystrokes, F4 followed by RETURN. (All debugger commands involve the use of the PC's function keys.) The cursor moves to the beginning of the 'main' function (assuming the 'main' module was compiled with '-VCSD').

Now you can step through the program by entering F4-RETURN or F4-⌔. F4-RETURN descends into called functions in modules compiled with '-VCSD', and executes them a step at a time. F4-⌔ executes called functions in a single step.

You can move the cursor around the source code with the ⌃, ⌄, PgUp, and PgDn keys. Long-range moves are done with a "find" command that can made to search either the current module or every module compiled with '-VCSD'.

To set a breakpoint, you move the cursor to the desired source code line and press the F3 key. The debugger highlights the line to show that a breakpoint is set there. Any number of breakpoints may be set at once. To clear a breakpoint, you move the cursor to a highlighted line and press F3 again.

The procedure for setting and clearing breakpoints is typical of this debugger's dependence on the PC's function keys. Each function key has a meaning; most commands require you to use two or more keys, combining their meanings as you would combine words to make a sentence. For example, F3 is 'trace,' and when used alone it sets or clears a breakpoint; F4 is 'run,' and F4 followed by F3 makes the program run to the next breakpoint. These key combinations are confusing at first, but soon start to seem natural. Mark Williams provides a function key overlay to help you while you learn.

To evaluate an expression, you move the cursor to the evaluation window by pressing the F9 key. Then enter the expression. When you press ENTER, the debugger evaluates the expression and displays the result. Press F7 to return to the source window. You may use the pseudo-cast '(str)' to display a character array as a string (see Figure 4).

You can enter several expressions and see their results at the same time. If the expressions overflow the evaluation window, they scroll off the top, but you can retrieve them with the cursor control keys at any time. You can also expand the evaluation window and contract the source window, so that more evaluated expressions are visible.

Each expression you enter is re-evaluated whenever the program stops at a breakpoint. This can be convenient if you want to watch how data values change during execution. It can also be disasterous if an expression has a side effect that you don't want to repeat. To evaluate an expression just once, you must delete it from the evaluation window before you proceed, using one of several commands involving the Del key.

The debugger's 'history window' shows a record of statements executed and expressions evaluated at breakpoints. A 'program window' shows the output of the program as it would be seen if the debugger were not running. You can switch among the debugger's four windows at will by pressing F7 (program), F8 (source), F9 (evaluation), and F10 (history).

Performance: The debugger loads more slowly than de Smet's. Once loaded, it runs fast. 'Run to breakpoint' appears to

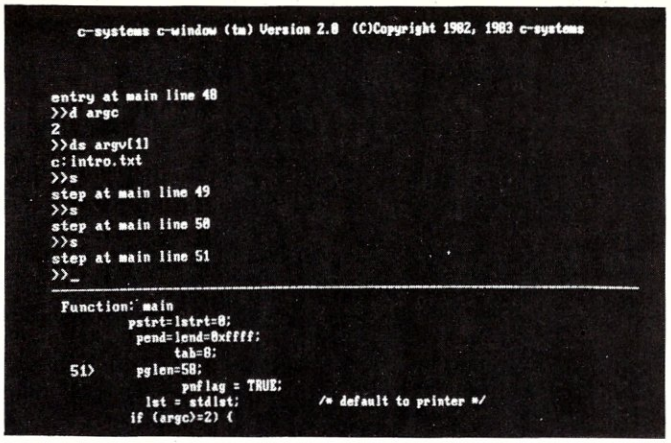


Figure 5. The c-systems C debugger's debugging screen: user I/O area (above) and source code display area (below).

go at the debugged program's normal full speed. 'Procedure-level step,' F4-◇, 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 no 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

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

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

```
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

	de Smet	Mark Williams	c-systems
Compile time			
without "debug" option	0:20	0:45	1:57[3]
with "debug" option	0:22	0:54	2:58[3]
Link time			
without "debug" option	0:08	0:22	0:18
with "debug" option	0:10	0:28	1:18
Debugger load time	0:03	0:14	0:04
Run time			
without debugger	0:08	0:06	0:10[2]
with debugger, "run to end"	0:08	0:06[2]	20:00[2]
with debugger, "procstep"	0:08	29:10[2]	n/a
with debugger, "run to breakpoint"	0:08	0:06	20:00[2]
Object module size			
without "debug" option	3081	3244	4150
with "debug" option	5216	9764	11,052
EXE file size			
without "debug" option	9728	7605	16,904[4]
with "debug" option	9728+2353[1]	12,720	100,962[4]

1 - second number is the size of the .CHK 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

	de Smet	Mark Williams	c-systems
COMPILER FEATURES			
Memory models supported	small[3]	small[2]	small, large[4]
Supports major UNIX Version 7 extensions	N3	Y	N
DEBUGGER FEATURES			
Procedure-level step	Y	Y	N
Breakpoints (not counting "run" command's built-in breakpoint)	3	no limit	9
Automatic evaluation of expressions at each step	N	Y	Y
Delayed & conditional breakpoints	N	N	Y
"Display target program screen" command (on IBM PC & compatibles)	Y	Y	Y
Source code "find" within module	Y	Y	N
Global source code "find"	N	Y	N
View source modules other than one now executing	Y	Y	N
Machine-level debugging	N	N	N
Source code capacity	no limit	no limit	1000 lines or 32 Kb
Compiler version reviewed	2.41	2.1.5	2.08A
Debugger version reviewed	1.4	2.1	2.0
Price (if compiler & debugger are separately priced, compiler is listed first)	$109 $50	$495	$199
Runs under MS DOS on computers not compatible with IBM PC	Y[1]	N	Y
Operating systems supported other than PC DOS & MS DOS	CP/M-86	Coherent	none

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

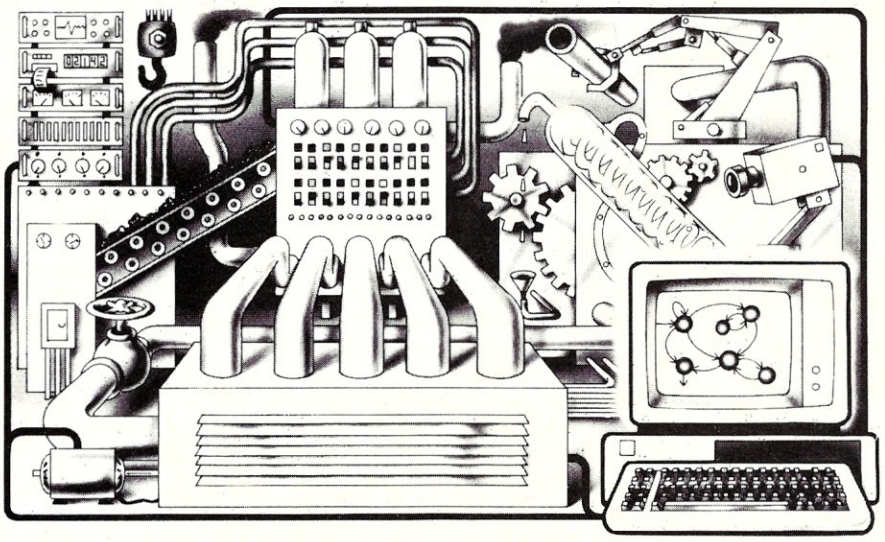
"...a stunning amount of bang for the buck ....loaded with excellent features."
— Houston, Brodrick and Kent, BYTE 8/83

$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



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SYSTEMS GUILD

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

VENDOR INFORMATION

C-Ware Corp.

Box C
Sunnyvale CA 94087
(408)720-9696

Mark Williams Co.

1430 W. Wrightwood Ave.
Chicago IL 60614
(312)472-6659

c-systems

Box 3253
Fullerton CA 92634
(714)637-5362

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 servicable. 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 without 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' options.

'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, procstep' 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.

```
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 *= r; 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

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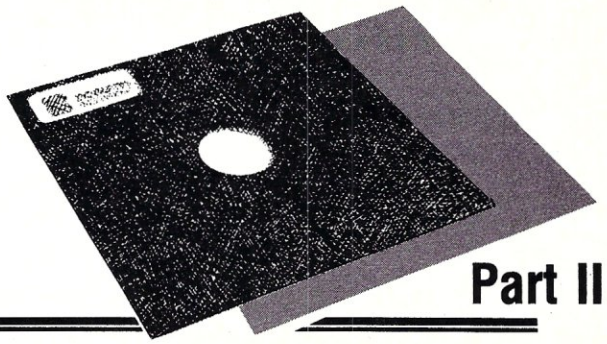
Implementing PC-DOS on Non-IBM Compatible Computers



Part II

By Christopher Cochran & Kristofer Sweger

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& 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 Figue 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 CLOCK$ 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 IBMDOS.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 (IBMDOS.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', ie. 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 date 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.

Figure 1
Locating The Startup Module In IBMIO.COM

```
Use these road markers to locate Startup Module within IBMBIO.com
image.  The first label, BIOS, is very beginning of IBMBIO.com
memory image.  When stepping through this 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.

BIOS: JMP     INIT           ;Jump over local data to initialization code
      . . .
      . . .                  ;Local BIOS data area
      . . .
INIT: . . .                  ;Lots of in-line code
      . . .
      . . .
      . . .
      JMP     STARTUP:ENTRY  ;Long jump to the startup module
      . . .
      . . .
      . . .
      ORG     0000           ;Startup Module begins at offset 0
ENTRY JMP     BEGIN          ;Jump over data area to code
      . . .
      . . .                  ;Local data area
      . . .
BEGIN:. . .                  ;Startup module code starts here

Everything from label ENTRY to end of IBMBIO.com memory image is
Startup Module (approximately 3k).  Save this portion on a
separate file.
```

Figure 2
Memory Map After System Bootup

```
Segment
Address

FFFF  +-----------------------------------------------------+
      |  Top of the physical address space, only ROM here   |
A000  |  Memory mapped devices may use this empty space     |
      |-----------------------------------------------------|
9FFF  |  Physical end of memory (640k in this case)         |
      |  Resident portion of the command shell              |
      |  Transient portion of the command shell             |
      |  User programs may extend and overlay command shell |
      |                  . . . . . .                        |
      |                  . . . . . .                        |
      |  Bottom of transient program area starts here       |
XXXX  |  Address depends on size of structures below it     |
      |-----------------------------------------------------|
      |  Attached device drivers specified by CONFIG.sys    |
      |  and any terminate/resident processes brought into  |
XXXX  |  memory with AUTOEXEC.bat                           |
      |-----------------------------------------------------|
XXXX  |  Hardware independent DOS and its internal tables   |
      |-----------------------------------------------------|
XXXX  |  RAM for BIOS tables, buffers and other storage     |
      |-----------------------------------------------------|
0070  |  Hardware dependent BIOS code and static data area  |
      |-----------------------------------------------------|
0040  |  Working storage for ROMBIOS and video control      |
      |-----------------------------------------------------|
0000  |  Interrupt vector table at bottom of memory         |
      +-----------------------------------------------------+

This is memory configuration after system finishes boot process.
```

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 IBMDOS.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.)

If you are unable to use 5.25″ diskettes formatted by an IBM-PC for your system, you will eventually have to develop a FORMAT program to initialize empty diskettes for use, but for your first system disk, all that is really required is that the disk be physically formatted and that its FATs and root directory be marked as empty. The requirements for a properly formatted empty PC-DOS diskette are shown in Figure 3.

Before your first system will come up, you must have the file COMMAND.com on the system disk, stored as a normal file. If you don't have access to a running PC-DOS system that can write to your diskette, placing this file on it will be complicated, since you must create a directory

Figure 3
Layout of an Empty PC-DOS Diskette

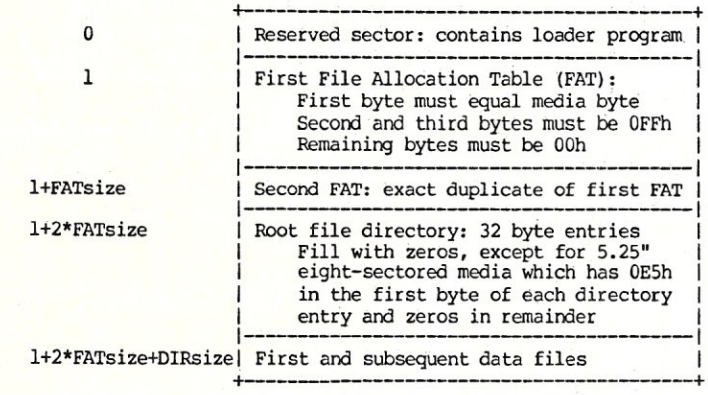

Table 1a

PROGRAM FILES INCLUDED ON IBM PC-DOS RELEASE DISKS
Programs which require no changes to work properly

File Name	DOS Versions	ROMBIOS Calls	Program Description
ASSIGN.com	3.1	none	Re-assign drive letters
ATTRIB.exe	3.1	none	Change file read-only attribute
BACKUP.com	3.1	none	Backup hard disk files
CHKDSK.com	2.0 2.1 3.1	none	Check directories and FAT
COMP.com	2.0 2.1 3.1	none	Compare files
EDLIN.com	2.0 2.1	none	Line editor
EXE2BIN.exe	2.0 2.1 3.1	none	Convert .EXE to .COM file
FIND.exe	2.0 2.1 3.1	none	Search file for character string
IBMDOS.com	2.0 2.1 3.1	none	DOS Basic Disk Operating System
JOIN.exe	2.0 2.1 3.1	none	Make drive be subdir of another
LABEL.com	3.1	none	Add or change volume label
PRINT.com	2.0 2.1 3.1	none	Background print program
RECOVER.com	2.0 2.1 3.1	none	Recover file with bad sectors
RESTORE.com	3.1	none	Restore files to hard disk
SORT.exe	2.0 2.1 3.1	none	Sort a (small) file
SUBST.exe	3.1	none	Substitute dir path for drive
TREE.com	2.0 2.1 3.1	none	Show directory tree

Table 1b

PROGRAM FILES INCLUDED ON IBM PC-DOS RELEASE DISKS
Programs which make ROMBIOS calls

File Name	DOS Versions	ROMBIOS Calls	Program Description
ASSIGN.com	2.0 2.1	11h	Re-assign drive letters
BACKUP.com	2.0 2.1	11h 13h	Backup hard disk files
COMMAND.com	2.0 2.1 3.1	10h 11h	DOS command shell
DEBUG.com	2.0 2.1 3.1	10h	Debugger
DISKCOMP.com	2.0 2.1 3.1	11h 13h	Compare diskettes
DISKCOPY.com	2.0 2.1 3.1	11h 13h	Copy diskettes
EDLIN.com	3.1	11h	Line editor
LINK.exe	2.0 2.1 3.1	11h	Linker
MORE.com	2.0 2.1 3.1	10h	Page-at-a-time file display
RESTORE.com	2.0 2.1	11h 13h	Restore files to hard disk
SHARE.exe	3.1	10h	File-sharing support

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 the rules for making a chain of clusters in a FAT. Needless to say, the whole exercise 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 severly reduced memory environments.

Table 1c

PROGRAM FILES INCLUDED ON IBM PC-DOS RELEASE DISKS
IBM PC Hardware-dependent programs

File Name	DOS Versions	ROMBIOS Calls	Program Description
ANSI.sys	2.0 2.1 3.1	10h 11h 16h	ANSI screen driver
BASIC.com	2.0 2.1 3.1	10h 15h	Basic interpreter
BASICA.com	2.0 2.1 3.1	10h 11h 15h	"Advanced" Basic interpreter
FDISK.com	2.0 2.1 3.1	10h 13h 19h	Format hard disk
FORMAT.com	2.0 2.1 3.1	10h 11h 13h 16h	Format floppy diskettes
GRAFTABL.com	3.1		Graphics character table
GRAPHICS.com	2.0 2.1 3.1	10h 17h	Print screen on dot-matrix printer
IBMBIO.com	2.0 2.1 3.1	almost all	DOS BIOS for the IBM PC
KEYBFR.com	3.1	15h 16h 18h	French keyboard
KEYBGR.com	3.1	15h 16h 18h	German keyboard
KEYBIT.com	3.1	15h 16h 18h	Italian keyboard
KEYBSP.com	3.1	15h 16h 18h	Spanish keyboard
KEYBUK.com	3.1	15h 16h 18h	British keyboard
MODE.com	2.0 2.1 3.1	10h 14h 17h	Set baud rate parity etc.
SELECT.com	3.1	11h	Select keyboard layout
SYS.com	2.0 2.1 3.1	10h 11h 13h 16h	Copy DOS to a diskette

Table 2

IBM PC ROMBIOS SOFTWARE INTERRUPTS

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

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 commmands with a single keystroke.

Interrupt-driven buffered I/O can allow you to type ahead or to 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.

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.

BACKUP - hard disk tree backup and file system.

MODE - sets baud rates, etc., and allows redirection of devices.

NULLPART - Create empty hard disk partition FATs and directory.

COPYHF - copy hidden files.

REFORM - Non-destructive hard disk re-formatter.

Background Processing - Limited background processing cabilities 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.

Table 3

INTERRUPT 21H CALLS USED IN STARTUP MODULE
Plus Other Undocumented Int 21h Calls

Function (AH)	Description
09h	Display string DS:DX on console.
0Eh	Select drive DL as default drive.
19h	Return current default drive number in AL.
25h	Set vector for interrupt AL to address DS:DX.
*32h	Check drive DL (1=A, 2=B, etc) for validity. Return AL with error code (0=OK, 0FFh=error), and DS:BX pointing to memory structure in DOS. For example, DS:18[BX] points to device driver header of drive DL.
33h	Get or set state of Ctrl-Break check.
*37h	Perform variety of operations depending on value in AL: 0 - Read switch character into DL 1 - Set switch character to character in DL 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.
3Dh	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.
48h	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.
4Bh	Load an overly or execute a program.
*50h	Unknown DOS INT 21h function.
*52h	Return a pointer to a DOS data structure in ES:BX.
*53h	Unknown DOS INT 21h function, possibly having something to do with setting a BPB pointer in DOS (DS:SI).

All INT 21h function calls for Startup Module are listed above, plus several undocumented Int 21h 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 doumentation. Their descriptions above have been determined through careful analysis.

Table 4

FLOPPY DISK BIOS PARAMETER BLOCKS

BPB Field	Size in BPB	8" DSDD	8" SSDD	8" DSSD	8" SSSD	5" DSDD	5" SSDD	5" DSDD	5" SSDD
Bytes/sector	Word	1024	1024	128	128	512	512	512	512
Sectors/allocation unit	Byte	1	1	4	4	2	1	2	1
No. of reserved sectors	Word	1	1	1	1	1	1	1	1
No. of FATs	Byte	2	2	2	2	2	2	2	2
No. directory entries	Word	192	96	68	68	112	64	112	64
Total sectors on media	Word	1232	616	4004	2002	720	360	640	320
Media byte value	Byte	FDh	FCh	FFh	FEh	FDh	FCh	FFh	FEh
Sectors per FAT	Word	2	1	12	6	2	2	1	1
Sectors/track	Word	8	8	26	26	9	9	8	8
Sectors for directory	--	6	3	17	17	7	4	7	4
Sector addr of 1st file	--	11	6	42	30	12	9	10	7

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 later 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.

Listing 1
Search For End Of Memory

```
Following routine will return register DX with top memory
paragraph available:

TOPMEM: MOV  DX,1000H          ;Begin search at 1000:0000 (64k)
        XOR  BX,BX
        PUSH ES                ;Preserve contents of ES
NEXTRY: INC  DX                ;Advance to next paragraph
        JZ   RETTOP            ;Done if memory wrap-around (Full Mbyte)
        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
        MOV  ES:[BX],AX        ;Restore its contents leaving memory unchanged
        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 an 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

```
Addr   Code      Label           Opcode  Operands

0000             STARTUP         SEGMENT PARA
                                 ASSUME  CS:STARTUP,DS:STARTUP,SS:STARTUP

                                 PUBLIC  LOADER_DOS_LOCN,FINAL_DOS_LOCN
                                 PUBLIC  DEVICE_LIST,MEMORY_SIZE,DEFAULT_DRIVE
                                 PUBLIC  NUMBER_BUFFERS,NUMBER_FILES,
                                 PUBLIC  NUMBER_FCBS1,NUMBER_FCBS2,LAST_DRIVE
                                 PUBLIC  SYSINIT

 0000                            ORG     0
 0000 E9 00F3 SYSINIT:           JMP     MOVINIT ;Jump over data area

 0003 0000    LOADER_DOS_LOCN DD      0    ;DOS loader offset and segment
 0007 0000    FINAL_DOS_LOCN  DD      0    ;End of BIOS where DOS will go
 000B 0000    DEVICE_LIST     DD      0    ;Start of device chain
 000F 0001    MEMORY_SIZE     DW      1    ;Memory size in paragraphs
 0011 00      DEFAULT_DRIVE   DB      0    ;Initial default drive number
 0012 0002    NUMBER_BUFFERS  DW      2    ;Number of sector buffers
 0014 08      NUMBER_FILES    DB      8    ;Max. number of handles
 0015 04      NUMBER_FCBS1    DB      4    ;FCBS = 1st parameter
 0016 00      NUMBER_FCBS2    DB      0    ;FCBS = 2nd parameter
 0017 05      LAST_DRIVE      DB      5    ;Highest acceptable drive no.

              ;               More working data variables go here

 00F3                         ORG     00F3H
 00F3 FC      MOVINIT:        CLD

              ;          Body of startup code goes here, followed at
              ;          end by messages & other character string data.

 00F4         STARTUP         ENDS
                              END
```

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.

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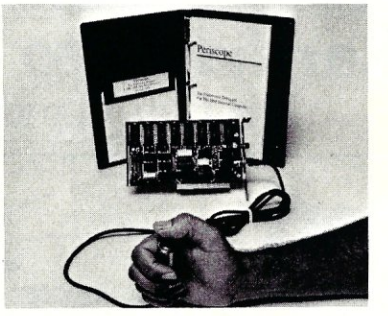

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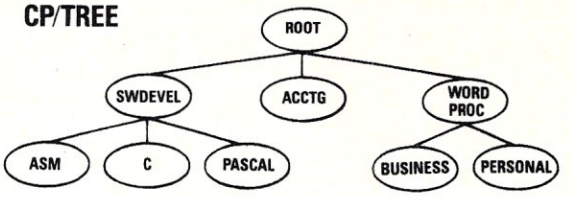

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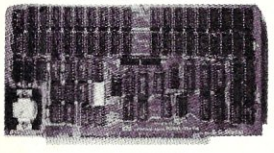

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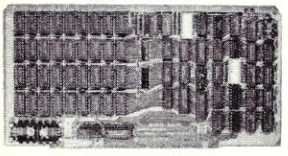

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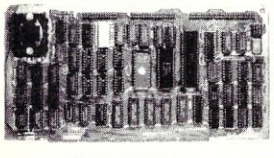

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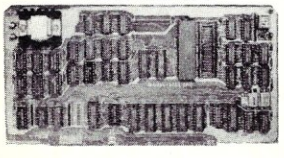

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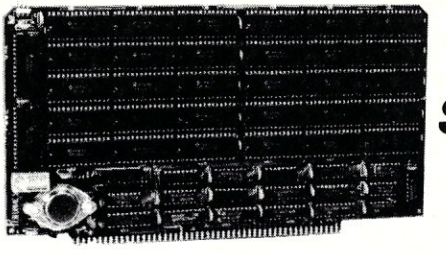

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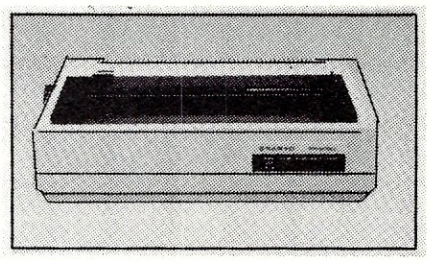

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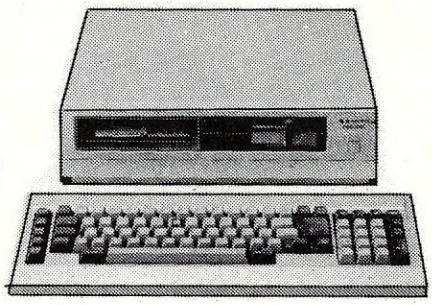

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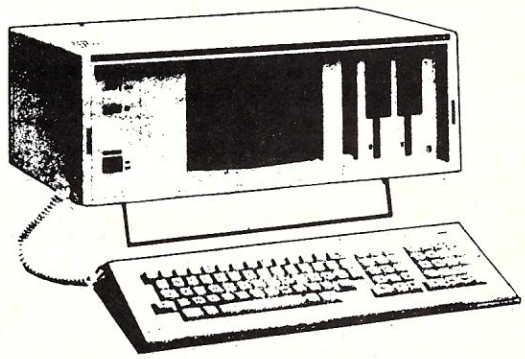

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Program Interfacing To MS-DOS

by William G. Wong

Part VI
Device Drivers - Why and How

What is a Device Driver? A person who drives a device? A new kind of screwdriver? Well, in this case it is a special program which allows a program to access a hardware device through an operating system in a standard fashion. The various interfaces in this system are between the program and the operating system, the operating system and the device driver, and the device driver and the hardware (Figure 1).

The interface between the program and the operating system is well defined, and, in the case of MS-DOS, has been discussed in my previous articles. The interface between the operating system and the device driver tends to be less standard depending upon the operating system (and its various revisions), the device driver, and how the device driver is associated with the operating system.

This article discusses the relationship between the operating system and the device driver. The next two articles will cover the details of building a MS-DOS V2.x device driver and an actual device driver for MS-DOS V2.x.

A device driver can either be part of the basic support for the operating system or loaded after the operating system. The latter is often called a *loadable device driver*. This article will be concerned with the loadable version since most people have access to an existing operating system configuration. Actually, there is little difference between the two except for their location in memory with respect to the operating system and how their presence is made known to the operating system.

The initialization procedure for a system normally starts with the operating system being loaded and with its corresponding basic I/O system that includes a default set of device drivers. The minimal set consists of the console driver and one disk driver, for a disk based system. Control is then passed to the operating system which typically loads additional drivers or runs a program which can load a device driver.

DEVICE DRIVERS WITH CP/M

Although this article is primarily concerned with MS-DOS device drivers, it does pay to look at CP/M and how device drivers were incorporated with it, since MS-DOS was initially based upon CP/M. CP/M consists of two parts: the Basic 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 device 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 perform the function if it were supported by the driver, otherwise, it would jump to the BIOS routine originally associated with the BIOS jump table enty 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 actaully 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 program. Alternatively, programs modify memory above the BIOS to pass parameters between programs. There are usually ways of working with these problem programs 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. Unlike 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 program 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 inadvertant 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 consist 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 initiailized. 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

Offset	Size	Description
0	4	Link to next device driver
4	2	Attributes
6	2	Device strategy routine offset
8	2	Device interrupt routine offset
10	8	Device name or unit number

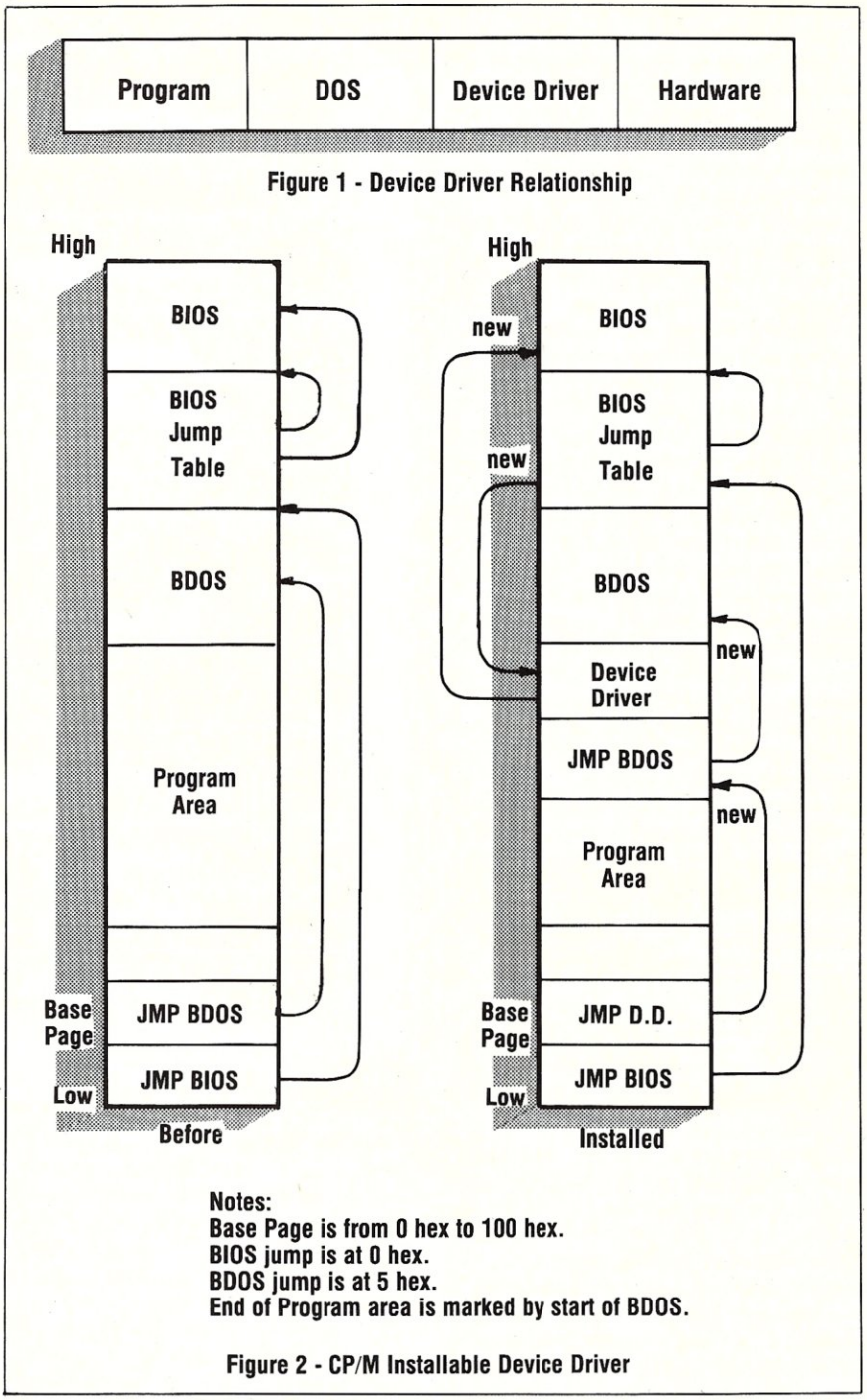

Figure 1 - Device Driver Relationship

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.

Figure 2 - CP/M Installable Device Driver

These fields will be discussed in more detail in the next article and covered breifly 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:

Device Driver Parameter Block

Offset	Size	Description
0	1	Size of parameter block in bytes
1	1	Unit code (base 0)
2	1	Command code
3	2	Status
5	8	Reserved
13	-	Depnds upon command code

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:

Command Code Values

Value	Char	Block	Description
0	yes	yes	Initialize driver
1	no	yes	Media Check
2	no	yes	Build BPB
3	opt	opt	IOCTL Input
4	yes	yes	Input
5	yes	no	Input Check
6	yes	no	Input Status
7	yes	no	Input Flush
8	yes	yes	Output
9	yes	yes	Output with verify
10	yes	no	Output Status
11	yes	no	Output Flush
12	opt	opt	IOCTL Output

opt - optional
BPB - BIOS Parameter Block
IOCTL - Input/Output Control

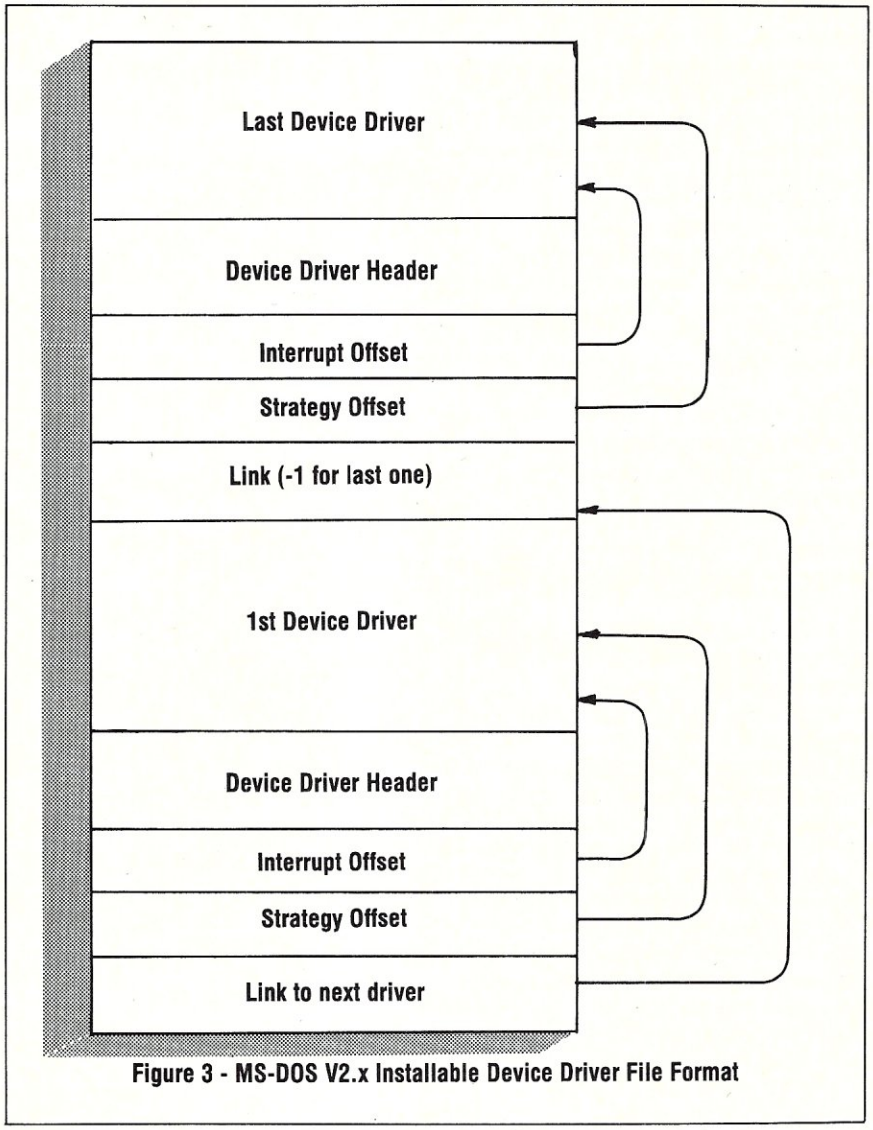

Figure 3 - MS-DOS V2.x Installable Device Driver File Format

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-

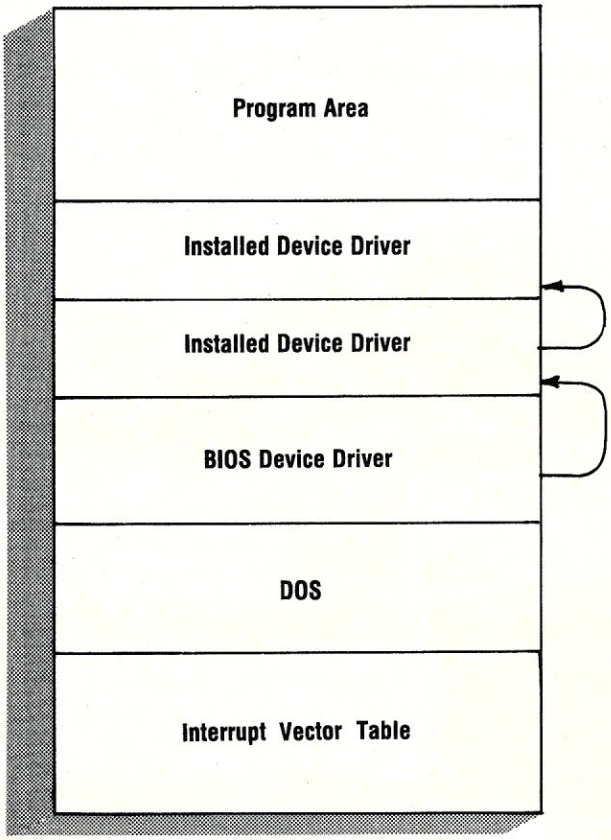

Figure 4 - MS-DOS V2.x Memory Configuration

vice, the number of directory entries, and so on. MS-DOS performs all buffering and deblocking based upon this information. A block device driver does not need, but may perform, any buffering. MS-DOS buffering is specified using the BUFFERS option in CONFIG.SYS.

Block device drivers with removable media can support either a single media format or multiple media formats. A single media format driver uses a single BPB whereas a multiple media format device driver will build the proper BPB based upon the type of media currently in the device. The BPB returned by the Initialize command must specify the largest sector size which can be found on the various media formats supported by the device.

Block device drivers can support more than one unit. A unit is referenced using drive letters starting from A. A device driver which supports more than one unit will be referenced by consecutive letters. The base letter depends upon the position of the DEVICE= line in CONFIG.SYS file associated with the device driver. Built-in device drivers are allocated first, followed by installable device drivers. This is the users point of view. The device driver itself is actually referenced by unit numbers from 0 for the first device supported. MS-DOS V2.x supports 63 block devices.

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 an exception is the hard disk drivers for the IBM PC and compatibles using MS-DOS V1.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.

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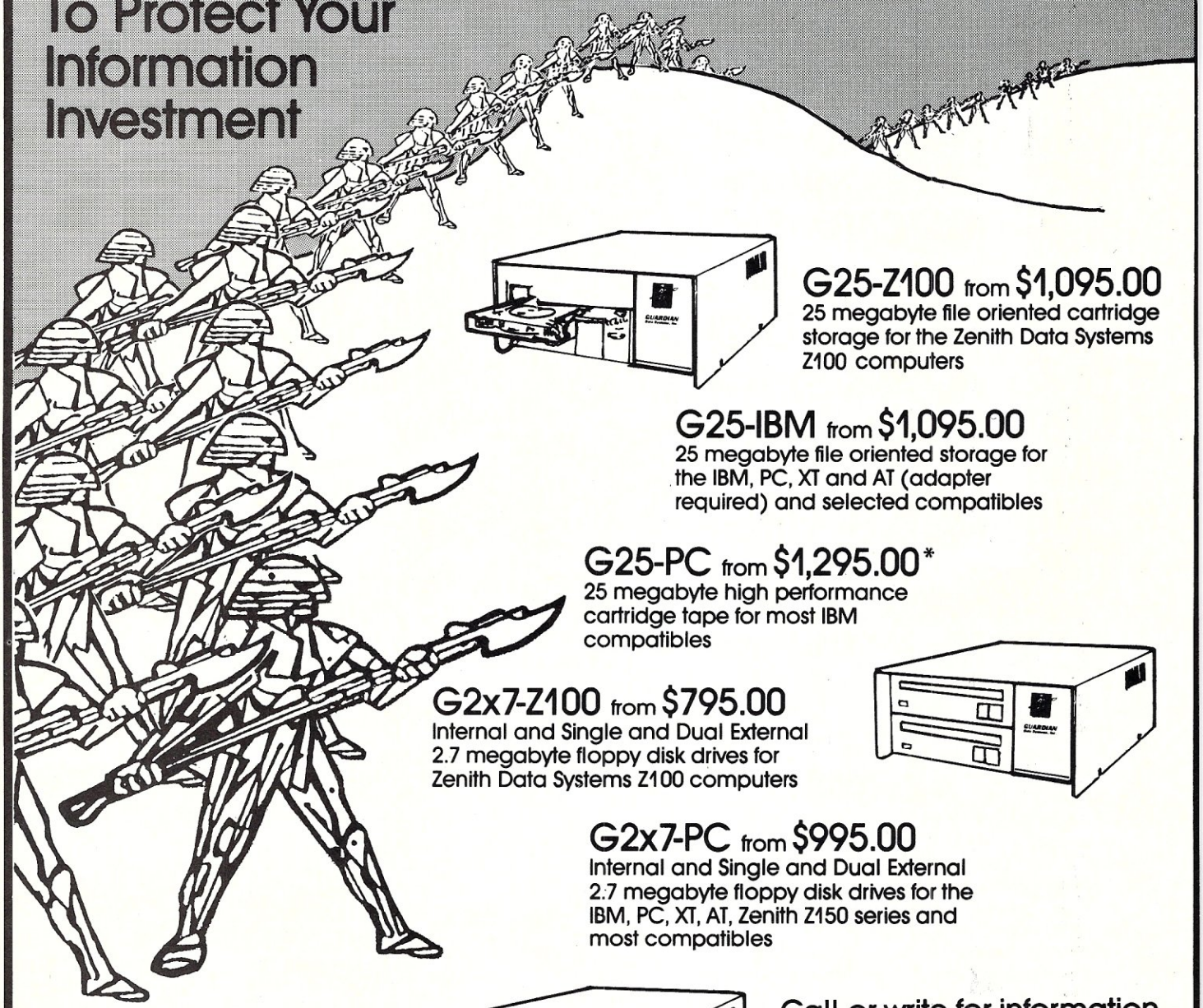

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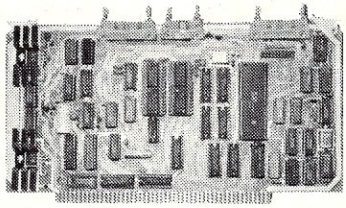

The PRO-180, using Hitachi's new high integration HD64B180 processor, packs a lot of performance in a small area, while maintaining the modularity of the S100 structure.

- 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.
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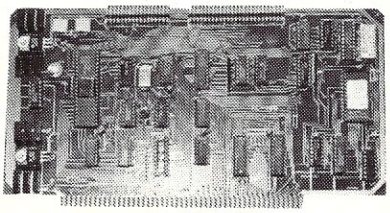
- The PRO-180 implements the full 24 bit extended address bus allowing it to address up to 16 megabytes of memory.
- Versatile interrupt controller with 8 internal and 4 external sources.
- Uses "off the shelf" components. No "hard to get" PALS or Gate Array devices.
- Built-in, programmable wait state generator. This allows wait states to be inserted only when they are needed for specific devices, allowing faster modules to run at full speed.
- Two channel, 16 bit, programmable, reload timer. The timer can be used for many timer functions, including real time clock applications.

MDC-1
Floppy Disk Controller



- The MDC-1 floppy disk controller can control any mixture of up to four 5 ¼ or 8" drives.
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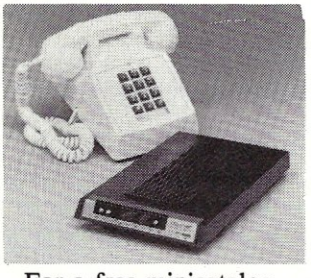

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- Structure Assignment, Passing/Returning Structures

Functions

abs	conbuf	feof	getcseg	isascii	movmem	replace	strcat
asm	conc	ferror	getdseg	iscntrl	open	repmem	strcmp
asmx	cos	fflush	getd	isdigit	outp	rewind	strcpy
atan	cpystr	fgets	putd	islower	peek	right$	strlen
atof	creat	fileno	getdate	isprint	perror	rindex	strncat
atoi	cursblk	filetrap	gettime	ispunct	poke	rmdir	strncmp
atol	curslin	find	geti	isspace	poscurs	scanf	strncpy
bdos	curscol	floor	puti	isupper	pow	setbuf	strsave
bdosx	cursrow	fopen	getkey	itoa	printf	setbufsiz	system
bios	cursoff	fprintf	getmode	keypress	putc	setcolor	tolower
biosx	curson	fputs	setmode	left$	putchar	setdate	toupper
calloc	delete	fread	gets	len	puts	settime	ungetc
ceil	drand	free	getw	log	putw	setjmp	ungetch
cfree	exec	freopen	heapsiz	log10	rand	setmem	unlink
chain	execl	fscanf	heaptrap	longjmp	read	sin	write
character	execv	fseek	hypot	lseek	readattr	sound	writechs
chdir	exit	ftell	index	malloc	reach	sprintf	xmembeg
chmod	exitmsg	fwrite	inp	alloc	writech	sqrt	xmemend
clearerr	exp	getc	insert	mathtrap	readdot	srand	xmemget
close	fabs	getch	iofilter	mid$	writedot	sscanf	xmemput
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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

The MEGARAM is a general-purpose IEEE-696 dynamic RAM card that can hold either 256KB, 512KB, 1MB, or 2MB of memory. Many of the problems that arise when using dynamic RAM on the S-100 bus have been eliminated by using the TMS4500 series RAM controller, which means that this board should work fine in any IEEE-696 system.

Like 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 dissapation 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

PRODUCT INFORMATION

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Thunder-186/Color Magic Board Combo
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Color Magic Video Board
Concurrent DOS Operating System
Price: $1,745

Thunder-186 Processor Board
Price: $1195

Color Magic (16K) Video Board
Price: $595

MegaRAM Board
¼Mbyte - $475
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1Mbyte - $795
2Mbyte - $1,095

Hazitall Board
Price: $325

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 S100-PC, but one can be added by simply plugging into the speaker connector on the COLOR MAGIC. A light pen can be installed in a similar manner.

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 is set 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 I/O port, an 8253 timer, interrupt logic, a math processor option, a 58167clock/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 CP/M. 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 DISKP) 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-PCXT. 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.

DOCUMENTATION

Documentation quality for the S100-PC varied from board to board. Much of the hardware documentation that we received was preliminary, so we couldn't really evaluate the finished product. For example, circuit diagrams and board layouts were only included for one of the boards.

Complete MS-DOS manuals were provided, but CCPM manuals were still in preliminary form.

All of the manuals provided enough information to set up the boards for most uses, but circuit diagrams in all cases would have really helped. And, of course, repair is nearly impossible without them.

COMPLAINT DEPARTMENT

Our wish list:

It would have been nice if there had been provision for a numeric co-processor like the 80187, since the math processor on the HAZITALL board will probably not be widely supported in the IBM-PC world.

We hope that the documentation is finished by the time this article appears.

The CTRL/NUMLOCK problem mentioned previously, while not a severe handicap (control-S/Q works fine), is a bit of a pain for those used to operating most other PC's.

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 proglem, 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 68000 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.

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 a 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 Schotcky 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-

Product Information
CompuPro S-100 PC Video Board
$495.00
Viasyn Corporation
26538 Danti Court
Hayward CA 94545; (800)/VIASYN-1

current CP/M window features.

The XIOS modules come pre-configured for different combinations of CPU boards (Viasyn 85/88, 8086, and 80286 CPU cards are supported), hard disk controller boards (Viasyn DISK2 and DISK3 with various disk sizes) and floppy disk systems (8 inch and 5-1/4 inch). The installation manual explains how to generate a new Concurrent CP/M system using the GENCCPM program and provided input files containing the system parameters. Loaders are provided to initialize the card and boot Concurrent CP/M either from a floppy or from a hard disk.

Unfortunatly none of the already configured XIOS files met my system configuration. I therefore had to edit the provided source files with my system's parameters and assemble a new XIOS. The procedure is explained in the Concurrent CP/M installation manual provided with the original software. I merely had to substitute the old object and source files with the newly provided equivalent files.

The WMENU and WINDOW utilities are included. WMENU is a window manager which resides in the background once it has been executed. WMENU will only *wake up* when prompted to do so by pressing the Ctrl key and the Plus (+) key on the numeric keypad simultaneously. When WMENU is active the user can place and size a window, change the foreground and background colors, maneuver the window over the screen image, set tracking modes, and write the current screen or window image to a file on disk. The user can have one window per virtual console. Up to four virtual consoles can be displayed on a single console with the activities of different programs being monitored in the four windows simultaneously. Pressing the Ctrl-Delete key toggles a window on and off. If the window is off, the current virtual console image fills the entire screen. If the window is on, only the part of the screen in the window appears. To switch between virtual consoles the control key and a number between 0 and 3, depending on which of the four virtual consoles is to be in the foreground, must be pressed. The operation is identical to Concurrent PCDOS on the IBM PC.

The WINDOW program performs similar actions as the WMENU window manager, by using command line parameters rather than cursor keys. With the aid of BATCH or SUBMIT files it is possible to define several screen layouts and just run the BATCH job to change between window configurations.

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 straight forward. 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 the characters and am no longer bothered by the pixels. 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 shortcuts and decrease programming efforts. Many MSDOS programs will start running correctly but do not respond to keyboard input. There seems to be an incompatibil-

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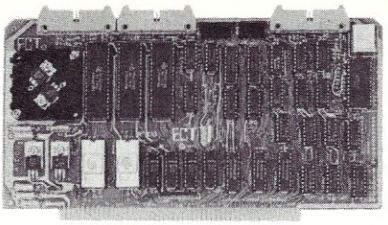

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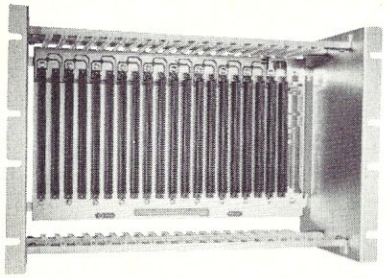

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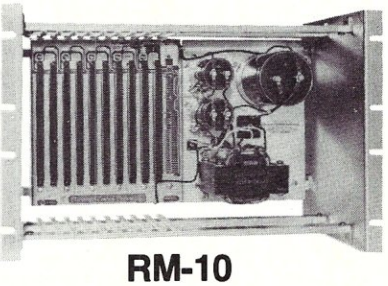

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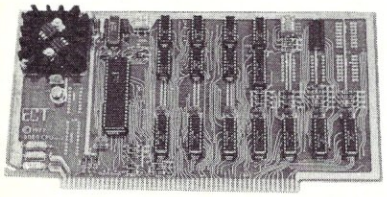

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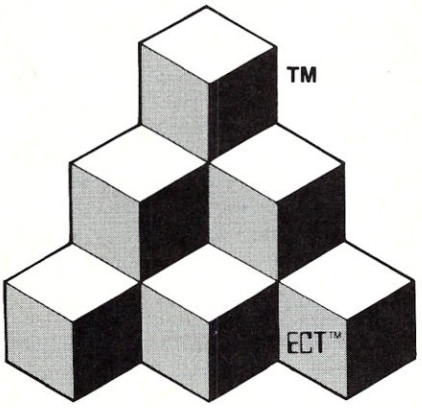

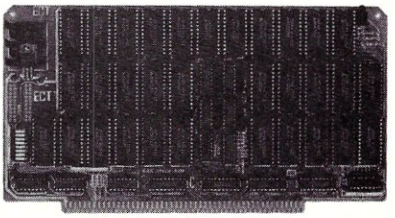

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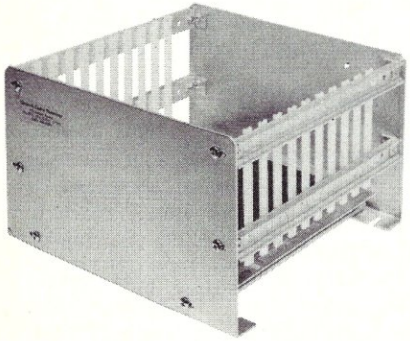

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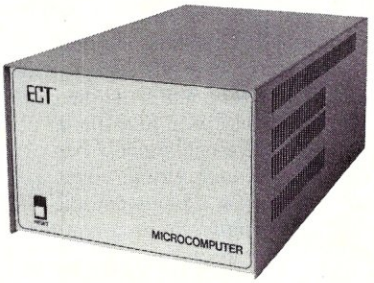

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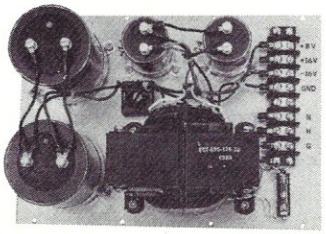

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ity in either the keyboard hardware or keyboard driver software used in the Concurrent CP/M 3.1 XIOS. Applications which make use of the IBM-PC sound generator circuit run very silently! I was surprised Viasyn did not include the sound circuit on their Video card. The availability of MSDOS 1.1 software seems to be rather limited as most of the programs I obtained are written to work under MSDOS 2.0.

I found that in most cases it is not the PC-VIDEO board which limits IBM-PC compatibility. Programs which are written for the IBM-PC to work under CP/M-86 or Concurrent-PCDOS perform without any problems. At the time of writing Concurrent CP/M 4.1 is about to be released by Viasyn. I experimented with a Beta test version of Concurrent CP/M 4.1 in my local systems center and found that the MSDOS support was vastly improved. Most of the MSDOS 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 copy 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.

At the time of writing rumors are in the air that the PC-VIDEO card can be modified to hold 32K of RAM and thus provide high resolution displays similar to the Hercules Graphics card. The Beta test version of Concurrent CP/M 4.1 by Viasyn does contain options for a 32K display card and I therefore expect to see such a card from Viasyn in the near future.

Another item on my wish list would be a list of terminal escape codes to be added to the PC-VIDEO card documentation. This list was omitted from the DRI Concurrent CP/M documentation and it took a lot of time to find a copy on the Compuserve CP/M SIG.

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 consoles 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.

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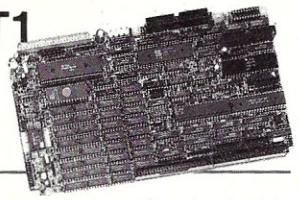

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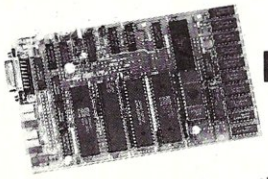

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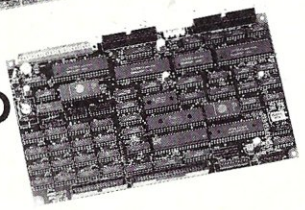

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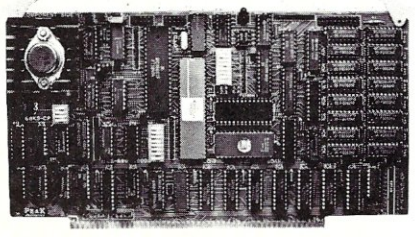

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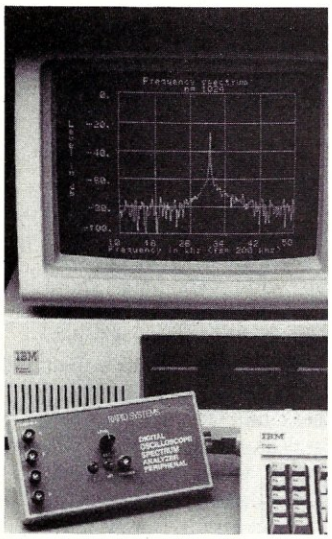

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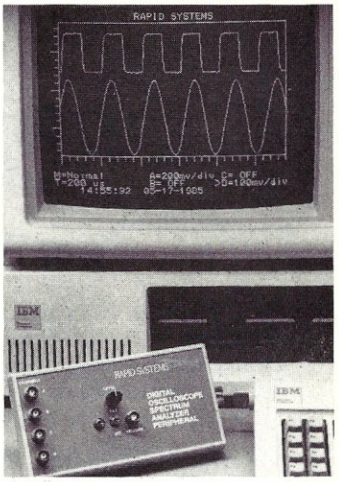

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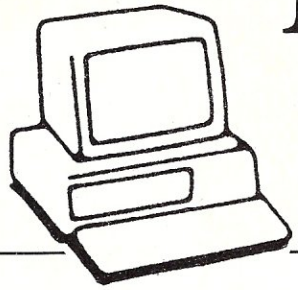

Part II

by Sol Libes

More info on building PC, XT & AT clones, Souping them up & troubleshooting

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 interferring 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 80286 (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 8088. One runs at the standard speed and another that will run the system 1.5 times normal speed. For example, Atlaz (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 worth 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 8088 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 8088 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.

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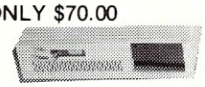

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Currently AT users are running Versions 2.1 or 3.1 of PC/MS-DOS. This is actually the same operating system used on 8088 and 8086 based systems. The result is that there is really no difference in operation, other than speed, when using an AT machine. 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 the 286 processor (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 disk drives preferring to 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

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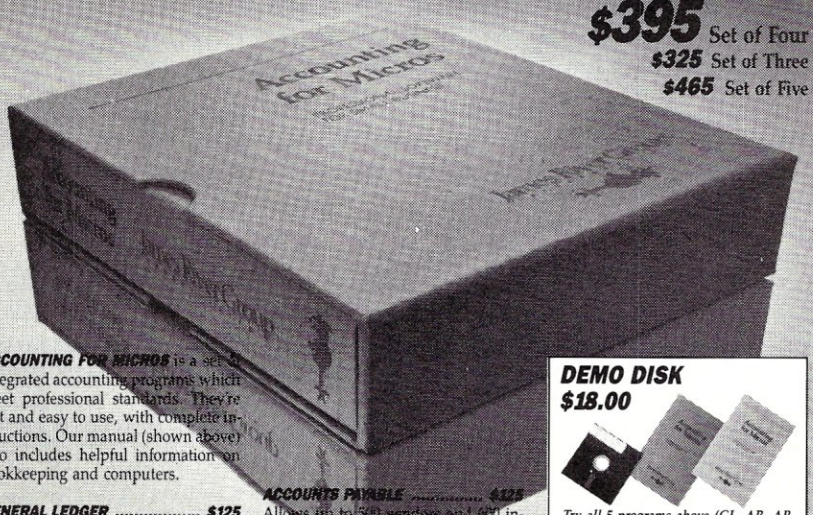

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usually cut, or notch the board, to remove the contact.

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.

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 warantees 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.)

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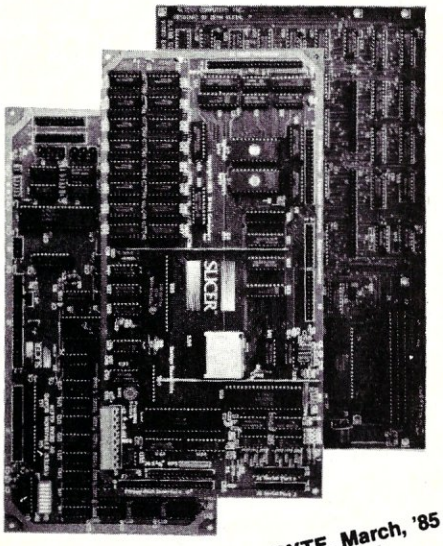

see BYTE, March, '85 page 193

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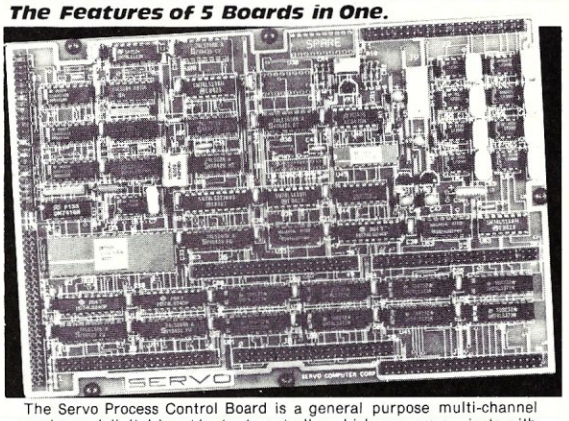

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The CP/M Bus

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 feed-back 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 glamourless 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.

Even thought DRI has decided to put CP/M+ on the mature list and as such will no longer actively supporting it, I am continuing to port it to different computers. My most recent adventure is with the Intercontinental 8-bit S-100 master board; on board memory management and many other performance features make the ICM board a natural for CP/M+.

Among the top ranking features of CP/M+ is its capability to automatically time and date stamp files at each access. This feature is especially important to me because I have the untidy habit of not religiously tracking my disk files during a heated development session. I wait for the project to conclude before trying to make good sense out of my files and then sometimes have trouble recalling the order in which I created them, and most importantly, which is the most current. Until Plu*Perfect Systems began to sell DateStamper there was no software available to add this desirable feature to CP/M 2.2. I've used DateStamper and have found it a most useful tool and safeguard.

If you are one of the many Z-80 computer owners that lack the hardware necessary to maintain time and date information then Ztime-1 may be for you. It is a complete real time battery driven clock board that is installed by inserting it in place of the Z80 chip of your computers main logic board. The Z80 chip is then placed in the provided socket on the Ztime-1 board. I have been running one for several weeks on my Ampro BBS system without any problems.

If you have ever run out of symbol table space during an assembly the folks at SLR Systems can help you. They have recently released the latest version of their now famous Z80ASM assembler. It has extra logic incorporated that will begin using tables on disk if memory fills to capacity.

My stack of things to do wouldn't be complete without a new programming tool. 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

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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.

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The UNIX File

by Ian F. Darwin

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 "ihnp4!darwin!ian". 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 compatability 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 *newsgroups* 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 again 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. I am 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 originate. I'd like to express my thanks to all of these people. You can show your thanks by using the net intelligently. Intelligent 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 ARPAnet 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. I knew it 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:

```
#! /bin/sh
# whopays -- who is on as a paying
        customer (system specific!!)
F=/tmp/whop1.$$
G=/tmp/whop2.$$

trap "rm -f $F $G; exit" 0 1 2 15

who | sort >$F

pwent `cut -fl -d' ' $F` |
        grep -v ',zz' |
        sed 's/:.*/ pays/' |
        sort >$G

join $F $G
```

The *pwent* program is a local system program that prints password file entries. The ",zz" 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!

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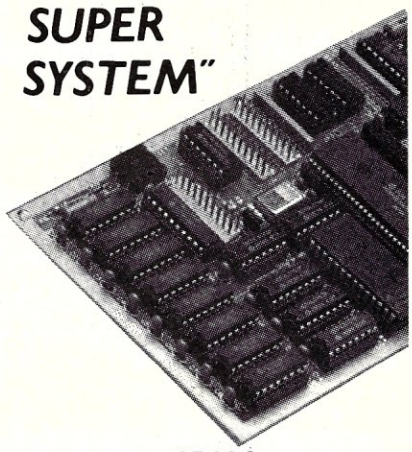

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The Data Base Forum

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 3 is 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 DEVELOPERS'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.

The dBASE III Developer's Release

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 can 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 training 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-II/III, Framework, and Rbase 5000 applications.

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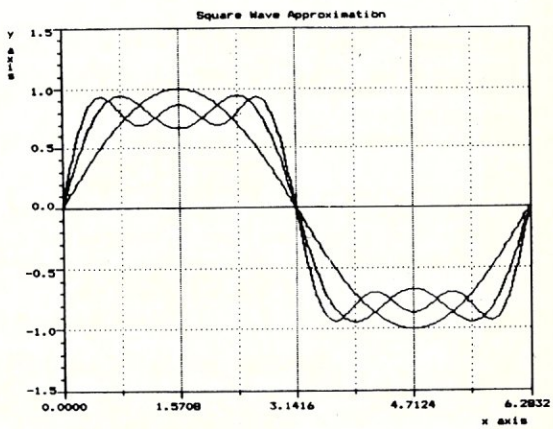

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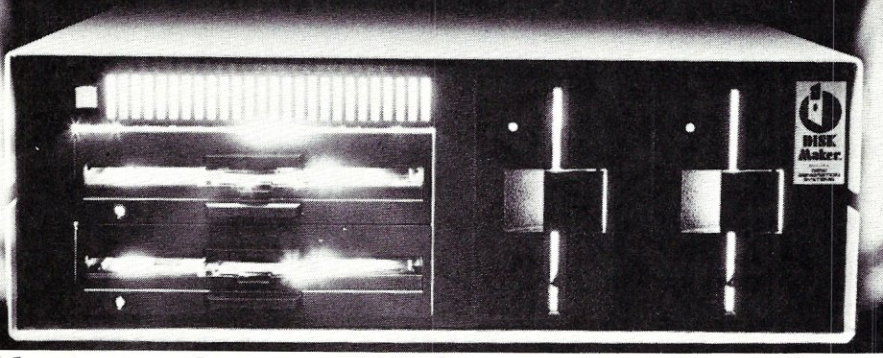

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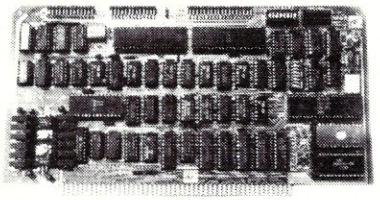

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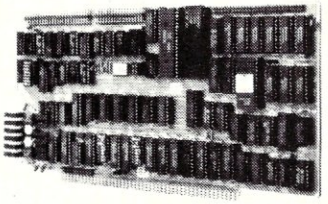

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The Scientific Computer User

by A. G. W. Cameron

TEX DEVELOPMENTS

I described the TEX text formatting language in the September-October, 1985, issue of M/SJ, 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 PC TEX) and Addison-Wesley (with 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, Swanson 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 is 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 TUGboat, 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.

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-1500 ($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-1500, 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. Timing limitations require that the image be assembled on the RAM disk before printing begins, since the entire image must be transmitted during the rotation of the drum in the printer.

One disappointing feature of most laser printers is that there is no way to mix TEX and graphics, except by hand-cutting and pasting. Such mixing is now possible using the Apple LaserWriter, with its built-in PostScript page description language. Textset (the TEX printing firm that did the output for my previous TEX article) has developed a driver for this machine, and both TEX vendors are selling it at $300. The LaserWriter is expensive, listing at $5995, but I have seen it discounted by nearly one-third; at many colleges and universities it can be obtained for still less. It connects to the PC through a serial port at 9600 baud; the cable requires crossing of pins 2 and 3. As yet there is little software for PC/MSDOS which can use the LaserWriter, but that is bound to change. Presently I only know about Microsoft Word version 2.0 and the Textset driver for TEX. I have a preliminary version of a Textset program for listing ASCII files without intermediate formatting in TEX; Textset will sell this separately.

Most of this article has been produced with a LaserWriter. I am using TEX, but not TEX fonts. The LaserWriter has 12 internal fonts available. Many people who have seen this type style (Times Roman) prefer it to the Computer Modern Roman which is standard TEX output, and which has somewhat wider letters than this font (see the above paragraph done with the LQ-1500, for example). No time is required to download the internal fonts to the LaserWriter. The internal fonts are stored as letter shape outlines; they can rotated and scaled to any desirable angle or size, and filled in when fixed on the page. TEX fonts, on the other hand, are stored in dot patterns at 300 dots per inch (for laser printers), and, though they can be scaled and rotated in the LaserWriter, they appear grainy at larger magnifications. The disadvantage of using internal fonts is that they are not transportable except to another device running TEX and using PostScript with the same font outlines. Textset has provided TEX Font Metric files for the internal fonts. 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 typewriter 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

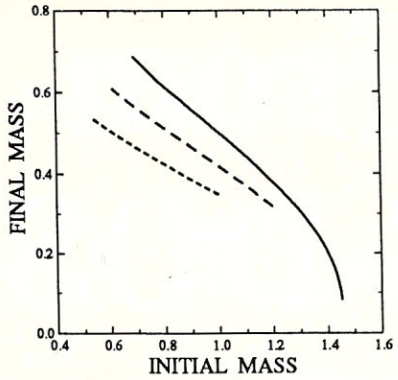

Figure 1. An inserted figure.

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) (positions in inches) 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 prepare 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 Hercules graphics board 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 (dpi), 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.

Addresses

Addison-Wesley Publishing Company, Reading MA 01867; (617) 944-3700.

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

Personal TEX, Inc., 20 Sunnyside, Suite H, Mill Valley CA 94941; (415) 388-8853.

Phoenix Software Associates, 1416 Providence Highway, Suite 220, Norwood MA 02062. (800) 344-7200.

Stanford Business Software, 4151 Middlefield Road, Suite 215, Palo Alto CA 94303; (415) 424-9499.

Textset, Inc., 416 Fourth St., P. O. Box 7993, Ann Arbor, MI 48107. (313) 996-3566.

TEX Users Group, c/o American Mathematical Society, P.O. Box 6248, Providence RI 02940.

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 Jlaser 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 matrix 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.

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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 8″ 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 the IOBYTE, 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.

Robert J. Stek
31 Candlewood Drive
South Windsor CT 06074

Running CP/M On The PC & Converting CP/M Programs Over To MS-DOS

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 C 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-80H running 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 M/PM 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 "CPEM" 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 BASICA was used on a stock IBM PC running DOS 2.1, and IBM BASICA 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 upto 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 ZCPR3) 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!

	Time (sec.)
4.0 MHz Z80, NorthStar Horizon MBASIC 5.21	199
4.77 MHz Z80B, Baby Blue I MBASIC 5.21	162
8.0 MHz Z80H, TurboSlave-P.C. MBASIC 5.21	111
6.1 MHz HD64180, Micromint SB180 MBASIC 5.21	147
CP/EMulator II, 6 MHz 80286 IBM AT MBASIC 5.21	644
4.77 MHz 8088, IBM PC BASICA, DOS 2.1	195
6 MHz 80286, IBM AT BASICA, DOS 3.0	76

TABLE 1
Relative Performance of Various Processors Running One Iteration of BYTE Sieve

By the way, the TurboSlave-PC board operates correctly in both 8-bit and 16-bit slots on the AT, as well as the PC or PC compatibles (such as the Micromint MPX-16) under DOS 2.0 and higher. The Baby Blue card does not operate at all on the AT or under DOS 3.0 or higher.

Since Earth Computers did not supply a copy of TurboDOS with their board, I cannot commentupon 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.

CP/EMULATOR II

If the thought of spending several hundred dollars to add another board onto your PC in order to run a few favorite CP/M programs doesn't turn your crank, that's okay. But suppose you could run those same programs on your PC for $20? That is the promise of CP/EMulator II distributed by the Heath Users' Group (Hilltop Rd., St. Joseph, MI,49805). Originally developed by Robert Metz and enhanced by P. Swayne, CPM2.EXE actually comes with full source code! The files included are:

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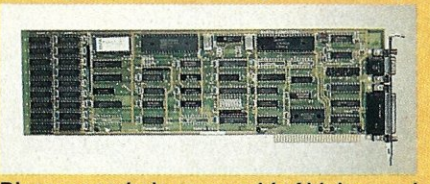

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CPM2.DOC — CP/EMulator II instructions.
CPM2.ASM — CP/EMulator II source code.
COMD.SYS — A system-command processor for CP/EMulator II that provides the usual CP/M commands such as DIR, ERA, SAVE, etc.
COMD.ASM — 8088 Source code for COMD.SYS.

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 BASICA. However, some .COM 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 under PC-DOS 1.1, and 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

fee) and offered to sell me another package from Flagstaff Engineering (Box 1970, Flagstaff, AZ, 86002) which would allow me to read 8" CP/M formats under MS-DOS 2.x. Having been stung once, I spoke with Flagstaff about my particular situation, and was told that they were "90 percent certain" that their software would work with my LNW disk controller, even though they had designed it around their own modification to the IBM floppy controller. Though Murphy's Law dictated that I would fall into that 10% uncertain range, I ordered the software. It didn't work. Floppy Disk Services took it back (less the 10% restocking fee).

Still undaunted, in the spring of '84 I learned about Xeno-Disk (Vertex Systems, 7950 West Fourth Street, Los Angeles, CA, 90048), a system of programs to read, write, format, and duplicate about 60 different CP/M formats on a PC. It also copied TRS-DOS and p-SYSTEM formats, and was user-configurable for any formats not currently supported on its menu. AND it was going to support 8" formats REAL SOON NOW! Even though the price was steep ($379), I was desperate to transfer about 6-MB of ASCII data files for an ongoing project, so I ordered it. I had exactly one 5" soft-sectored CP/M disk to try it with; it worked! I was able to transfer several useless MBASIC programs from a KayPro disk to an MS-DOS disk. Finally, real progress! (By the way, did you know that Microsoft changed many of the BASIC keyword tokens when they wrote BASICA? That is, unless an MBASIC program is saved in ASCII format, it will list back as mostly gibberish when read under BASICA.) When I called Vertex in April and asked about the availability of the 8" formats, I was told it would be ready in May. When I called in May, I was told June. When I called in June, I was told July. ... July, ... August. ... August, ... September. ... September, ... October. ... ... December, ... January, 1985. I stopped calling.

Meanwhile, I looked into CrossData (Award Software, 236 N. Santa Cruz Ave., Los Gatos, CA, 95030), which is a $99 program that can do everything that Xeno-Disk promised. Having been stung once, I spoke with Award about my particular situation and was told that they were "90 percent certain" that CrossData would read my 8" CP/M formats if I knew the values of the Disk Parameter Block, skew table, etc. for my particular Morrow formats. As long as the 8" drive was installed with a device driver under MS-DOS 2.x, I should have no problems.

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 parameters; it looked good. I got out my copy of the CP/M BIOS for the Morrow and worked out the values I needed. I then installed my 8" device driver and loaded CrossData. After a few seconds of disk whirring, my operating-system prompt returned. I tried again with the same results. I rebooted the system without the 8" driver and tried CrossData again; it worked fine. CrossData uses a copy-protection scheme. The copy-protection scheme thinks I have an illegal copy when I have the 8" driver loaded. The only reason I got CrossData was to transfer data from 8" CP/M disks to MS-DOS. I must have the 8" device driver loaded in order to enter the 8" parameters into CrossData. CrossData works only when I don't install my 8" device driver. (Heavy sigh!)

CompuView (1955 Pauline Blvd., Ann Arbor, MI, 48103) advertises SYS-TRANS and TRANS-SYS, programs which would unquestionably transfer data to and from 8" SSSD CP/M format. Having been stung before, I spoke with CompuView about my particular situation. Compu-View did tell me that their programs would not support any double density formats, though they would work fine with single density. I asked if they could tell me where to patch in my double density parameters, or if they could create a version for my Morrow formats. "Well, we didn't really write the program, and we don't have the source code. It's licensed from a guy in .... We don't think we can support you." At least, I avoided the restocking fee.

By mid-summer, CP/M to MS-DOS 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. Selfware, 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 unswerving 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 meant that MS-DOS programs could read and write to CP/M data disks directly. That is, I could use my dBASE II under MS-DOS to write .DBF files on a CP/M disk.

So I gave them a call. I spoke with Ron Porosal of MicroSolutions about my particular situation and was told that they wanted their software to work with the widest possible variety of formats, and they would modify Uniform until it worked properly on my system. Well, that sounded promising. He was uncertain of the characteristics of my LNW controller, but since they had Uniform working on 8" disks with a Maynard controller, he was sure that they could accomplish the same for the LNW controller. I sent him a copy of the device driver which ran under MS-DOS. He noted (as did their software manual) that Uniform would work for 8" drives only if the disk controller automatically switched into 8" mode when an 8" drive is selected. By disassembling the device driver and contacting the new manufacturer of the Bus Board (Aquix Advanced Systems, 4051 E. La Palma, Anaheim, CA, 92807) for schematics, Ron discovered that my controller required a value be output to an additional port when an 8" drive is selected. Aha! So that was the probable reason why all that other stuff didn't work!

Ron sent me a test copy of Uniform modified for my system. When I installed it, it selected my 8" drive properly, but MS-DOS gave a "Disk not ready" error. I gave Ron the results. He sent me a new copy. IT WORKED!!! At the time, it only supported 2 of the 4 Morrow formats I wanted, but it worked! It had only taken a year, but finally I had access to my megabytes of CP/M programs and data.

I can't give Ron and MicroSolutions enough thanks for finally solving my problem. To be honest, 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.

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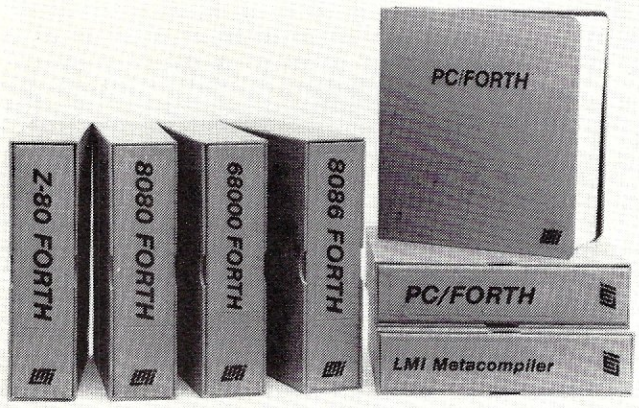

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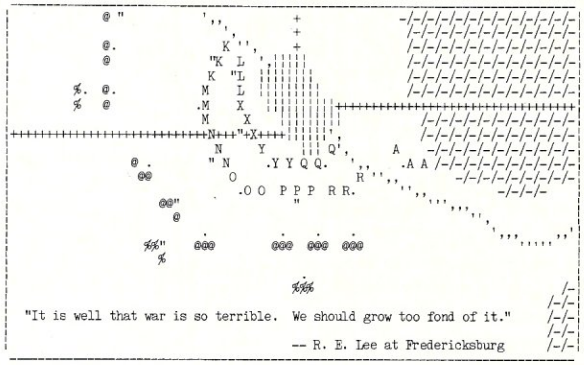

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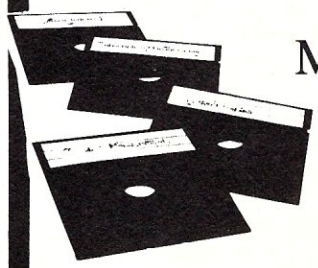

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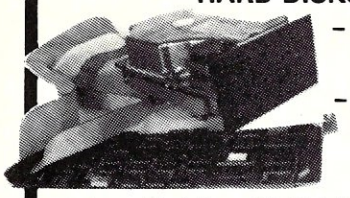

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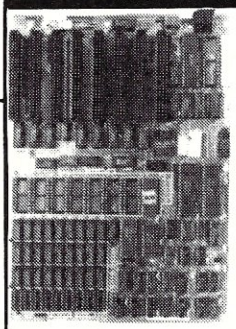

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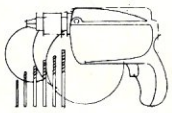

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Publisher: Software House, 1227 Goler House, Rochester NY 14620; (716)454-3188

Program Name: SciPlot Graphics Library
Requirements: PC/XT/AT or compatible, Microsoft Fortran-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.
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Publisher: Softaid, Inc., Box 2412, Columbia MD 21045; (301)792-8096

Program Name: MTBASIC*ROM
Requirements: Z-80 based CP/M system
Description: ROMable version of MTBASIC compiler available in either diskless (24K) or disk (30K) versions. Supports multitasking (up to 10 separate programs run concurrently) using software or hardware interrupts. Features windowing, strings and string arrays, assembly language calls, in-line machine code, and user defined functions.
Price: $1,100
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 Lattic C, MS-Fortran, assembly language and other software packages; No limit on size of commons 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., 31244 Palos Verdes Drive West, Suite #243, Rancho Palos Verdes CA 90274, (213)541-1200

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). Fully integrated one entry menu-driven system. 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
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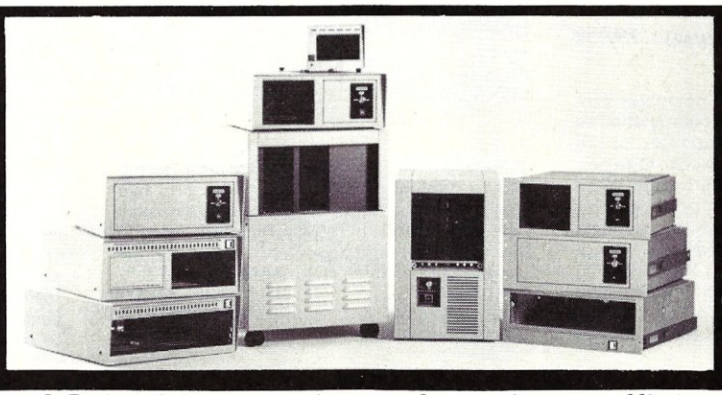

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New Products

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/ZENITH-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.

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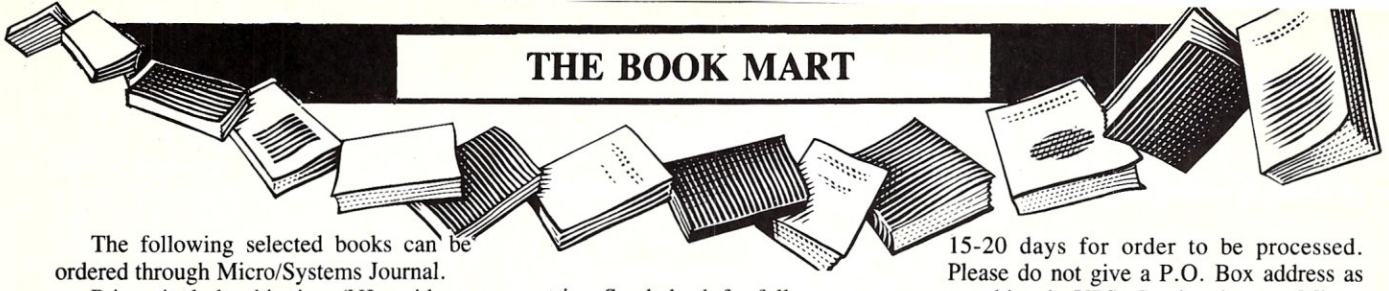

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C Language

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 Schildt. For programmers looking to make transition from Basic to C. $16.95

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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

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From Basic To 8086/8088 Assembly Language by Tempelton. $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.

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.

A Programmer's Notebook: Utilities For CP/M Plus $18.95

Inside CP/M $27.50

Inside CP/M-86 $18.95

Inside Concurrent CP/M $18.95

The Osborne/McGraw-Hill CP/M-86 User's Guideby 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 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. Fugate. $20.95

PC/BLUE Software Directory Catalog listing contents of public domain software disks in PC/BLUE library. Includes cross-reference index by application and other useful information for PC/MS-DOS public domain software users. $5

OTHER BOOKS OF INTEREST

Designer's Guide to Disk Drives by Teja & Gonnella. $ 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)

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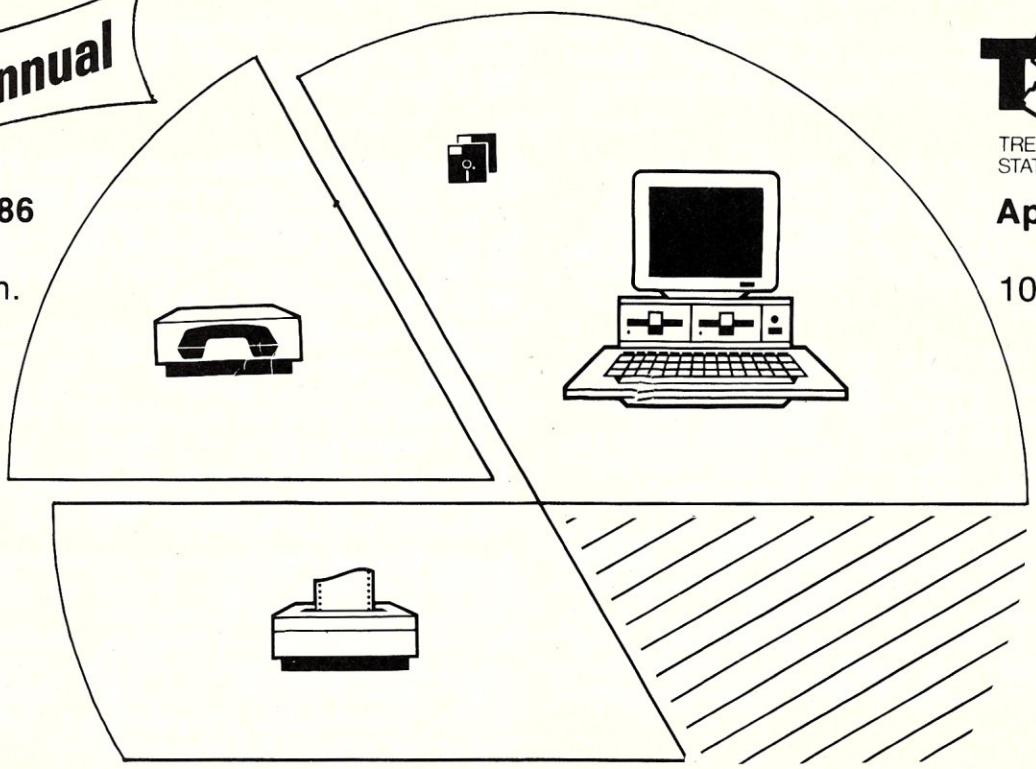

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MARCH/APRIL 1985 (Vol 1., No. 1): Bringing Up CP/M Plus, Assembly Language Extensions for MS-Basic, New Tricks for CP/M2.2, Building an IBM/PC or XT Clone, Extended Single Density Storage, Variable Size Arrays in C;REVIEWS: dBase-III and 16-Bit Lisp & ProLog-Part I.

MAY/JUNE 1985 (Vol 1., No. 2): Build an S-100 to PC-Bus Converter, Interfacing to MS-DOS Part-1, 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.

July/August 1985 (Vol 1., No. 3): Structured Programming With Microsoft M80 Assembler, Local Variables In Forth, Interfacing to MS-DOS Part-II, Data Translation with Turbo Pascal, Implementing Sets with Bit Operations in C, A Unix Mail List System; REVIEWS: Scientific & Technical Word Processors - Part I, Macrotech MI-286 S-100 CPU Card, Slicer System, Concurrent PC-DOS, Coherent Operating System.

September/October 1985 (Vol. 1., No. 4): Who Prints on Printer With CCP/M, Interrupt Borrowing With Turbo Pascal, Upgrading CompuPro I/O Boards, Program Interfacing to MS-DOS Part-III, SIG/M & PC/Blue Public Domain Software Distribution Points, TurboDos INSTALL program; REVIEWS: CompuPro 10+, TEX.

November/December 1985 (Vol. 1, No. 5): TurboCharge Your 8086/8088 Computer, Faster Floating Point Math with C, Bringing Up CP/M-68K, Program Interfacing To MS-DOS Part-IV, Advanced Machine Level Interface Techniques For Turbo Pascal, Context-Independent Macros for C, Build Your Own PC Program Library Using Public Domain Software, dBase-II Speed Techniques-Part I, Tuning Unix Program; REVIEWS: Peak 68K8-CP, Eureka For CP/M-80, Scientific Workstations.

January/February 1986 (Vol. 2, No. 1): Implement PC-DOS on Non-IBM Compatible Computers, Part-I; TurboCharge Your 8086/8088 Computer, Part-II; Assembling An AT Clone; Build An S-100 EPROM Emulator; Transfering Files Between CP/M and MS-DOS Systems; Program Interfacing To MS-DOS Part V; dBase-II Speed Techniques; Unix Public Domain Software; Reviews: Scientific Word Processors-Part II; Turbo-DOS PC; Turbo Pascal Support & Enhancement Products.

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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, Xenith 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, Computime 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 CBIOS; 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 hor H-19/Z-19 Terminal; Relocatable Code; REVIEWS: Graftalk, JES S-100 Graphics Controller, ZCPR2.

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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 & MacroAssemblers; REVIEWS: Pickles & Trout S-100 488 Controller; CP/M Utilites; 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 M26 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.

NOVEMBER/DECEMBER: Introduction to the C Language, Virtual Segment Procedures, Little-Ada Part-II, A Disk Alignment Routine, Northstar DOS/BIOS Directory & File Conversion using UCSD Pascal; REVIEWS: BDS-C, Small-C, Tiny-C and Whitesmiths-C; Tarbell Double-Density Disk Controller

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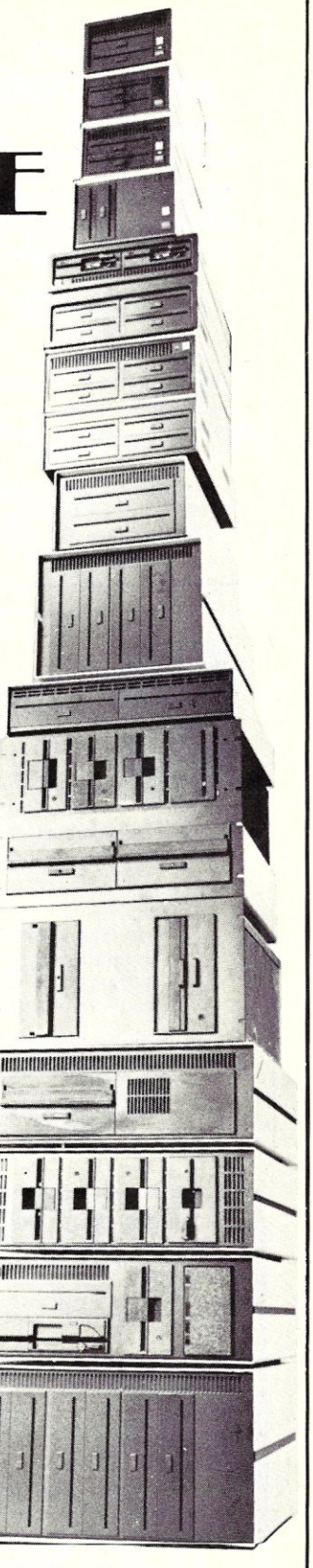

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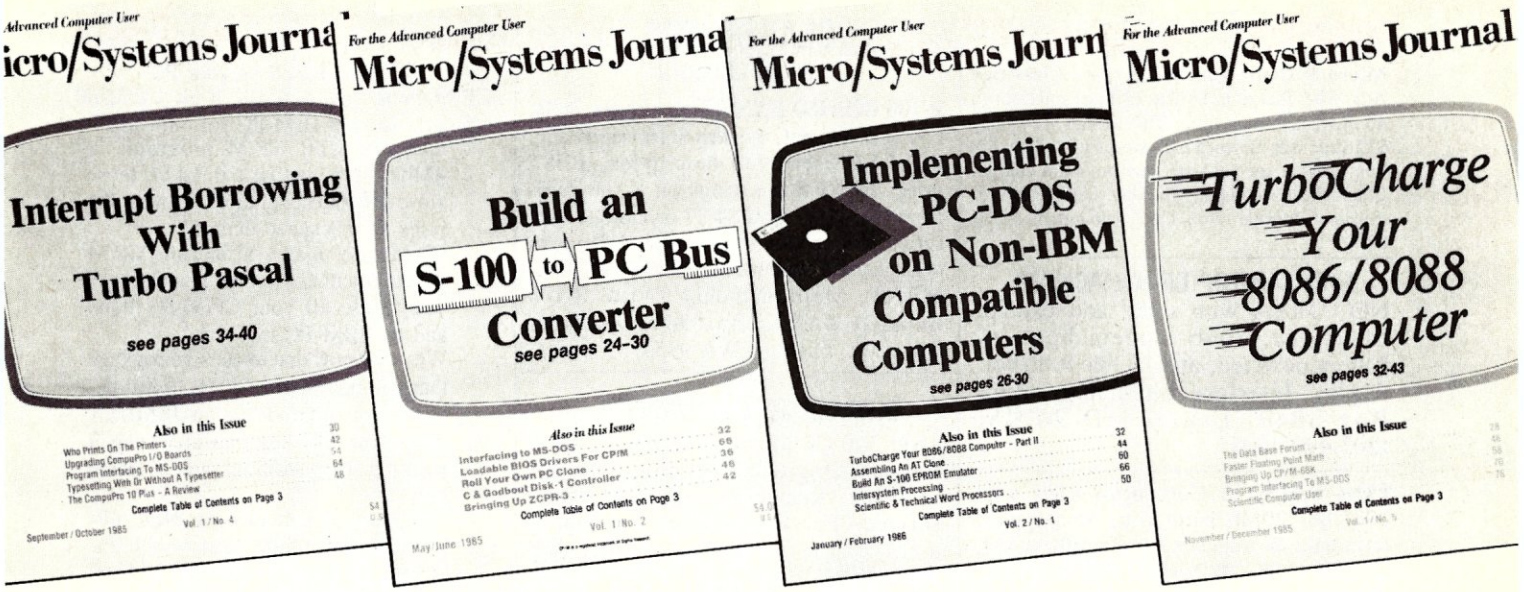

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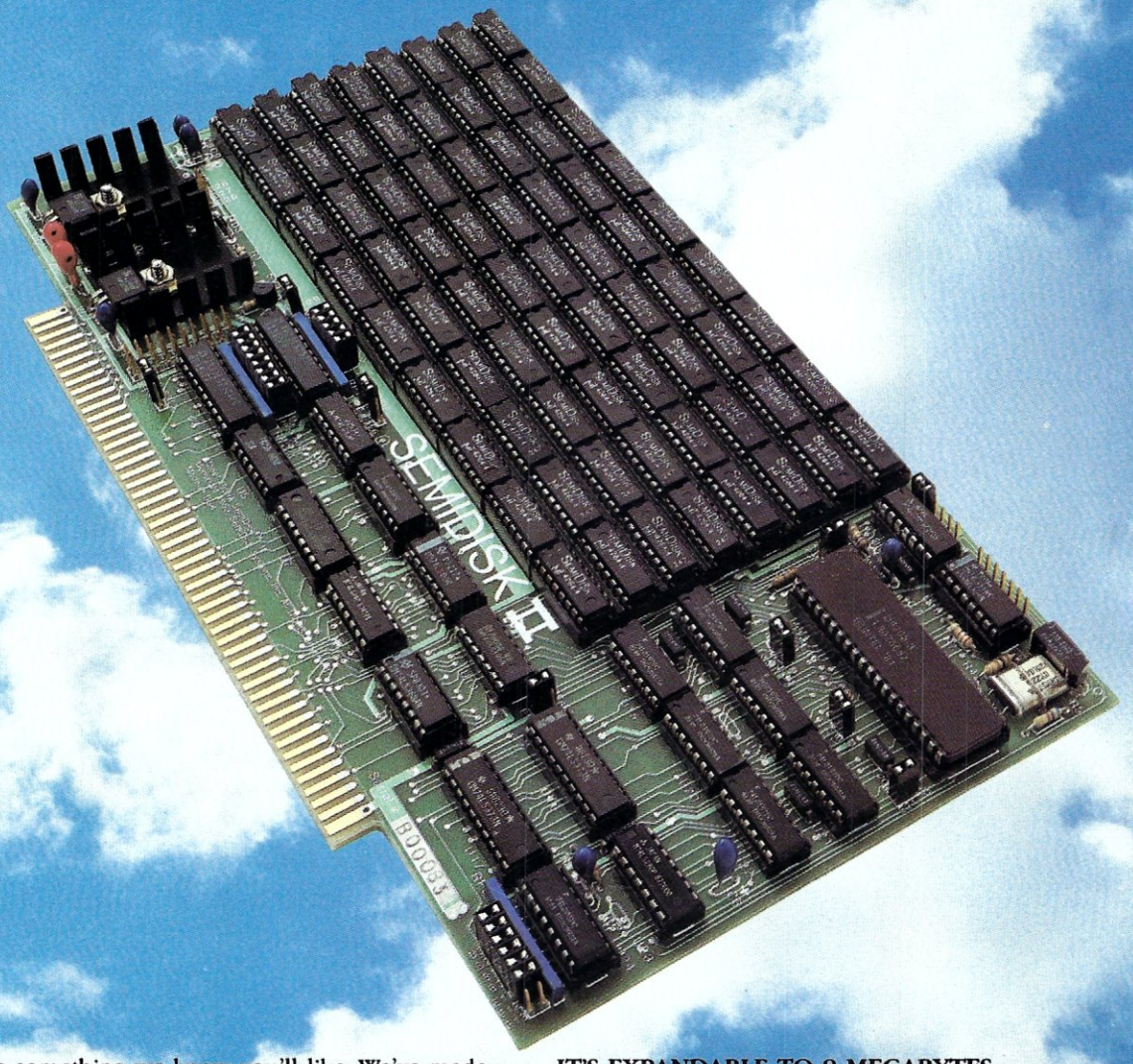

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