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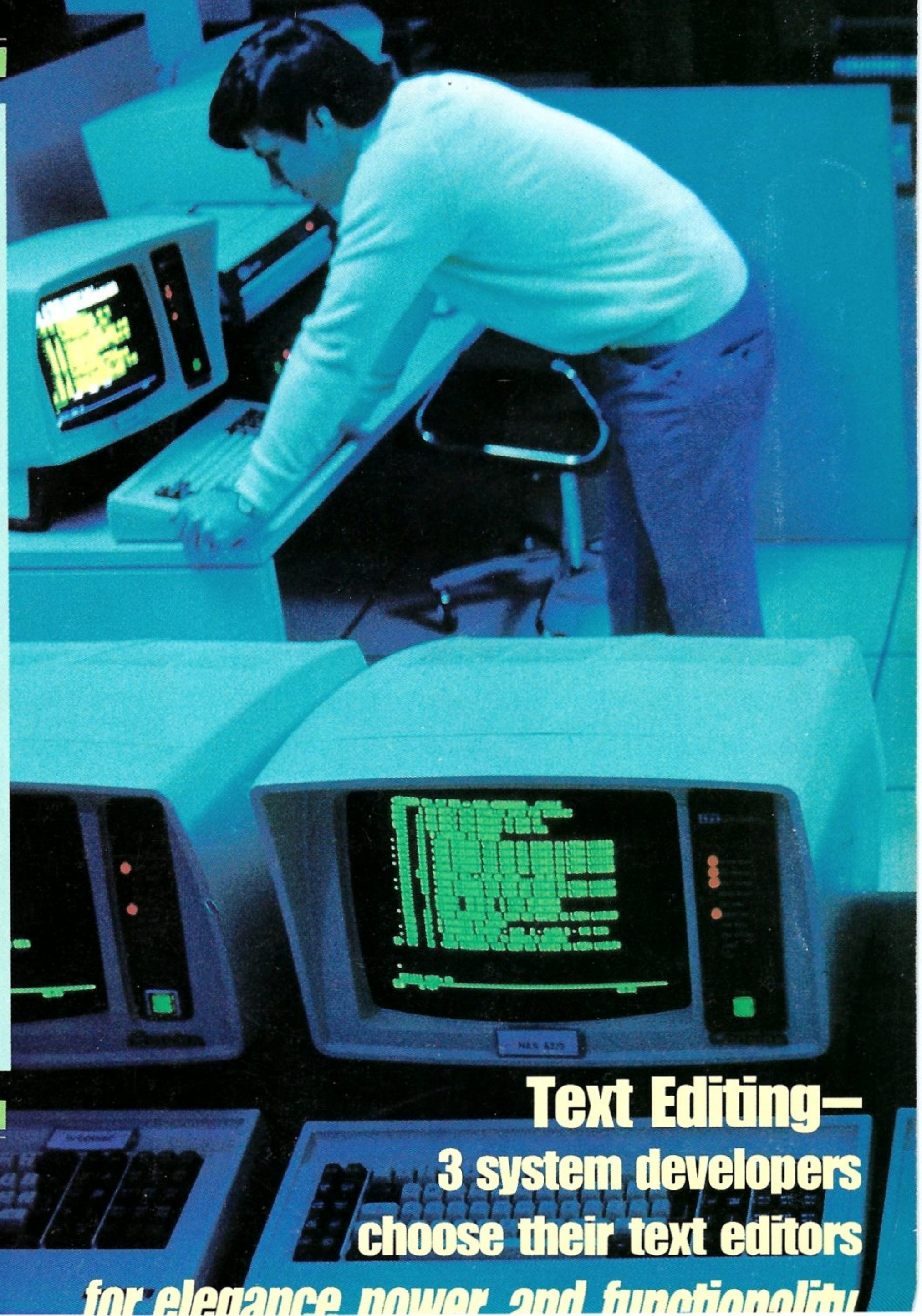

TEXT EDITING

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UNIX

UNIX File: A full report on the USENIX Conference

MS-DOS

MS-DOS Window: A look at 4 new word processors

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How to interface with IEEE-488

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AT&T PC

DEC PRO/350

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MS-DOS for CP/M-80 Systems

Text Editing—

3 system developers choose their text editors for elegance, power, and functionality


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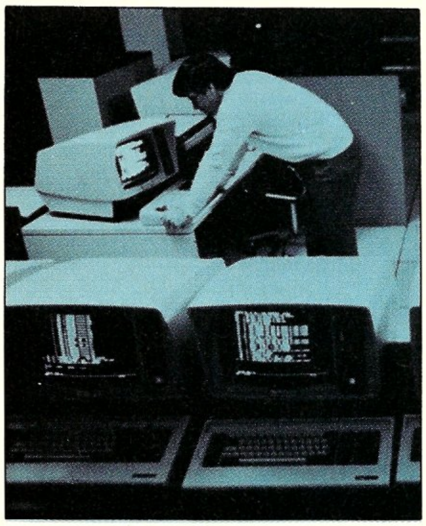

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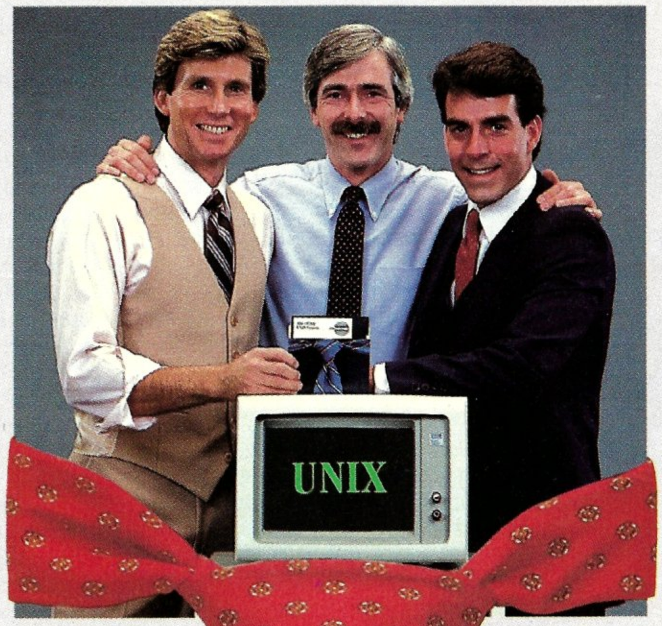

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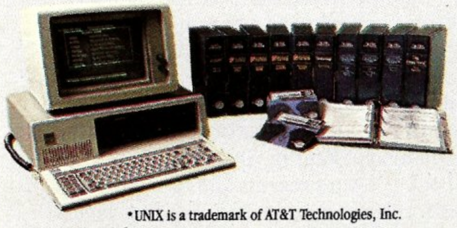

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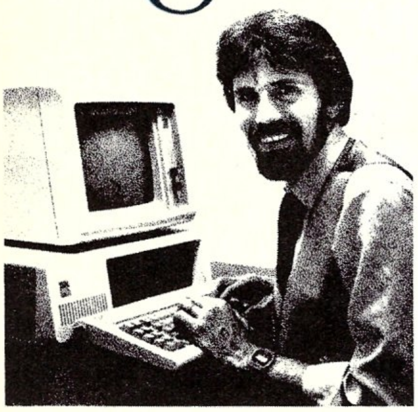

AT&T's 6300: a bridge to the future

by Mark Rollins

I just don't understand the comments in the daily press (*The New York Times* and *The Wall Street Journal*) about the new AT&T PC, the 6300. On the other hand, perhaps the comments are an indication that *they* just don't understand what it is that drives the micro industry—first, the fact that the industry is market-driven, and second, the place the 6300 can have in exerting market influence.

The AT&T 6300 is just plain and simply *not another (ho hum) IBM PC clone*! In fact, even that statement belies the impact of what is really going on with the introduction of the 6300. Not only is the 6300 a better machine than the PC, it also maintains the compatibility that protects the software investment of both developers and end users; it is marketed by a major player, lending confidence to the end user that it will be well supported; and, in terms of price/performance capabilities, it is a positive move in the direction that current machine development is taking.

A better machine

The 6300 is a quantum step forward in machine capabilities without being a quantum leap to another machine level in terms of cost. It has an 8-MHz 8086 instead of a 4.77-MHz 8088, and comes with a monitor interface that includes at least low-level color capabilities, a clock timer, a parallel port, and a serial port—all included on the motherboard. Thus, the apparent 5% lower cost of the 6300 is actually a saving of several hundred dollars because of the built-ins. The cold boot routines are more efficient, allowing a *much* shorter boot time; the boards we've tested so far plug right into the 6300 and run just fine (the major thing we haven't tested yet is any expansion chassis); and the 6300 can run *all* the programs written for the IBM that we've tested so far.

Future directions

Let's take a brief look at how the industry developed in terms of market factors. Early micros were inexpensive enough to allow at least some developers to purchase them. On the other hand, they were not inexpensive enough to achieve serious market penetration. Thus, the initial market was almost entirely the development community—the academic, scientist, engineer, entrepreneur.

Because of the nature of this community, a wide variety of disparate product designs—both hardware and software—were developed. The situation was eased somewhat with the development of the CP/M operating system, which gave at least some degree of portability across various vendor machines. It also produced a powerful environment in which applications could profitably be developed and marketed to end users. This broadened the market base and began to bring costs down. On the other hand, the design of the operating system was not quite strong enough to create a truly standard environment for the industry. Nor were the corporate and middle-to-small business communities totally convinced of the credibility of these new machines, even though they were convinced enough to begin playing with them, which at least increased the market base enough to motivate further development. As for the consumer, not enough software was provided to gain serious market penetration.

The perception of the industry changed with the introduction of the IBM PC. All of a sudden, micros gained credibility in the corporate and business communities, and the market base was substantially increased. In the development community, reaction was mixed. They were happy that the micro industry had finally gained credibility—and with a 16-bit machine that was in advance of most machines in the hands of end users at the time, no less—and that the PC-DOS/MS-DOS operating system, especially version 2.0, gave them a significantly more powerful development environment. Nevertheless, they were disappointed in the hardware architecture of the PC, which was inferior to some of the other 16-bit machines then available. On the other hand, the rapid market penetration achieved by the PC *did* at least provide a relatively standard environment that protected the software investment of both the end users and the developers. Most developers decided it was worth the inferior machine architecture.

This, essentially, is where we are today. The IBM PC represents the first step toward a standard environment for the industry. Developers continue to foresee advances in hardware and software system designs. However, those advances will occur only with the market penetration that will pay for them.

The point is, that, as the industry matures, people are going to make the choice of which machine to purchase less on the basis of raw power or functionality, and more on the basis of traditional market factors, such as advertising, packaging, and cost. Here, the AT&T 6300 represents the first step toward a more mature and exciting level of competition for the industry.

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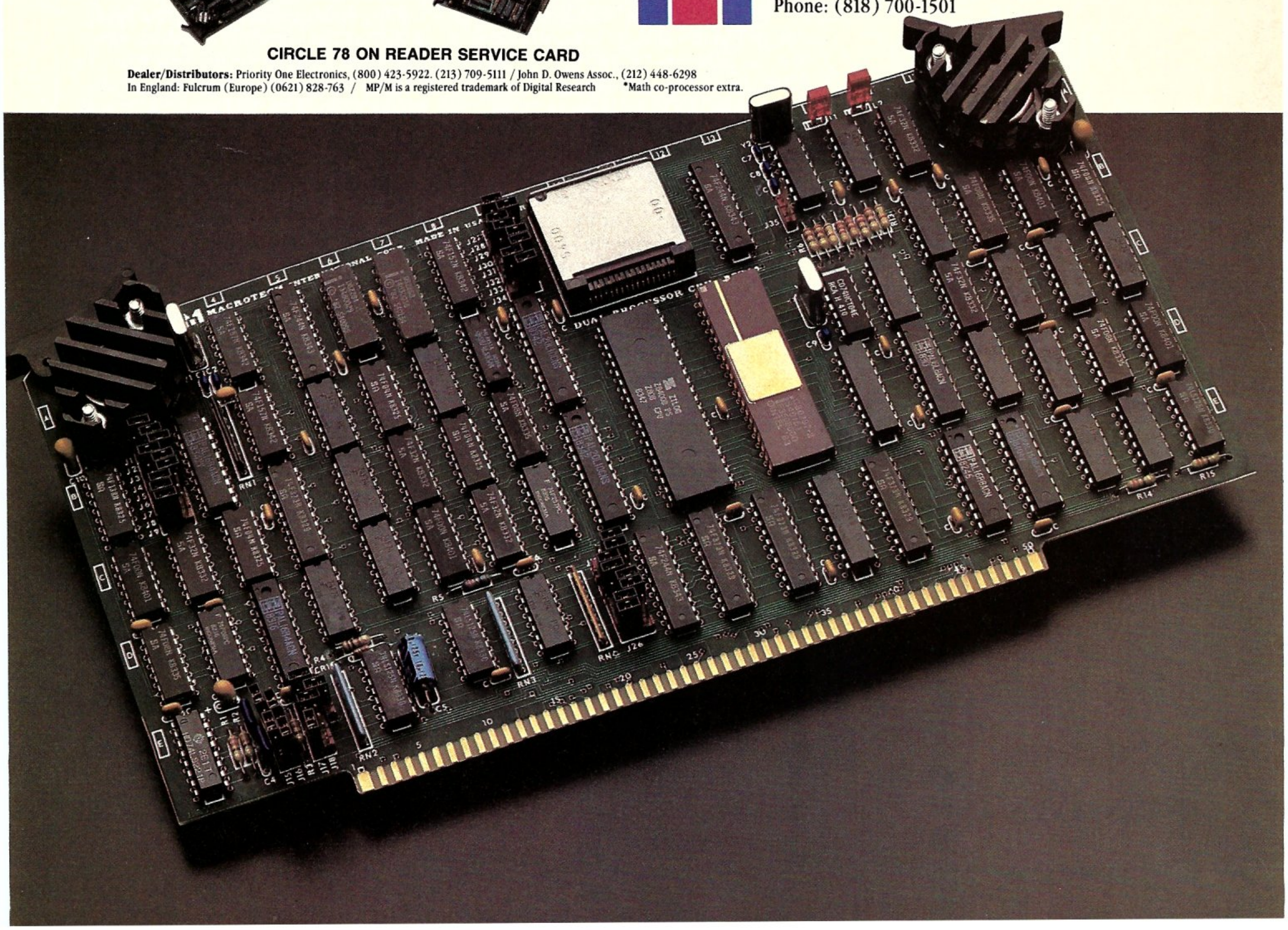

News & Views

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

by Sol Libes

Digital Research has disclosed that it is working on a major update of its recently released Concurrent PC-DOS (the one with windows and MS-DOS V1 compatibility). The new version, to be called V4, will have PC/MS-DOS V2 compatibility (in other words, it will work with hierarchical directories) and is intended to run on 80286-based systems. DRI has also disclosed that it is working on an entirely new DOS—code-named "Otter"—to be released (hopefully) in 1985, for 80386-, 68020-, and WE32-based systems (32-bit system). Apparently, they already have development contracts from Intel, Motorola and AT&T for this project. Otter is expected to support CP/M, PC/MS-DOS and UNIX software in multiwindows via memory management. . . . IBM is rumored to be evaluating Berkeley 4.2 UNIX for use under VM/370. This is believed to be a countermove to AT&T's development of a virtual memory version of UNIX.

In a recent talk, Bill Gates, chairman of Microsoft, expressed the view that the IBM has "a year or two to go" as the prevailing microcomputer standard before 80286 technology takes over. . . . IBM is expected to announce their 80286-based system either this month or next, with initial deliveries expected at year-end. This should be an expansion of the PC family and not a replacement for any system in the family . . . . Sharp Electronics is reported to be already sampling an 80 character x 25 line, 1.5″ thick electroluminescent display panel to several computer manufacturers. Hewlett-Packard is expected to be the first company to introduce a product using it.

IBM is rumored to be developing a 3.5″ hard disk drive storing 20 MB. They are expected to use this new "micro-Winchester" in systems to be introduced next year and to offer it to other computer makers. . . . There are reports that Eagle Computer, a maker of IBM-PC compatibles, is having problems with cash flow and poor sales, and that the company is considering some layoffs . . . . Digital Research is shortly expected to release "Crystal," a software developer toolkit containing a large collection of routines that can be merged and integrated into programs to reduce development time and provide features such as menus, graphics and multitasking.

Supermicro news

Motorola has announced a new pin-grid array package for the 68000 that will allow the device to directly address up to 2 Gbytes of memory. The new unit, to be called the 68012, is housed in an 84-pin package with 31 address pins.

Texas Instruments had agreed to second-source the National Semiconductor 16000 processor family of chips and jointly develop future peripherals, software and development tools. For the past two decades, the two companies have been bitter rivals. TI's thrust into the 16-bit area, the 9900, which was one of the first 16-bit microprocessors to be introduced, proved unsuccessful. The second-sourcing of the family, which will include National's 32032 32-bit device, will provide National with the support needed to gain acceptance by the major portion of the industry.

IBM networking

IBM, known for some time to be developing a token-ring-based Local Area Networking (LAN) system, has finally begun releasing some of the details for the system. However, in doing so, IBM indicated that their LAN is still about two to three years off.

IBM released specifications for the cabling system so that users can begin installing the necessary building wiring. Early announcements like this have frequently been used by IBM to forestall competition. The IBM move is viewed as an attempt at blocking penetration of rival networking systems.

However, many experts feel that this time the tactic will work against IBM because of the very long lead time. For example, several LAN suppliers are expected to now use the cabling specifications for their systems, which are very close to introduction. Further, several baseband (e.g. Ethernet) and broadband (includes video and CATV) LAN systems are already on the market. Thus these manufacturers will have a lead of several years over IBM's LAN introduction.

The likelihood is that IBM will introduce an interim LAN system from an outside vendor that will tide them over until they introduce their own LAN in 1986 or 1987. IBM is known to be evaluating LAN systems from Sytek, Ungermann-Bass and 3Com for possible adoption. It is also interesting to note that IBM has named six of the seven Bell operating companies as distributors and installers of their LAN cabling system.

IBM is known to be working with Texas Instruments on the development of ICs for their LAN project. TI is believed to have run into development

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New & Views

Continued from page 8

problems, which, some speculate, is causing IBM to reassess its fundamental LAN architecture. The development of a networking system to interconnect a huge number of highly varied devices is a huge task, and IBM appears to be taking its time in order to do it properly. Further, the demand for LAN systems appears to be growing slowly, so IBM may not really be under a great deal of pressure to get their system out.

IBM is already known to have wired 10 of its buildings in Rye Brook, NY, with 3.5 million feet of cable connecting 2800 devices. And they are also wiring 11 additional buildings. Thus, IBM is expecting to do intensive testing of its LAN system before it is released, and this will take time.

CP/M and Apple IIC

It is estimated that there are over 400,000 Apple IIs running CP/M via plug-in Z80 cards. Unfortunately, the new Apple IIc computer no longer has a plug-in card facility. Thus, people who want to run CP/M on an Apple must purchase the older IIe model. However, Advanced Logic System (ALS), a maker of Z80 cards for the Apple, has indicated that they are considering making a peripheral expansion box for the IIc that would allow running CP/M.

UNIX news

Rumors are that the delays in introduction of systems running UNIX System V are due to delays in AT&T's licensing procedures. Word is that AT&T's reorganizations has created an internal atmosphere of confusion in terms of licensing procedures and vendor support. Further, there appears to be a possible conflict of interest between the group selling AT&T's new 3B series of UNIX systems and the group selling UNIX to AT&T's competitors.

In the meantime, Motorola is the only current source of UNIX System V for OEMs. Their port to the 68000 was approved by AT&T in April. National and Zilog have still not completed their ports for the 16032 and Z8000. When they have done so, they must submit their ports to AT&T for qualification. Thus I don't expect them to market their packages until late this year or early next year. Intel is not expected to finish its port to the 80286 until early next year, in which case UNIX System V for 80286-based machines will not be on the market until late 1985.

OEMs who wish to use System V must first obtain a license from AT&T. In this way AT&T is really controlling the entrants of new UNIX System V systems into the market.

Apple Computer owners who want to run UNIX on their systems might want to know about a 6809 coprocessor card for the Apple that includes the Microware Systems OS-9 operating system. The package, which includes the coprocessor card, OS-9 and Basic-09, is $525 and will run on an Apple II with as little as 48K of memory and one disk drive. The user interface is very similar to UNIX and permits multitasking, I/O redirection, memory allocation, sequential and concurrent task execution, and multiple job batching. Also offered is a Pascal enviroment that is a true compiler and includes an assembler ($375 extra). The package is available from *Stellation Two, Box 2342, Santa Barbara CA 93120; (805) 966-1140.*

There is also word that Tandy will shortly release an update for its Model 16 UNIX System III, which was done in-house. . . . DEC is expected to introduce Venix for their PRO/350 desktop computer system . . . . DEC is also expected, early next year, to release a system to compete with systems now offered by SUN, Apollo, Cadmus, etc. . . . NEC Information Systems (NECIS) has introduced its new Advanced Personal Computer III (APC-III), an 8086-based system that runs either MS-DOS or UNIX System III. Prices start at $1,995 . . . . IBM has expanded distribution of its $900 PC-IX package for the IBM XT to include its own Product Centers, and there are rumors that it may soon be available via IBM retailers. Initially the distribution of PC-IX was limited to the IBM National Account Sales offices.

Bill Gates, Microsoft chairman, reports that Microsoft has already sold 65,000 Xenix licenses. He also predicts the number will reach 250,000 by the end of next year.

Random news

The FORTH Interest Group (FIG) will hold its 6th annual FORTH Convention and Banquet on November 16-17th at the Hyatt, Palo Alto CA. For further information call 415-962-8653 or write: *FIG, Box 1105, San Carlos CA 94070. . . . JRT Systems, Mill Valley CA,* which previously brought out Pascal and Modula-2 compilers, has announced that it will shortly begin shipping an Ada compiler for CP/M- and MS-DOS-based machines.

Initially, the compiler will support only a subset of Ada, with a full Ada compiler promised for mid-1985. A 68000 Ada compiler is also said to be in development . . . . Sony has introduced a color monitor, using its Trinitron CRT, that it claims will display 1,280 x 1,024 pixels.

Public domain software news

SIG/M (Special Interest Group for Microcomputers, Amateur Computer Group of New Jersey, Inc.) has issued four new volumes of public domain software, bringing their total up to 176 volumes. The new volumes contain the following:

Vol.	Description
173	Regular Expression Compiler Vol. 5 & 8080-to-8086 converter
174	ROFF 4 V1.60 Text Formatter
175	MODEM Source-8086, Squeeze & Unsqueeze
176	Updated SD, CPM3 & Dated Routines, Conditional Submit Files & Z80 Unsqueeze

For complete SIG/M software information send $2.50 ($4 foreign) for printed catalog to: *SIG/M, Box 97, Iselin NJ 08830.*

The PC-BLUE user group has issued six more volumes of software for PC/MS-DOS-based systems. They now have released 59 volumes. The next most recent volumes are now on dobled-sided format containing up to 320K of programs. The older volumes are also being re-released in double-sided format to reduce the number of disks in the library. Thus one will now find Volumes 1 and 2 on one disk.

The contents of the new volume are:

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54	FIG-Forth (Volume 1 of 2)
55	FIG-Forth (Volume 2 of 2)
56	Utilities for Lotus 1-2-3
57	Ultra Utilities, Squeeze/ Unsqueeze & Library Update System
58	Genealogical System
59	Epistat Statistical Pack (V3.0) update & PC-Compare

For a copy of the PC-Blue printed catalog send $2.00 ($2.50 foreign) to: *Sol Libes, Box 1192, Mountainside NJ 07092.* The disk ($6 each, $9 foreign) can be ordered from *New York Amateur Computer Group, Box 106 Church Street Station, NY NY 10008;* or call *(212) 864-4595.* Many of the clubs and individuals who distribute the SIG/M software now also distribute the PC/Blue software. It is therefore recommended that they be contacted first to obtain copies of the volumes.

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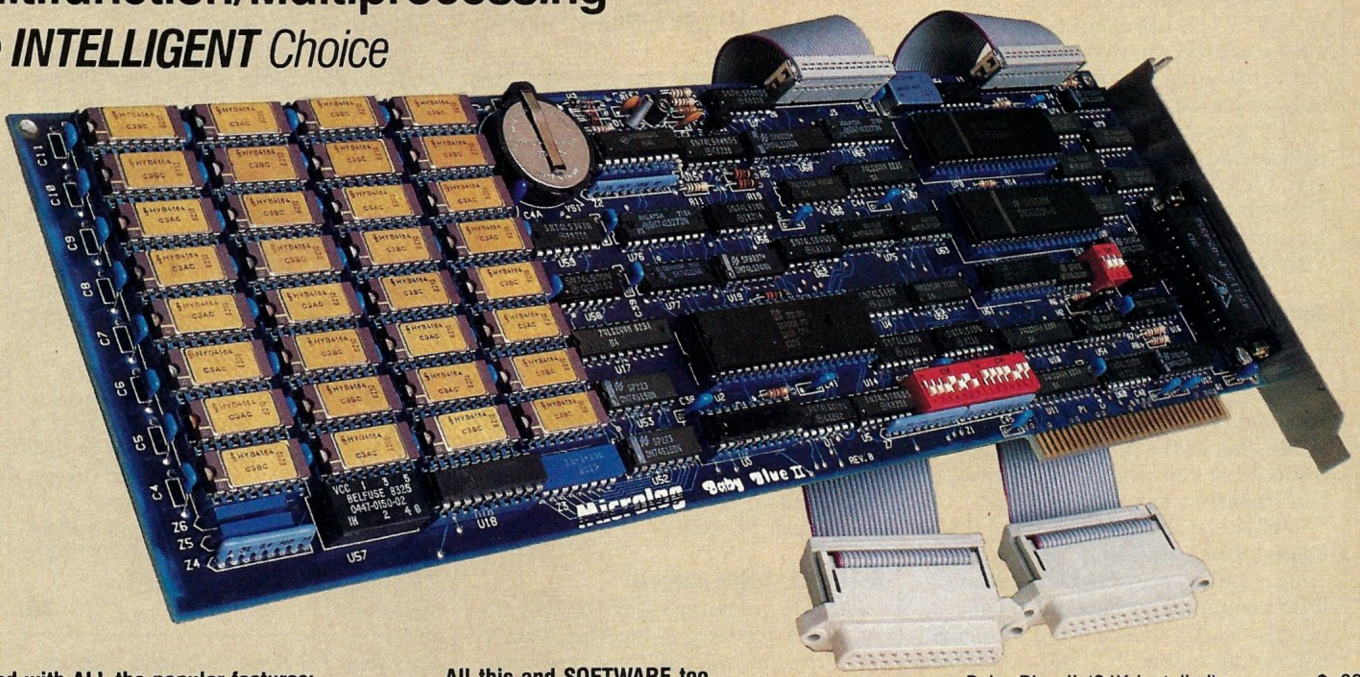

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CIRCLE 116 ON READER SERVICE CARD

News & Views

Continued from page 10

A brave new operating system

Multi-Solutions (Lawrenceville NJ; 609-695-1337) has announced S1, a new OS for microcomputers that claims to be the first fourth-generation DOS. The following claims are made for it: it is UNIX source code compatible; it can read and write CP/M, UNIX, p-System, Flex, IBM 3741, DEC 11 and MS-DOS files; and can handle record, stream and keyed files, ISAM and VSAM, and B-Tree.

Multiprocessing on the PC

IBM is rumored to be beta testing a multitasking version of MS-DOS for their forthcoming 80286-based system. An announcement is expected from IBM either at the time the system is introduced or before year end, with system shipments expected next year.

However, it should be noted that Digital Research (DRI) has been delivering a multiprocessing DOS with PC-DOS compatibility since July. The product, called "Concurrent PC-DOS" will run up to four PC-DOS or CP/M tasks concurrently on a standard PC. And it contains a true windowing system and communications support. DRI has also introduced a plug-in board for the PC which turns Concurrent PC-DOS into a multiuser system that will support up to four users; the board and software are called "StarLink." It appears that DRI has about a six- to nine-month lead over IBM's introduction of a multiuser PC system.

IBM is testing a multitasking version of MS-DOS for the 80286.

S-100 directory update

Since preparing the S-100 Directory, which appeared in the May issue, I have been informed of some new companies that have begun manufacturing S-100 products. They are:

Syntech Data Systems, 10111 Miller Rd., Dallas TX 75238; 214-340-0303. Syntech is a combination of Octagon and S/D Systems. They make a complete line of S-100 boards, systems, and hard disk subsystems.

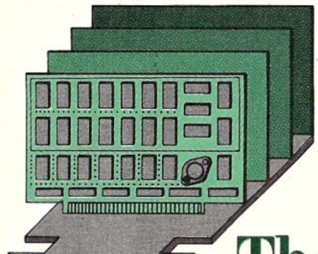
Futech International Corp., 2100 N. Hwy. 360, Suite 1807, Grand Prairie TX 75050; 214-660-1955 makes industrial-grade S-100 minframes.

Micromation Inc., 1620 Montgomery St., San Francisco CA 94111; 415-398-0289 makes a very complete line of multiuser/multitasking systems supporting up to 16 users, as well as networking using CP/M-80, CP/M-86, MP/M-I, MP/M-II, DR-Net and DRI Concurrent PC-DOS.

PSCE Inc., Box 8, Port Jefferson NY 11777, makes a 68000-based single-board computer with RAM, ROM, two serial ports, Centronics port, floppy disk controller for 8", 5.25", and 3.5" drives, DMA controller, and dual timers.

Speech Ltd., 3790 El Camino Real, Suite 213, Palo Alto CA 94306; 415-941-2490, makes a speech digitizer/synthesizer.

Sol Libes, PO Box 1192, Mountainside, NJ 07092



The S-100 Bus

Building an NSC-800 adaptor for the CPU 8085/8088 processor board

Most of the reader mail that I receive is in the form of questions, along with an occasional comment or suggestion. This month's S-100 Bus is dedicated to an unusual letter that I received from Larry Hampton (17733 W. McNichols, Detroit MI 48325) about a special adaptor he made for his CompuPro CPU 8085/8088 processor board. Although the CPU 8085/8088 is a very versatile dual-processor board, Larry missed the use of the Z80 processor that much of his software required. Oddly enough, the day after I had submitted my manuscript, the *Microsystems* editorial office received a similar letter from J.C.Parker (16 Langford St., Surrey Hills, Melbourne, Australia 3127), describing an almost identical adaptor.

Not wanting to give up the advantages of the dual processor system, both of these gentlemen independently decided to modify the CPU 8085/8088 board and replace its 8085 chip with a National Semiconductor NSC-800. The NSC-800 is virtually an 8085 from the hardware point of view, having a multiplexed bus and similar timing structures, but from a programmer's viewpoint the NSC-800 supports the Z80 instruction set. An NSC-800 adaptor gives the user the best of both worlds.

The main differences between the 8085 and NSC-800 are:

1. The five interrupt lines, HOLD, and HLDA are inverted
2. CLOCK OUT is inverted
3. SID and SOD on the 8085 are replaced with PS* and RFSH*
4. The NSC-800 has an opcode fetch cycle that is very similar to that of the Z80; the 8085 does not
5. The NSC-800 has to run at a lower clock rate
6. The NSC-800 interrupt structure is different from that of the 8085
7. The minimum input high-level signal for the NSC-800 is +3.5 volts, as

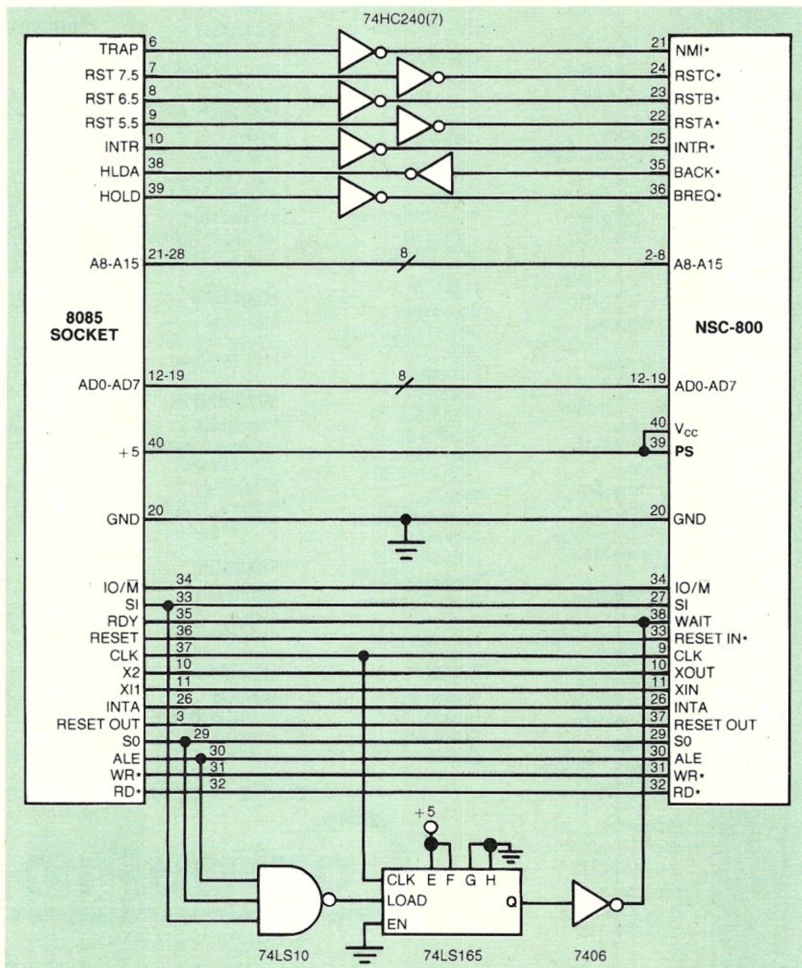


Figure 1: NSC800 Adaptor for CompuPro CPU 8085/8088 board.

by Dave Hardy

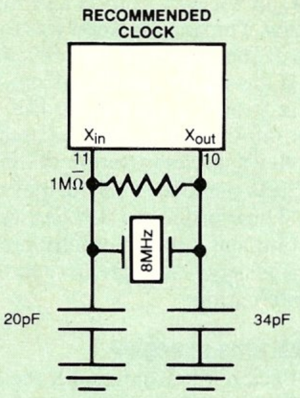


Figure 2. Crystal oscillator recommended by NSC.

against +2.5 volts for the 8085

8. Nearly all the signals appear on different pins

9. The NSC-800 has a write cycle with a write strobe that is roughly half a clock cycle shorter.

Both our correspondents mounted the NSC-800 on a separate board that carries the fastest NSC-800 available (NSC-800-4) with an 8 MHz crystal (Figure 2); this drives the NSC-800 at 4 MHz. Mr. Parker's board plugs into the 8085 socket with the aid of two component carriers soldered back-to-back; Larry Hampton used a separately mounted board with a short ribbon cable that plugs into the 8085 socket. The CompuPro board has a 12 MHz crystal for a 6 MHz Z80 with a switch to drop the clock frequency to 2 MHz. In this position a 4 MHz clock signal is available to drive the NSC-800. The 6 MHz position can't be used—the NSC-800 won't run at this frequency.

Point 4 causes the most problems. The NSC-800 opcode fetch cycle allows less time for the memory to respond than does the 8085. Both correspondents therefore decoded NSC-800 status signals to detect when an opcode fetch cycle is in progress and to enable a wait state generator: Mr. Parker used a dual J-K flip-flop (74LS107A) to generate the wait states; Larry Hampton used a 74LS165 counter (see Figure 1). However, both correspondents say that the wait states do not noticeably reduce the operating speed of the board, and both adaptors have been in use for several months and have proved reliable. Larry Hampton's adaptor, shown in Figure 1, it has slightly fewer chips. Larry cautions, however, that the input of the unused 74HC240 inverter *must* be tied high, since a CMOS chip will not tolerate a floating input line.

Dave Hardy, 736 Notre Dame, Grosse Pointe, MI 48203

The UNIX File

The USENIX 1984 Summer Conference

by Ian F. Darwin

This month's column is a little different, in that it consists almost entirely of a report on the 1984 USENIX Summer Conference held at Salt Lake City, and a few companies I visited after the show. This twice-yearly conference is the world's largest gathering of UNIX experts, not counting those of marketeers and vendors, and the oldest. The mid-June meeting provided a much-needed gathering of the clans for exchange of ideas, teaching, learning, criticism and (in the evenings) recreation.

Standards

The first day or two of the week were devoted to standards committees and special interest groups (several organizations other than USENIX also held meetings at this time). The **/usr/group** Standards Committee announced that its system interface standard had been approved by the general membership of **/usr/group.** This is the culmination of over two years of committee meetings spent defining a standard for the interface between applications programs and the OS itself. The committee consists of volunteers from systems houses, applications developers and end users. Your columnist joined the committee halfway through the effort, and attended a few of the meetings. Let me tell you that people work on standards projects because they regard the standards as important, not because the meetings are exciting. Part of this meeting was devoted to minor clarification of the standard, and also several areas of extension and transportability.

The system interface standard document consists of expanded UNIX manual pages for section 2 (system calls), section 3 (standard libraries) and section 5 (header files required by the standard). It is not a complete "UNIX Standard," nor is it intended to be such. Rather, it's a guide for systems implementors and applications developers to the standard set of UNIX functions necessary to develop portable UNIX applications. Copies of the standard can be had for $30 ($50 overseas) from **/usr/group**, *4655 Old Ironsides Drive, Suite 200, Santa Clara CA 95054.* I urge both system vendors and developers of applications programs to read and use this standard as a guide to cross-system portability.

The committee considered standardization of **termio**, the terminal control structure of System III/V—called **tty(4)** in Seventh Edition and Berkeley systems. The final decision was to adopt most of the System V **termio** standard, with a few **ioctl** extentions from Berkeley. A proposal to standardise a program multiplexing scheme based upon Berkeley's implementation of "job control" was postponed for further discussion. These proposals will be circulated for comment, and eventually presented to the general **/usr/group** membership for ratification.

Exhibit area a jungle?

Back at the Conference, the exhibit area looked a little like a jungle movie set, with numerous ceiling-height yellow vines for Tarzan to swing from. These vines were in reality Ethernet™ cables, connecting together a stellar network of stars from around the UNIXverse. Most of the hardware vendors and porting houses had their systems on this local-area network, and you could transfer files, do remote logins, etc., from one system to another. Most of the vendors joined this net with little advanced planning, and found that their systems worked with the others on the network. The Ethernet standard defines the hardware and packet interfaces, while the TCP/IP standard defines the higher-level protocols. That a dozen or so competing vendors were able to connect their equipment together like this demonstrates that Ethernet with TCP/IP is a real network product that operates across a broad spectrum of UNIX systems available off-the-shelf today.

In wandering up and down the exhibit aisles, I was struck by the small size of the exhibition floor compared to Washington (see this column in April, 1984), the quality of the products exhibited, and the large proportion of Canadian software houses. UniForum at Washington, D.C., in January had perhaps double the amount of exhibitor space, and certainly more than the 60 or so exhibitors who showed their wares at Salt Lake City. Many of those at S.L.C. were established companies in the UNIX marketplace. Hardware vendors, software companies, books & magazines, consultants & training—all were here. Notable by their absence were Digital Equipment (DEC) and a number of small- to medium-sized UNIX companies. The exhibit hall was never wall-to-wall people, so you could always get at the exhibits. Some of the vendors seemed to feel that they hadn't gotten as much out of exhibiting, due to the lower number of attendees. Other vendors, including some who had not exhibited in S.L.C. but wished they had done so, felt that the technical level of the attendees made up for their lower numbers. The old line about "pleasing

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Continued from page 16

some of the people some of the time" is still true.

Since Toronto has long been a hotbed of UNIX activity, it's only natural to find that more than 10% of the exhibitors—perhaps 20% of the software houses—are from Canada. Here's a quick look at some of these companies:

Emerald City *(20 Richmond East #700, Toronto, ON Canada M5C 2R9; 416-863-9923)* offers Emerald, a new office automation product.

Fulcrum Technologies Inc., *331 Cooper St., Ottawa, ON Canada K2P 0G5; 613-238-1761* has Ful/Text, a full-text information retrieval system offering the searching power of large text databases (similar to Dialog™ or The Source℠) to the UNIX user.

Human Computing Resources *(10 St. Mary St., Toronto, ON Canada M4Y 1P9; 416-922-1937).* HCR is one of the oldest companies in the UNIX game, and has services ranging from UNIX porting to business applications.

Nial Systems *(Box 2128, Kingston, ON Canada K7L 5J8; 613-549-1432)* has Q'Nial, an integrated language system.

Officesmiths *(331 Cooper St., Ottawa, ON Canada K2P 0G5; 613-235-6749)* has an established series of office automation products.

Rhodnius, Inc. *(10 St. Mary St., Toronto, ON Canada M4Y 1P9; 416-922-1742).* Rhodnius has a range of products, including "Mistress," which is one of the oldest commercially available relational databases for UNIX.

Tyme Systems *(5490 Avenue Royalmount, Montreal PQ Canada H4P 1H7; 514-341-6300)* represents "Progress," an integrated database, word-processing and spreadsheet package.

Technical sessions

The technical program got off to an interesting but halting start. An excellent paper by Stuart Feldman (author of several fundamental UNIX utilities—see Volume 2 of your pre-System V manual set) compared the history of western architecture to the evolution of the UNIX operating system. This excellent talk, alas, began late due to an excess of introductory remarks, and was halted halfway through by a projector failure. The rest of the program went more smoothly, although there were continuing difficulties in keeping to the schedule as speakers went overtime. The two parallel streams were in two hotels several blocks apart. Thus people trying to flit back and forth, or to arrange meetings during sessions that they considered unappealing, were frustrated by the talks beginning at random times. Another annoyance was the number of speakers who tried to display what I call "tiny type." Typewritten notes (or handwritten material about the size of typewriting) blown up to a full-size screen is just not legible at the middle or back of a large auditorium. As a general rule, put no more than 10 lines of text on a foil, and fill the entire screen area with it—then your slides will be readable. I hope that subsequent organizing committees will have learned the value of backup audio-visual equipment and a trained staff. I also hope that in the future more emphasis will be given to informing speakers of the need for correct timing and proper preparation.

The orientation of USENIX is technical, while UniForum is more commercial.

The calibre of technical sessions presented here made up for the technical difficulties. The committee made clear up front that papers were expected to be technical rather than "salesy." There were several "workshop" sessions, longer than the short papers. Presentations of both types ranged from teaching novices about UNIX, to compilers and languages, to kernel enhancements, to mail, news and networking. Tech sessions ran all day Wednesday, Thursday and Friday. As well, a wide series of "Birds of a Feather" (BOF) sessions was held Thursday evening. The Proceedings from the technical session were prepared in advance for distribution at registration, forcing the speakers to at least think about their papers ahead of time. This also allowed conference attendees to read the paper, consider the issues ahead of time, and prepare some intelligent questions. Kudos to the committee for biting the bullet and taking a strong stand on the proceedings issue, then sticking to it. You can order copies of the proceedings (388 pp.) for $25 (plus $5 for overseas delivery) from *USENIX, Box 7, El Cerrito, CA 94530.*

An informal part of the technical conference, mainly for fun, was Rob Pike's UNIX Trivia Quiz. Questions about the phone number of the person who wrote the first multiplexor, the first version of UNIX to introduce pipes, and the person who had the idea of a heirarchical file system had the old timers and UNIX historians doing lots of head scratching and reference checking.

Snowbird

All attendees were invited to a barbecue dinner held at Snowbird, a ski resort (still open in June!) in the Wasatch mountains. Those who attended were treated to some of the best scenery around, including a tram ride to 11,000 feet up to the top of the world—at least that's how it seemed when the cable car lifted us above everything in sight. Congrats to those who organised this highlight of the social program. Back at the hotels, the usual hospitality suites were held other evenings, as was a by-invitation-only reception by AT&T.

The receptions, and the scenery, and Snowbird, and the other attractions in and around Salt Lake City made this an enjoyable site for the Conference.

Next time

The Winter USENIX Conference will be held in Dallas in January. There should be a UniForum conference at the same time in Dallas, but with minimal cooperation between the two shows. The orientation of the USENIX conference is technical, while the UniForum is more commercially oriented. This is the first time the two are being held in the same city (though under different roofs); USENIX and **/usr/group** are constantly adjusting to each other's presence. Time will tell what the relationship between the two organisations and their conferences will turn out to be.

After the ball was over

After the Conference, I headed west and found myself in Silicon Valley for a few days. Pyramid Technology presented the inauguration of their "Prism" product support program, in which they provide software suppliers with assistance in porting software to the Pyramid and in marketing the products. Pyramid's 90X is a reduced-instruction-set computer (RISC machine, a recent computer science idea for building better computers). It's very fast, and it's in the $100,000 range—hardly a microcomputer, but a mainframe-class computer system. And it's further proof of the wide range of machines on which UNIX can run. Their UNIX port is unique in allowing each user to choose either the 4BSD or AT&T (System V) "universe" at any time, and get the corresponding ver-

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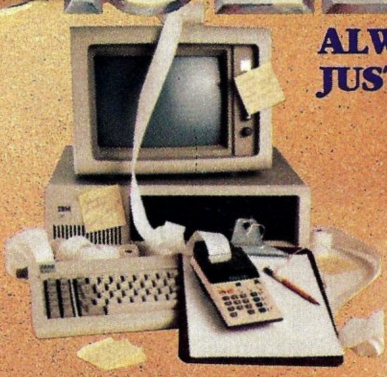

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UNIX File

Continued from page 18

sions of commands, manual pages, and the like. *Pyramid Technology* is at *1295 Charleston Rd., Mountain View, CA 94039-7295; 415-965-7200.*

Regular readers will recall that my personal UNIX computer is a Dual System/83 *(Dual Systems, 2530 San Pablo Avenue, Berkeley CA 94702; 415-549-3854).* So naturally I dropped in on Dual, to meet in person the telephone voices I've been dealing with for so long. And to see their latest hardware offerings. Their SMD disk controller looks very good. And their "TCON" 9-track tape controller is now available. Their designs are good stuff—watch these people! All Dual boards and systems are IEEE-696/S-100 compatible.

A final jaunt took me to CompuPro, where I got to see their new "32016" 32-bit processor CPU board, replacing their previously announced "16032" board. The UNIX port (being done by an experienced porting company) wasn't ready yet, so I didn't get to see the system running. But the board looks good—the layout is spacious, and the design and construction seem up to CompuPro's usual high standards. By the time you read this, they should have announced a "System 816" based upon the 32016, with the UNIX announcement later in the year. They also told me about a few developments in the DOS-compatible arena, which you'll be reading about elsewhere in *Microsystems.*

UNIX job listings

Every USENIX and UniForum meeting has a wide range of job listings for UNIX experts, ranging from marketing and customer support, to administrators for timesharing UNIX and instructors, to "kernel hackers"—those who dare to modify the deepest innards of the system. Most of the jobs on the board at Salt Lake will be filled by now, so there's no point listing them here.

But two sources of regular job opportunities should be mentioned. On is (you guessed it, I hope) UNIX itself, in the form of the UNIX network. USENET, and in particular the newsgroup "net.jobs" contains a few job listings a week, although some weeks there's nothing and other weeks there's a flood of listings. Occasionally people acting out of ignorance place job listings in the wrong newsgroup ("net.general" is a perennial favorite wrong newsgroup to put things into).

The other is an employment agency specialising in UNIX jobs. The **Whitman Challenge Company** specialises in finding qualified people for UNIX jobs nationwide and internationally, and has been operating in this particular area for over two years. So if you know enough about UNIX to make your living from it, and are looking for new employment, call *Bill Hamilton* at *213-459-7863,* or write to *18125 Coastline Drive Suite C, Malibu CA 90265.* Bill tells me that Whitman Challenge works "on an exclusive and retainer basis with many companies. This differs considerably from the Agency [approach], which deals in a volume amount of resumes." They also have contacts in the venture capital arena, so if you have an idea to develop, give them a call.

Please feel free to write in with questions or comments. Addresses for regular mail and electronic mail are given below. I can't always answer immediately, but I will get back to you. And I'm always glad to hear from readers with comments either on the column itself or on their reactions to particular UNIX systems or products.

The UNIX File looks at many aspects of the UNIX operating system. If you have comments or questions about UNIX or this column, feel free to write to Ian Darwin at Box 603, Station F, Toronto, Ontario, Canada M4Y 2L8.

If you have UNIX mail access to the **uucp** *network, you can contact me at* **ihnp4!darwin!ian.**"

The MS-DOS Window

MultiMate and DisplayWrite 2— competitors for the WP market

by Hank Kee

Word processing, spreadsheets, and database/information management comprise, by far, the majority of processing on personal computers. In the word processing field, the major players are IBM, Wang, and Digital Equipment, with Data General, Hewlett-Packard, and Prime being among the minicomputer manufacturers in the business.

There are also a few independent custom manufacturers, such as Lanier and NBI, who have achieved a degree of success in the marketplace. The main difference between these commercial machines and personal computers is that the hardware for the former has been designed for dedicated use.

Fairly recently, however, word processing software on personal computers has been developed to take advantage of the increased power of the new machines. We have come a long way from Electric Pencil, the first of the personal computer WP programs, to the 250 or so WP programs for the IBM PC alone. WP programs for personal computers now have many of the features of today's dedicated word processing systems. In the scramble for recognition and sales, WP software for personal computers has become very competitive.

The competitors

Let's take a quick look at some of the major competitors in the personal computer word processing market, and then go on to more detailed description of their products.

Wang has been one of the major forces in office automation. It was, therefore, no great surprise that somebody would port Wang's highly regarded WP system to the IBM PC. MultiMate came out with a software package that looks very much like the Wang system, and Leading Edge came out with a version that is designed after the Wang, with several valuable enhancements. Both are selling well in the corporate environment.

Meanwhile, IBM has been quite successful selling their DisplayWriter as a dedicated word processor in the office environment. They have recently introduced a software package called DisplayWrite 2 for the PC/XT that emulates the DisplayWriter. Functionally, it is also very close to the original, with some additions.

And Digital Equipment has announced WPS Plus for their Rainbow 100 series. WPS Plus is akin to their WPS on the DECMate 2, as well as the WP on their VAX All-In-One System for the office.

Exactly how good are these word processing systems on the PC? Functionally, they compare favorably with their big brothers. They suffer on the PC, however, from having keyboard layouts that are different from their larger brethren. In time, no doubt, a DisplayWriter- and/or a Wang-like keyboard will be marketed for the IBM. Since the PC keyboard is detachable, why not install different keyboards for different functions? Digital Equipment does, in fact, offer a WP keyboard for the Rainbow, and Cromemco has one for its S-100 systems.

DisplayWrite 2

DisplayWrite 2 is easy to use, while remaining a full-function WP. The manual is comprehensive, readable, and easy to use as a reference. My only complaint is that there is no summary of command codes.

The system is designed around the typical typewriter environment. The "ruler" is constantly displayed at the top of the screen, with margin and tab information. It requires either an IBM 5218 WP proportional letter-quality printer, or an IBM graphics printer (Epson FX Series). This is a limitation, in that lower-cost, letter-quality printers cannot be used. A minimum of 192K of memory is also needed—the more memory the better. With the IBM 5218 printer, an additional 64K is required.

Although it is possible to use DisplayWrite 2 with a two-diskette drive system, it is much more effective with a hard disk. Each time a DisplayWrite 2 command call is made, there is an associated disk I/O operation to load one of two function modules. Since they don't both fit on one diskette, constant diskette changing is required.

The package has a lot of features for $299, including a document merge function and a spelling checker.

Since most readers are familiar with WordStar, I shall use it as a reference with which to compare DisplayWrite 2. Like many other screen-oriented software products, DisplayWrite 2 writes directly to the IBM PC video RAM, and will function properly only on the IBM and close compatibles. It is not a generic MS-DOS product. WordStar, by comparison, is more expensive when all the options are added to the cost, but is available on a broader range of personal computer systems.

At load time, DisplayWrite 2 can be initialized with a module that allo-

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MS-DOS Window

Continued from page 22

cates a larger buffer than normal for typeahead, making it difficult to overrun the typeahead. In WordStar, an overrun can sometimes occur.

In DisplayWrite 2, there is a document attribute file associated with each document to be edited, allowing the user to specify different format attributes for each document. In WordStar, the document description is global.

A very nice feature of DisplayWrite 2 is its handling of widows and orphans. It will automatically carry over a single line of text onto the next page, or include the last line of a paragraph from the following page, making for better document presentation.

Both DisplayWrite 2 and Wordstar have the ability to print a document in the background while editing another document.

Visually, in DisplayWrite 2, what you see is what you get. In Wordstar, you can specify text to be 'bold print,' and a set of associated codes will be appended to the text. In DisplayWrite 2, you get to actually see the text in 'bold.' (There is no 'bold' option on the regular DisplayWriter.)

Specifying a block of text is also much easier in DisplayWrite 2. There is also soft centering of text—you specify the center of a line, and then begin entering the data. The text automatically centers itself as keyboard entry is made.

The number of options on DisplayWrite 2 is large. For instance, there are math, as well as columnar, functions. Anyone familiar with the DisplayWriter will feel right at home with DisplayWrite 2.

MultiMate

MultiMate looks like the popular Wang WP software, for an IBM PC. It preceded IBM's introduction of The Professional Editor. Many of the advantages of DisplayWrite 2 noted above also apply to MultiMate.

One major reason MultiMate has penetrated the marketplace so rapidly is the ease and quickness with which purchasers have learned to use it productively. A very nice screen feature in MultiMate is the display of the shift key and numeric lock key status. This appears in the lower right-hand corner of the screen, with an arrow pointed up to indicate shifted and down to indicated unshifted, positions.

Where DisplayWrite 2 is currently limited to the IBM 5218 proportional printer, MultiMate provides drivers for almost every popular letter quality printer. It is a two-diskette system requiring a minimum of 192K of memory. The dictionary is too large to fit onto the MultiMate system disk, necessitating the second diskette. MultiMate is page oriented, whereas Wordstar is virtual text oriented. Many secretaries would select MultiMate over Wordstar because of this page orientation, coupled with its ease of use.

The system is very responsive. The screen displays are rapid, and the HELP file is thorough. The inclusion of a spelling checker and file merge within MultiMate makes it a good product for the office systems user.

Digital Equipment WPS Plus

At the time of this writing, WPS Plus had been announced, but not released. I will be receiving a beta copy for testing from Digital Equipment in the near future, and plan to comment on it then. If it's like the WP on the VAX All-In-One, it will be a very attractive WP package for the Rainbow.

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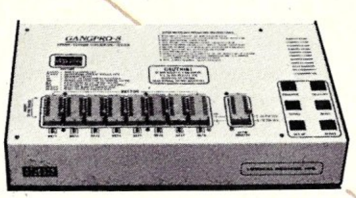

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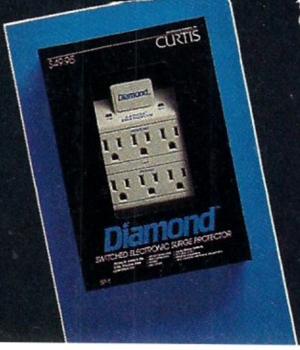

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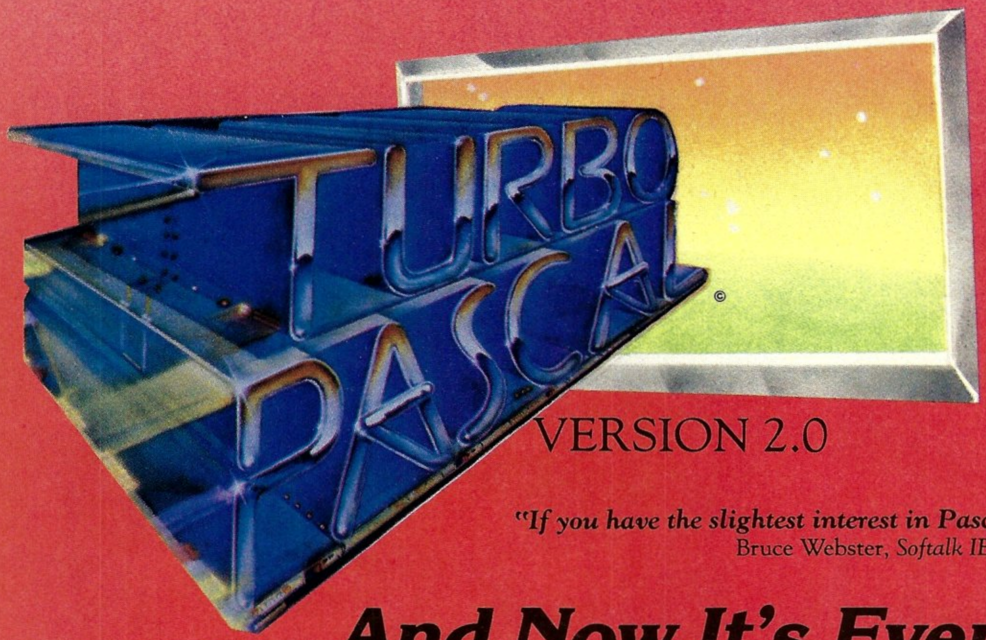

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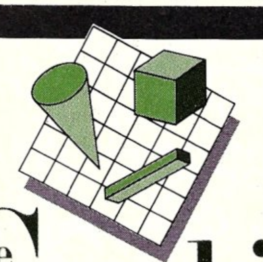

The Graphics Palette

GKS— The Graphical Kernal System

by Dave McCune

Imagine, for a moment, that the American National Standards Institute were to adopt one computer language—Pascal, say—as a programming standard. ANSI could recommend that all programming henceforth be done in Pascal and declare all other languages non-standard.

Ridiculous, of course. ANSI does set language standards, to be sure, but the purpose is not to declare one language better than another. Instead, ANSI standardizes the features and capabilities of each of many different languages. ANSI has defined a standard Fortran, for example, as well as a standard Pascal.

No language is ideal for every application, and we should be grateful for the multiplicity of programming languages. The coexistence of Fortran, Pascal, Basic and C is a boon to both programmer efficiency and creativity.

In the graphics world, however, shrill voices often demand that one or another of several very different graphics encoding techniques be recognized as *the* standard.

In the past two months, *Microsystems* has published descriptions of two graphics schemes (NAPLPS in July and ANSI X3.64 in August, 1984). Both schemes have been standardized by ANSI. But the two standards sprang from, and serve, different needs. NAPLPS serves videotex, while X3.64 is useful to manufacturers and programmers of primarily alphanumeric CRTs and typesetting terminals. Both are useful; the one no more excludes the other than Basic excludes C.

Another useful graphics encoding scheme evolved in Europe in the late 1970s and may now be the world's most widely used set of graphics functions. The Graphical Kernel System (GKS) provides a portable graphics interface between high-level languages and a variety of graphics input and output devices. It is now under review by ANSI, which may soon define a standardized version of GKS.

(The ANSI GKS spec is called X3.124-198x, and you can get it by sending a $35.00 check and self-addressed mailing label to *X3 Secretariat/CBEMA, 311 First Street, N.W., Suite 500, Washington, DC 20001*. The spec is a bit dense and poorly illustrated, but it is a good reference source and also contains some helpful sample Fortran GKS programs in an appendix.)

Unfortunately, GKS is sometimes best known in the U.S. as a "competitor" to CORE, another graphics scheme advanced by the Association for Computing Machinery in the late 1970s. CORE will be the subject of a future column. Rather than contribute to the rhetoric cast between the GKS/CORE camps, we will simply examine these and other graphics schemes in order to highlight their strengths and weaknesses. The reader is free to enter or ignore the fray.

Basic GKS concepts

GKS provides an interface between applications programs and graphics terminals which is conceptually similar to the READ and WRITE statements of Fortran. The READ statement, for example, is a language-specific implementation of an abstract, general computer function, i.e., getting input data from an external device. We could easily create a long list of such abstract functions used daily by programmers: get data (from disk, keyboard, joystick, etc.); output data to terminal; create and organize disk file (sequential, random, etc.), and so on. As an interesting intellectual exercise, we could even codify these abstract functions into a general data I/O kernel system. If we were to actually build this system on a computer, we would have built an operating system. Our next task would be to create language-specific *bindings* of the general functions, i.e., to translate the general *get input data* concept into, say, the Fortran READ. Assuming our general data I/O kernel system were implemented on a variety of computers, and also assuming language bindings existed for these machines, then we could write portable I/O code that could run on any of the machines.

Such a general data I/O kernel system exists more in practice than in theory. For graphics output, though, the theory has preceded the reality. GKS is a set of abstract graphics functions, such as *draw lines to connect a series of points* or *draw a marker at each of a set of points*. The abstract functions must be implemented on particular computers along with drivers to control specific graphics I/O devices. In this regard, an implementation of GKS is rather like an extension of a computer's operating system (see Figure 1). Before the GKS 'extended operating system' can be useful, of course, its functions must be callable in a uniform manner from one or more high-level languages. Subroutine and function calls must be defined for each language. Currently, a GKS language binding exists only for Fortran.

Output primitives

GKS sends graphic output in the

Palette

Continued from page 29

form of *output primitives* and *primitive attributes* to an abstract graphic terminal called a *workstation*. Input may also be read from the workstation (see Figure 2). We shall see that the workstation concept is the pillar that supports GKS portability.

The programmer interacts with GKS by means of subroutine calls. The precise execution of a subroutine is affected by parameters passed to it and by global modal variables (used like COMMON areas in Fortran).

POLYLINE, for example, is one of the six GKS output primitives. It is called like any subroutine, with three arguments:

```
POLYLINE (NUM--POINTS, X--COORDS,
          Y--COORDS)
```

The last two arguments contain arrays of coordinate data. GKS will draw lines connecting the points X--COORDS(1),Y--COORDS(1) to X--COORDS(2),Y--COORDS(2) and so on to X--COORDS(NUM--POINTS), Y--COORDS(NUM--POINTS). The resulting line could represent anything from a simple graph to an outline of a human face.

But the polyline call only specifies coordinates; it has nothing to do with the thickness of the line, its texture (solid, dotted, dashed, etc.) or its color.

(Note also that this primitive—like all other GKS geometric primitives—only handles two-dimensional coordinates. GKS has no built-in three-dimensional support. For now, your only option is to write an applications layer over GKS to handle 3D drawing. Rumor has it that a 3D GKS extension is being built. In the meantime, programmers who demand 3D support may want to look at other graphics options, such as CORE, which include 3D.)

Attributes

GKS provides two basic ways of specifying primitive attributes: bundled and unbundled. The concept of bundled attributes is key to understanding how GKS offers a high degree of independence between applications programs and physical terminals.

Continuing with our POLYLINE example, GKS offers three attributes: LINETYPE, LINEWIDTH SCALE FACTOR, and POLYLINE COLOR INDEX. (See Table 1 for a list of all six GKS output primitives and selected attributes.) The exact effect of various settings of these attributes varies with particular terminals, of course. Some plotters can draw lines with only one thickness, for example, and some monitors can produce only two colors (black and white).

From the applications programmer's perspective, though, GKS does its I/O to abstract workstations. At some point before doing any I/O, the programmer opens and activates one or more workstations. (Another GKS strong point is its ability to perform I/O on multiple workstations simultaneously. A graph might be drawn on a monitor and plotter at the same time, for example.) Associated with each workstation is a bundle table for each output primitive. The programmer can use the function

```
SET POLYLINE REPRESENTATION(WS,
     PL--IND, LT, LWS, PLCI)
```

to set values for linetype, linewidth scale

Associated with each GKS workstation is a color table.

factor, and polyline color index. This set of attribute definitions is then assigned a polyline index number (PL--IND) and associated with a particular workstation (WS).

At one installation, for example, polyline index 3 for workstation 1 (a monochrome monitor, say) might define a boldface, solid, white line, while the same polyline index 3 might define a thick, solid, black line on workstation 2 (a plotter). From then on, a programmer could set the polyline index to 3 and draw the same polyline to workstations 1 and 2. The lines would be quite different on each device, but the effect (an emphasized line) would be the same.

The precise values passed to SET POLYLINE REPRESENTATION are very much site-dependent, varying with the particular hardware available at each installation. The local system manager will have to take considerable care to define a range of attribute bundles that work well on the local devices. These definitions will be executed by a group of SET xxx REPRESENTATION calls (where xxx may be POLYLINE, POLYMARKER, and so on). These function calls may be provided in a local system library and linked into a portable applications program.

Attributes do not have to be bundled. It is possible to set each attribute individually, e.g., with the SET LINETYPE or SET LINEWIDTH SCALE FACTOR functions. Once one of these individual attributes is set, all further primitives will be drawn on all workstations with the new attribute setting. The disadvantage here is that it is up to the programmer to know what effect a particular attribute setting will have on each specific hardware device.

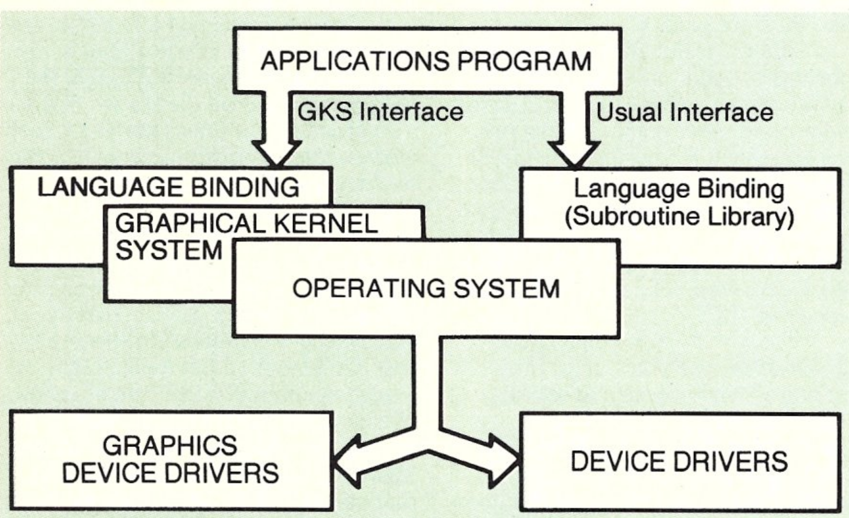

Figure 1. GKS is a layer *between an operating system and an application. An application program communicates with GKS via a language-specific set of function calls (a language binding). To the application program, GKS looks like an extension of the operating system.*

The applications program is less portable when unbundled attributes are used.

Color

Color is an important attribute, of course. GKS does not specify color in absolute terms. Instead, colors are specified as an index which points into a table of color definitions. In other words, associated with each GKS workstation is a color table with entries 0 to n. Each entry in the table contains a color definition made up of three real numbers: intensities of red, green and blue. As an example, the polyline color index might be a bundled attribute set to 5. Thus, on one workstation color index 5 could point to magenta (a mixture of red and blue), while on another less capable workstation the same index 5 might be defined as pure red or pure blue. The number of entries allowed in each workstation table and the precision with which red, green and blue may be mixed is highly hardware dependent, of course. Some workstations may only have two predefined color table entries—0 and 1, for black background and white foreground. And others may provide very high color resolution. The definition of the actual values in each color table entry may be done by the applications programmer or, as described above for other bundled attributes, by the local system manager.

Coordinates and transformations

Coordinate data is a difficult problem for hardware independence in any graphics encoding scheme. One video driver might offer a resolution of 1024 x 1024 pixels, for example, while another provides only 512 x 512. The applications programmer plotting a graph, on

GKS takes great pains to provide hardware independence.

the other hand, might measure axes on a scale of 0 to 100. While on the one hand we want to be able scale the graphics to fit in various areas of the display, we do not want to deal with the logical or physical units of resolution on each device.

One of GKS's most elegant but confusing features is its method of insulating the programmer from the physical dimensions of the display devices. GKS performs the translation from the programmer's coordinates to the physical device coordinates in four layers (see Figure 3).

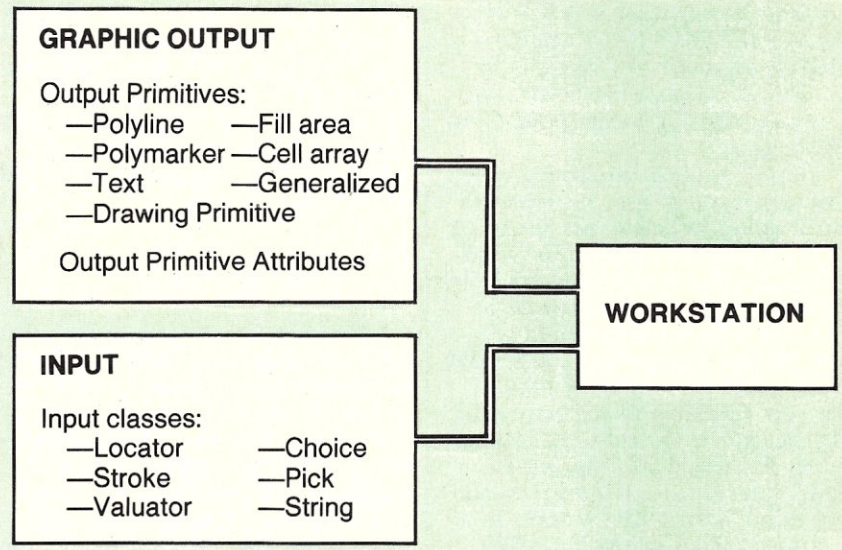

Figure 2. GKS programmers communicate *with the outside world via abstract devices called "workstations." Each workstation maps to a physical I/O device.*

Internally, GKS always passes coordinate data in terms of a two-dimensional Cartesian coordinate system. A particular application, however, may require the user to manipulate graphics on, say, a logarithmic scale. In that case, it is up to the applications programmer to translate the logarithmic scale into *world coordinates*, a Cartesian scale in which each axis is divided into an arbitrary number of equal units. In some cases, of course, the coordinate data manipulated by the user will already be mapped to a Cartesian system, in which case this first-level translation is only implicit.

Once the data is stored in world coordinates, it must be mapped onto the display screen. Here GKS shines. Suppose we are drawing a graph on a plotter. We might prompt the user for input from a raster display screen. Our graph appears on the monitor, and the user moves a cursor around the screen to enter coordinates. Once all coordinates have been entered, we send the output to the plotter. Now, while we display the graph on the monitor, the origin of the x- and y-axes might be at the lower left corner of the screen, and the graph might cover the entire screen display. But when we send the graph to the plotter, we might want to draw it in the upper right quarter of the paper, or we might even want to rescale it and draw it across the top half of the paper. This is quite easy to do in GKS.

We store the input data in world coordinates, say on a scale from 0 to 100 on the x-axis and 0 to 500 on the y-axis. When we write our output primitives to workstations, though, we specify coordinate data in terms of an abstract, virtual display area which measures 1 virtual unit on each axis. A point half way across and at the bottom of our virtual display would be at virtual coordinates 0.5,0.0. And a point in the middle of the display would be at coordinates 0.5,0.5. This virtual coordinate system is called *normalized device coordinates* (NDC).

The transformation of our data from world coordinates to normalized device coordinates is a two-step process. First, we define an area, or window, of the world-coordinate display which we want to output. The function

```
SET WINDOW( ID, X--WINMIN,
        X--WINMAX, Y--WINMIN,
        Y--WINMAX)
```

does this. The minimum and maximum X and Y coordinates outline an area of the world-coordinate display. In our example, X--WINMIN and Y--WINMIN might both be 0, while X--WINMAX could be 100 and Y--WINMAX could be 500. This would select the entire graph area for output.

The next step is to define an area of the NDC display, a viewport, onto which this window will be mapped. We use this function:

```
SET VIEWPORT( ID, X--VIEWMIN,
        X--VIEWMAX, Y--VIEWMIN,
        Y--VIEWMAX)
```

Palette

Continued from page 31

Here we might set X--VIEWMIN and Y--VIEWMIN to 0.5, and X--VIEWMAX and Y--VIEWMAX to 1.0. This would place the viewport in the upper right quarter of the NDC virtual display.

It is quite possible to define a window such that only part of a primitive can fit within the boundaries. We might, for example, draw a polyline in world coordinates that extends from 50 to 500 on the x axis. But our window might only stretch from 100 to 400. In this case, the ranges from 50 to 100 and 400 to 500 would fall outside the NDC viewport. GKS offers two choices. If a *clipping indicator* is set to 'clip,' then all output that would fall outside the viewport is removed. If 'noclip' is specified, then GKS will tell the device to try to draw the full primitive if it will fit within the physical display area, even though some of the graphics falls outside the viewport.

A pair of SET WINDOW and SET VIEWPORT calls defines a *normalization transformation*. Note that by varying the window and viewport coordinate limits, we change the relative scales of the x- and y-axes. We can use this, for example, to stretch a graph along either axis. Each pair of SET WINDOW and SET VIEWPORT calls is given a unique ID number. Then, just before we output a graphic primitive to a workstation, we can select one of several transformations with

```
SELECT NORMALIZATION
         TRANSFORMATION(ID)
```

Consider for a moment the fact that GKS allows us to perform I/O to multiple workstations. We can also store the coordinate arrays for multiple graphics at one time. If we then maintain a number of normalization transformations and select different ones as we output each piece of our graphic, we can assemble and compose a complex graphic "on the fly."

We should also note that GKS provides a large number of 'inquiry' functions which allow the programmer to ask a workstation to report, for example, various attribute values. Thus, a program could find out the red, green and blue intensities which make up a particular color slot on any workstation. It would be possible, then, to save attribute values temporarily and reset them after a subroutine had executed and drawn a graphic. This capability is the envy of NAPLPS programmers, who have no way of saving attribute states.

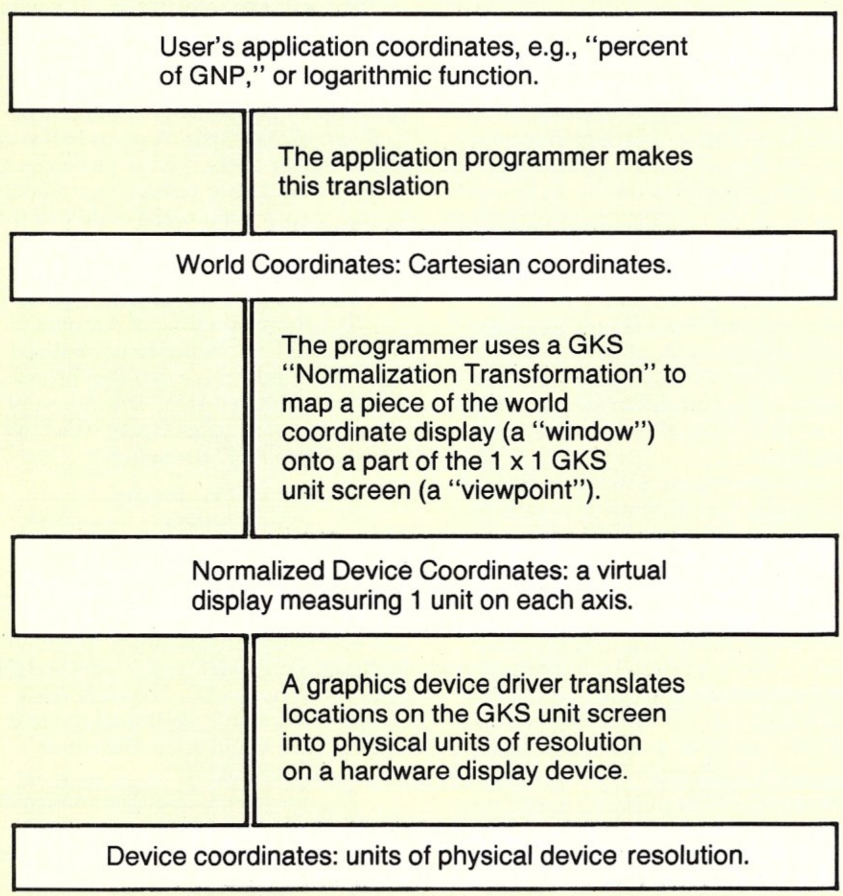

Figure 3. The transformation of coordinate data *from the user's points of reference to the display device's physical coordinates is a four-step process in GKS.*

Segments

Sophisticated GKS graphics are built from repeated calls of primitive functions. A drawing as simple as a child's boxlike house may require several polylines, fill areas, text strings and so on. It is not necessary, however, for the GKS programmer to repeat all these calls in order to redraw the house. Instead, all the output necessary to draw the house can be stored as one unit, called a 'segment.'

A segment begins with an OPEN SEGMENT(ID) call. From then on, all graphic output will be stored in the segment named ID until the next CLOSE SEGMENT call. Segments are normally associated with whichever workstations are active when the segment is created. In other words, segments are stored in the data areas set aside for each active workstation. (GKS also provides a way to store segments independent of any workstation, so that any workstation can access them.)

The extraordinary power of segments derives from the way GKS allows the programmer to modify them. Entire segments—including all their primitives—may be moved, rotated and even scaled along both axes.

Input

GKS receives input from a user in three modes: In *request* mode, the program pauses with an outstanding read request until the user enters data. In *sample* mode, the application checks the input status of a logical input device and then continues executing. In *event* mode, finally, GKS maintains a queue of event reports, i.e., reports of asynchronous input from logical devices. The application checks the event queue and acts on reports as needed.

The logical devices which operate in these three modes provide data of six types:

Locator data consists of one set of world coordinates. It is used to supply a coordinate location to the application, e.g., the location of a cursor.

Stroke provides a series of world coordinates. It might be used, for example, to input from a lightpen or tablet a series of points which define a polyline.

Valuator input consists of a single

Table 1. The six GKS output primitives and selected attributes.

Primitive / Attribute	Function
Polyline	Draws lines connecting 2 or more sets of coordinates
Linetype	Specifies solid, dotted, dashed, etc.
Linewidth scale factor	A real number specifies a multiple of the standard line thickness for the particular device.
Polyline color index	An index into the color table for the specific device
Polymarker	Put a market at each of 1 or more sets of coordinates
Marker type	Specifies dot, plus sign, asterisk, etc.
Marker size scale factor	A multiple of the standard marker size for the particular device
Polymarker color index	An index into the color table for the specific device
Text	Output strings of text
Text font and precision	Selects a font and determines how precisely it will be treated on output, i.e., by the string, individual character or individual stroke
Character expansion factor	The ratio of character width to height
Character spacing	Blank space, measured in a multiple of the character height, to be inserted between characters
Text color index	An index into the color table for the specific device
Character height	Vertical size of characters
Character up vector	Determines the angle at which the characters will be written
Text path	The writing direction of the string, i.e., left, right, up, down
Text alignment	How the text is oriented on both the X and Y axes with respect to its starting point.
Fill Area	An area defined by sets of X and Y coordinates is filled
Fill area interior style	May be hollow, solid, pattern or hatch. Pattern and hatch may be user-defined
Fill area color index	An index into the color table for the specific device
Cell Array	An array of cells (e.g., logical pixels), each of which may be set to a different color
Generalized Drawing Primitive	A way to command some output device to draw non-GKS shapes. A sample GDP might be "circle," followed by device-specific data. This is similar to the GKS ESCAPE function, which allows the programmer to send non-GKS code to devices.

Palette

Continued from page 32

numeric value. It might be used to input a point on a graph or a scaling factor for redrawing a graphic.

Choice returns an integer which represents a selection from a list of choices. This might be used to select from a menu.

Pick input allows the user to select one object from a segment. Take as an example a complex drawing of a house. The entire house could be one segment. But if the user wished to modify, say, just one window, it would be necessary to select just the polyline which made up that window. Each object in a segment has a unique *pick identifier*, which can be returned to the application.

String input returns a character string, such as a filename.

Metafiles

The I/O devices we have dealt with so far have been traditional graphics devices, i.e., plotters, monitors, printers and so on. GKS also includes hooks for graphics I/O to disk files. The principle is that graphics data is formatted in some more or less compact and standardized manner and stored in so-called *metafiles*. These graphics metafiles can then be transported from one GKS system to another, for example, over phone lines.

Unfortunately, GKS now provides only relatively high-level I/O functions for metafiles. No standardized format for data storage in metafiles has been accepted. Just as it is up to an individual GKS implementor to write a hardware-specific driver for each supported graphics device, so it is left to the implementor to define a data storage format and adapt the high-level I/O functions.

Summary

The GKS spec states three design goals. First, GKS should include all the capabilities necessary to perform everything from simple passive graphics output to highly interactive applications. It is obvious from this statement and from the 185 functions provided by GKS that the standard is complex and that this column has only been able to highlight some of GKS's major features. With some exceptions—the lack of 3D support is most notable—GKS seems to live up to this first goal.

Second, GKS aims to address a wide range of graphics devices in a uniform way. Certainly, GKS takes great pains to provide hardware independence. The concept of world and normalized device coordinates is an example. This quite abstract way of dealing with coordinate data may at first seem confusing and appear to be a high price to pay. And GKS puts a heavy burden on implementors, who must write the individual drivers for physical devices. But, if graphics are ever to be as widespread and easy to transport as ASCII data, the price will have to be paid.

Finally, the GKS designers hope to provide the capabilities needed by a majority of applications without making GKS too large. This is an intriguing concept: it implies that implementors should determine their target applications and be free to implement only a necessary subset of GKS. In fact, GKS explicitly describes such subsets in terms of varying levels of implementation. Needless to say, the thought of different implementations of GKS provide different levels of functionality is worrisome. Some of the benefit of graphics portability will disappear if GKS applications will run only under those GKS implementations that provide an equal or higher level of functionality.

Despite the potential problems, GKS is a powerful, comprehensive graphics tool. Next month we'll try one micro-based GKS implementation.

David McCune, Proteus Group, Inc., 195 Garfield Pl., Brooklyn, NY 11215. CompuServe user no. 71046,1647.

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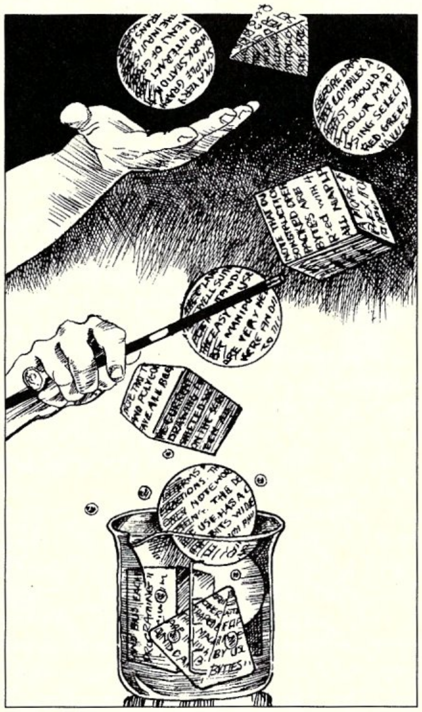
Elegance, Power and Functionality in Text Processing

Discussing text editors is almost as hazardous as discussing politics or religion—for each editor there are enthusiasts who cry "We'd rather fight than switch!" Nobody in the data processing world is lukewarm about a text editor; the only shades of opinion that we find are dazzling white or ultra-black. What is it that makes programmers so vehemently pro or con? What do they look for in an editor?

To find any kind of an answer, we have to remember that professional programmers are under constant pressure to produce large and often complex systems within time frames that are established by non-programming managers and are often unreasonably short. A text editor, therefore, is a tool that can make or break a reputation—or a career. A powerful editor that is easy to use leaves the programmer free to concentrate on the logic of the program; a difficult or inadequate editor can slow down all phases of the work—source code entry, debugging, and correction.

Programmers are familiar with computers and are not deterred by cryptic commands, so they gladly sacrifice clearly marked function keys for control characters that lie right under their fingers. Source code format is simple, though unforgiving, so they willingly give up headers and footers (often supplied by assembler/compiler directives), justification, automatic indenting, and other formatting capabilities needed by writers, in favor of screen window power, i.e., cursor movement by character, word, line, or block, and window movement by line or block.



Programmers often work at all hours of the day and night, and constantly have to make many corrections in a hurry. Because of this, they are liable to make mistakes, and some mistakes can destroy data when the program is run. Thus, a garbage stack with something like an UNDO command is a treasure beyond all price. They want to pull verified routines from other programs, so multiple buffers are more than just a convenience.

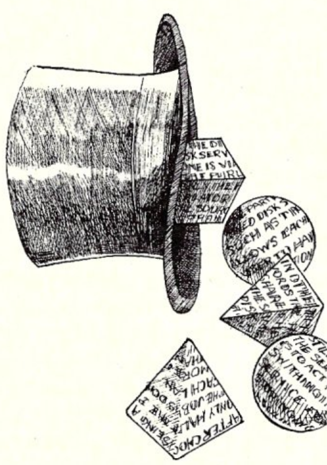
Apart from entry and correction of source code, programmers have to assemble or compile modules, link these together, and run the program, which are time-consuming processes. Thus, the capability of temporarily exiting from the editor to the operating system to create and execute a batch file, and then returning to the editor where it left off, is a most valuable feature.

Above all, programmers want macros, because these allow a complex series of changes to be specified in a couple of command lines and executed in jig time, without the necessity to display each change as it is made. Such changes are not confined to words or phrases; they can even be set up as a batch command to perform translation from one assembly language to another.

Just how far all these requirements can be met, and how easily the functions can be invoked, are matters of opinion that form the basis of the heated discussions that arise. The reviews of XyWrite and PMate that follow illustrate two approaches to providing editing tools that have both elegance and power. And the description of ROFF4, a public domain technical text formatter, shows one solution to the problems facing scientific and mathematical writers who must incorporate equations and special characters into their text.

XyWrite for Programmers and Writers

The *elegance* of XyWrite . . .



by Dave McCune

Like so-so singers trying to substitute sequins for skill, many next-generation microcomputer word processors substitute technological razzmatazz—windows, bit-mapped graphics, mice—for substance. Such software spangles are interesting only if they make a word processor faster and easier to use, not just snazzier and simpler to sell.

Thought, not technology, is the most important ingredient in good word-processing software. XyWrite II Plus proves the point. Without recourse to any faddish I/O pizzazz, XyWrite (pronounced **zi-write**) is the best word processor for the IBM PC I have seen. With ease and elegance, it handles all my varied writing needs: programs, letters, memos and proposals, and long book chapters. Its extraordinary repertoire of features is organized logically. It is incredibly flexible. At $295 (or $195 without mailing list and keyboard redefinition functions) it is better than any of the more expensive competition I have seen. I'll kill for my XyWrite.

XyWrite is not perfect. But its shortcomings are minimal compared to its achievements. Its worst weakness is its documentation, which is sometimes confusing, sketchy, and peppered with typos. (The XyWrite manual is a demonstration of the oft-overlooked fact that good word processors do not necessarily produce good writing.)

Installation is simple and takes no more than five minutes. All you do is copy several files onto your working system disk and type EDITOR. XyWrite is yours.

Learning XyWrite is a bit like puberty—tough to get through but worth the effort. The attractive manual comes with a slightly chatty tutorial which will teach you the basics in an hour or so. You should read the tutorial, at least, if for no other reason than to get familiar with the terminology used in the rest of the manual. Follow this with a few hours of simple memo or letter writing, and you'll be ready for XyWrite's more sophisticated features.

XyWrite is modelled on what is arguably the fastest word processing system ever built—the Atex text processing and composition system widely used by newspapers, magazines and other publishers. The Atex system runs on DEC 11/34s and caters to the needs of deadline-hounded news people. It makes extensive use of programmable function keys. And the video display is created from host-based video RAM, so it can be updated in a flash.

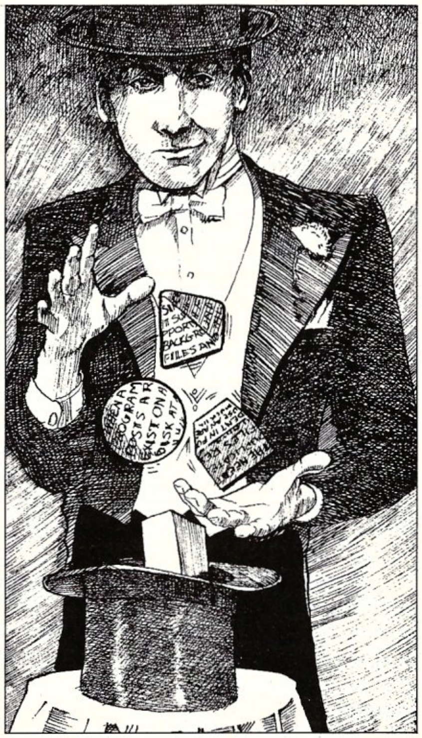
XyWrite's authors are former Atex employees who took with them an intimate familiarity with writers' needs. They also understood that in the era of micro-based, decentralized data processing, many Atex customers would snap up Atex-emulating PC software for remote bureaus and on-the-road writers. In fact, I first heard of XyWrite from friends at one of the newsweeklies. They use Atex in-house and now plan to use XyWrite for correspondents. XyWrite files are compatible with the Atex composition software, so copy written on a remote PC can be telecommunicated directly into the main Atex system for further editing and composition.

XyWrite is driven by commands and function keys, rather than menus. The IBM PC function keys are used extensively, some in non-shifted, shifted, control and alternate modes. The keypad keys control cursor movement. The key assignments are logical. The left-arrow key, for example, moves the cursor one character left, while the alt-left-arrow combination moves it left one word and the ctrl-left-arrow key jumps to the end of the line. Similarly, the del key deletes the character at the cursor position, while the alt-del combination deletes the current word and ctrl-del deletes from the cursor to the end of the line.

For larger entities of text, such as lines, sentences or paragraphs, the function keys can be used to define "blocks," which can be copied, moved, deleted and even associated with arbitrary keys for later easy recall. Unlike some word processors, the act of defining a XyWrite block is straightforward. The F1 key starts a block at the current cursor location. As the cursor is moved, text is highlighted. Another stroke of F1 ends the block. A single keystroke can delete, move or copy the block. And for clumsy or suicidal users, the alt-F3 key restores the last-deleted text, be it a single word or line or several paragraphs. (Are you listening, MicroPro?) Unfortunately, this restore feature is not of the garbage stack variety. The restore buffer only contains the last-deleted item, so if you delete two lines in rapid succession, the first-deleted line is gone. The PMATE text processor, by comparison, retains deleted items in a LIFO stack. Due perhaps to my heavy-handed typing, I prefer the PMATE approach.

Like its Atex cousin, XyWrite uses high-speed direct video-RAM I/O, so screen displays change nearly as fast as the eye can see.

XyWrite is generally a "what-you-see-is-what-you-get" program, so the display screen closely resembles the final printed output. Boldface and underlining appear as such on the video display. Sub- and superscripts, however, show up in reverse bold on the CRT, though they work fine on printers.



Like a skilled magician, Xywrite handles all my varied writing needs with ease and elegance.

Formatting commands such as margin settings and page breaks are entered on the command line. They take immediate effect in the text. The locations of these commands are marked in the text by small bright triangles. By pressing Ctrl-F10, the triangles can be expanded in the text to show their full content.

Some formatting functions—full right/left justification and multiple line spacing—do not show up on the screen. The Shift-F10 combination removes the triangles and previews the copy in a form almost identical to the final printer output. (On long files this preview formatting process takes several seconds, during which XyWrite appears dead.) Wide line spacing shows up here, though text will still not appear justified on both the right and left sides.

Both left and right margins may be set and reset at will throughout the text. XyWrite automatically reformats all text following any format command. You can thus switch between various formats within a single file; the format commands act like "ruler" lines on some other word processors. As the user enters or deletes text in a paragraph, the paragraph is immediately and automatically reformatted.

XyWrite files are stored as 7-bit ASCII. The only real carriage returns/line feeds are those entered by the user to end paragraphs. When written to disk, a XyWrite paragraph is one long line of text. Formatting commands are embedded in the text and are enclosed in the only non-7-bit codes used by XyWrite. Each formatting command begins with AEh (an ASCII '.' with the high bit set) and ends with AFh ('/' with the high bit set). XyWrite formats the ASCII paragraphs into proper screen displays as the user scrolls through the text of a file. Because the formatting commands are straightforward ASCII—**LM 5** sets the left margin to 5, for example—bracketed by AEh and AFh, programmers should have no trouble writing applications which produce or massage valid XyWrite files.

In order to use XyWrite as a program editor, the user simply refrains from entering any formatting commands. The margins can be set up to 255 columns wide, and each line should end with an explicit carriage return.

XyWrite handles both short and long files, though very long files that cannot fit in memory are swapped back and forth from disk to memory as the user scrolls through the file. To avoid this inconvenience, you can break your files into more manageable chunks of 50K or so.

Once you learn the basics, you are ready to have your socks knocked off by XyWrite's sexier capabilities. Here is a sampling:

Split screen. You can split the screen into variable-sized windows either horizontally or vertically. You can open one file in each of the two windows and scroll through either. Text can be copied or moved from one window to the other. As I am writing this article, for example, I have notes on the bottom half of the screen while I write on the top half.

XyWrite II-Plus

Continued from page 39

While two windows are great, I wish XyWrite would allow for more than two simultaneous text buffers. When using PMATE, for example, I sometimes hold several pieces of text (such as subroutines for a program or boilerplate for a letter) in simultaneous buffers.

Table-driven printer support. XyWrite supports a wide variety of dot-matrix and daisy-wheel printers. Special "printer output tables" are supplied with the program to control codes for the escape codes sent to effect underlining, boldface and so on. These files are easy to customize. Another table, called a "printer substitution table," allows you to substitute any arbitrary string of characters for any single character in a file during output to a printer. Thus, a zero with a backslash might be created on a printer by substituting the string *30h 08h 2Fh* (0, backspace, slash) for a simple zero.

If your printer is not supported by XyWrite and you can't figure out how to set up your own printer table, XyQuest will create one for you if you send them a copy of your printer's manual.

Table-driven keyboard definitions. The definition of every keyboard key—including non-shifted, shifted, control, caps-lock, caps-lock and shift, and alternate functions is determined by a keyboard table. Each key may be redefined. You might, for example, switch the locations of the IBM '^' and 'shift' keys, in order to fix an annoying quirk in the layout of the IBM PC keyboard. I have redefined the caps-lock and shift functions of all alphabetics so that a shifted letter while caps-lock is on produces upper case. I have also created a German/Swedish keyboard, which includes characters peculiar to those languages. You are free to redefine the function keys and keypad keys as well.

Save/gets. In keeping with one of the most valuable features of the Atex system, XyWrite allows the user to assign any arbitrary string of text or commands to a single key. Examples range from defining a key to insert the current date at the cursor location to having one key call a file from disk and enter a string of formatting commands at predefined locations throughout the file. These strings of text and commands may be saved to disk files and later retrieved and attached to keys (hence the name save/get).

Macros. Any string of valid XyWrite commands can be stored to disk, recalled and executed or attached to a keyboard key. XyWrite provides a poorly documented but very powerful "Extended Programming Language," which includes logical operators, conditionals, branching and looping, and assignment and storage of variables. This "language" is not as powerful as PMATE's macro facility (it doesn't allow bit-masking, for example) but it can be used to add many convenient functions to XyWrite. I wrote a simple macro, for example, which determines the number of characters between the beginning of a file and the cursor location and then divides this number by 6.0 (the average length of a word in my articles) to arrive at an approximate word count. I have attached this program to the alt-c key, so this simple command displays a current word-count. Another sample program is called STARTUP.INT. This macro file executes whenever XyWrite is started and can be used to define default formatting parameters and load default printer and keyboard tables.

With XyWrite you can split your screen into variable-sized windows.

Since XyQuest makes a point of not offering customer support for the Extended Programming Language, a newly-formed XyWrite users group may be a valuable source of ideas and help.

Modifiable help files. XyWrite provides brief on-line help in the form of four screens of command summaries. These screens are simply editable text files, so you can modify them to reflect new keyboard definitions or save/gets and macros you create. The only problem is that the help files provided with XyWrite are jammed with information, so you would be hard-pressed to add anything without deleting valuable help text. Unfortunately, XyWrite only allows four help screens.

DOS access. You can run DOS programs from inside XyWrite by means of a **DO xxx** command, where 'xxx' is an external program. You can even temporarily leave XyWrite by entering the **DOS** command. This leaves XyWrite intact in memory and runs

COMMAND.COM a second time. From then on you are free to use DOS any way you choose, such as to run a spreadsheet or a telecommunications program to retrieve a file. You can even run XyWrite again, effectively nesting it inside itself! You return to XyWrite by typing **EXIT** on the DOS command line. When you return, XyWrite has preserved your context, including any files left open when you entered DOS. One problem here is that XyWrite does not recognize DOS paths, so you must have COMMAND.COM in your default directory when you try to enter DOS. This is not as bad as it may seem since XyWrite allows you to switch DOS directories from inside the program. XyWrite seems to use DOS function 4B (Load and execute a program) for its **DO** command. So you can pass parameters and a pathname to your DOS program, but you can't execute a batch file this way. For that you must first enter DOS with the **DOS** command.

Math package. No need to reach for your pocket calculator for simple computations. You can perform addition, subtraction, multiplication and division on real numbers. You can enter the numbers either on the command line or in your text.

Form handling. You can create forms for data entry which permit the user to enter data only in specific parts of the screen. In combination with the Extended Programming Language, you could probably build a simple order-entry system, complete with field validation.

List merging. You can merge a list of information—e.g., addresses of customers—into specific fields of a form letter. You can identify the fields with names or numbers. When XyWrite prints a merged letter, it reformats lines to take into account the fact that the "name" field, say, may be long in one letter and short in another.

Footnotes. Numbered footnotes may be entered and edited. They can be output at the bottom of each page or at the end of a chapter or file.

Index and table of contents support. As you type, you can mark words for insertion into an index and enter phrases for building a table of contents. In the case of an index, XyWrite will extract the entries and print them in alphabetical order along with a page number. Entries for a table of contents are extracted and printed in numerical order by page number.

This list is just a sampling of XyWrite's capabilities. It has many other features which endear it to me, such as multiline headers and footers, widow and orphan control (conditional page breaks), status displays for page, line and column number (added to the current release at the request of users), direct jumps to specific page-line locations, column definition and moves, and on and on.

I have been hard-pressed to come up with serious deficiencies in XyWrite. Those I have found are rather picky. It would be nice, for example, if XyWrite provided a status display of current formatting and printing parameters, such as page-length settings and line spacing.

Basically, though, I like this program very much. It is the only full-function word processor on the market today that I think is really worth its price. It is refreshing to discover that even a software niche as overpopulated as word processing has room for creative programming.

Price: $295 (XyWrite II-Plus); $195 (XyWrite II). *Requires:* IBM PC or compatible, 128K RAM, 80-column monochrome or graphics display, one disk drive.

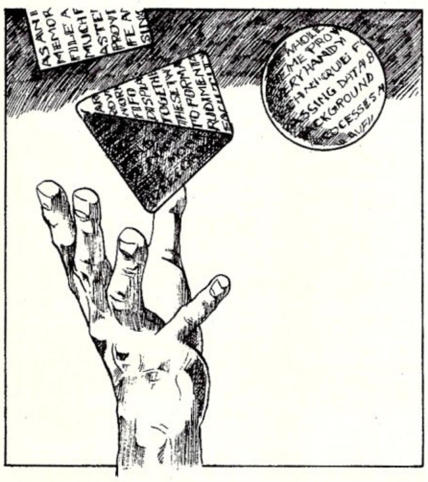
For more information about *XyWrite II-Plus*, contact *XyQuest, P.O. Box 372, Bedford, MA 01730; (617) 275-4439.*

CIRCLE 282 ON READER SERVICE CARD

Dave McCune, The Proteus Group, 195 Garfield Pl., Brooklyn, NY 11215

PMATE—The Programmer's Tool

The *power* of PMATE...



by Todd Katz

Once upon a time, before high-level languages made writing full-screen editors a teething exercise for junior programmers, there were only a few good screen editors. They lacked fancy screens, windows, pretty printing, online help menus, and good documentation. But they were small, nimble and portable in the noncompatible CP/M world.

Over the years some of these screen editors went the way of all silicon, while others became grown-up word processing programs. One well-known text editor, Mince, became the less well-known Final Word. Another, WordMaster, was a warm-up for WordStar.

A popular, if somewhat controversial, screen editor was—and is—PMATE, an acronym for Phoenix/Mike Aronson's Text Editor. Aronson is one of the more productive members of the East Coast microcomputer programmer community. Among his achievements are an early implementation of MS-DOS on the Godbout 8085/8088 S-100 system, and development of the first co-processor board for the IBM PC, marketed under the name Baby Blue.

Although Aronson's editor remains largely unknown to the general computer community, it has something of a cult status among serious micro programmers and in a surprising number of high-tech system programming shops.

PMATE, as it has evolved in the 16-bit MS-DOS environment, is popular for several reasons: it is simple to operate; it is compact and extremely fast; it is highly adaptable to different systems and editing styles and tastes; it allows you to edit files larger than memory; it offers multiple text buffers so that several files may be worked with simultaneously; it provides complete and easy access to the tree-structured MS-DOS 2.0 directory system; and it includes a powerful structured macro language that gives the user the power to create new, fully-customized versions of the program.

So much for the pragmatic. To me, the *real* reason for PMATE's popularity—there are nearly 5,000 registered users—has to do with its potential. You may never need to use 90% of its power, but if your livelihood depends upon your ability to manipulate source code and text, you will instinctively want an editor that can perform as many acrobatics as possible. In this area, PMATE—with more than 200 commands—has few rivals.

Granted, PMATE is not without its critics. The program is often faulted for its user interface, which can be exasperating; for its documentation, which lends new meaning to the term "terse"; and for its many commands and options, which, critics claim, can be more distracting than helpful.

Getting started

In terms of its initial operation, PMATE does present a short but steep learning curve. Part of the problem is Aronson's "nonstandard" control code arrangement. For example, in MicroPro's WordStar, a program that is nearly impossible to avoid learning, the control-E moves the cursor toward the heavens. Aronson, quite rationally, decided it would make more sense if the hand that pressed the control key did not do double duty moving the cursor. So in PMATE cursor up is control-Y.

What happens if you, the unsuspecting novice and card-carrying member of the WS.COM alumni society, press PMATE's control-E? Well... unless you've pressed control-T to tag the beginning of your block of text, your screen goes completely blank, without so much as a hint as to why—or, more importantly, how to get your program back (hint: try control-R to retrieve your text).

Another area of considerable confusion occurs when the newcomer attempts to exit PMATE without having to do a warm reboot. A graceful exit requires some knowledge of the three modes of PMATE—INSERT, OVERTYPE and COMMAND mode. The familiar INSERT and OVERTYPE work as you might expect. The COMMAND mode, however, generally operates from the program's command area at the top two lines of the screen. It is here that the logged-in file, if any, is named, and where the current buffer, line, and column numbers are indicated.

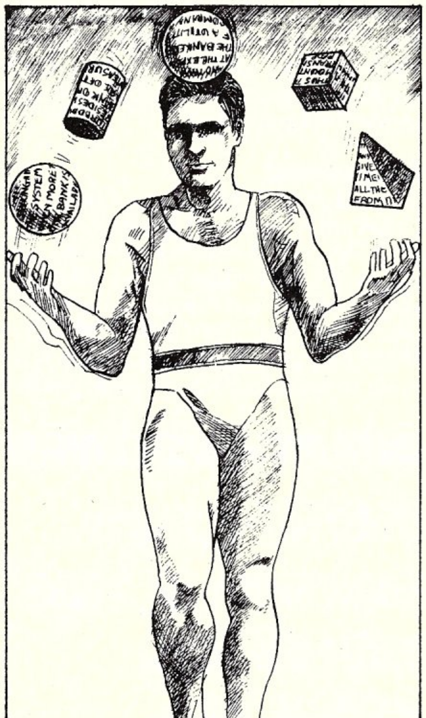
In the case of saving files or exiting the program in favor of the operating system, there are several "X" commands that offer the user considerable flexibility in exchange for a few minutes spent learning the system.

The more important "X" or file-oriented commands are shown in Listing 1.

Macros

Much advertising money is currently being expended on programs with "macro" capability—those which allow you to save strings of text under various function keys—or even to remap your keyboard for the Dvorak or other arrangement.

However, PMATE's combination of multiple buffers and command line strings are in many cases more useful, at least for the programmer. For example, the string **'printf ("%d'** can be loaded



You may never use 90% of its power, but you'll want an editor that performs the acrobatics PMATE does.

into a spare buffer and inserted into your text whenever it is needed either by pressing the appropriate function key or executing a two-letter command string. Multiple commands issued from the command line can be strung together and are executed only when the Escape key is pressed twice.

Thus a command to (1) save text to a filename, (2) enter another editing buffer, (3) get the text you just saved, (4) go to the end of the file, and (5) append another file could be as simple as

```
xotextname <Esc> b4e btg z
        xitext2<Esc> <Esc>
```

where **xo** saves the text to the file 'textname'; **b4e** enters buffer 4; **btg** gets the contents of the 'text' buffer, the main editing buffer; **z** goes to the end of the buffer; **xitext2** inserts the contents of the file text2.

The single Escape call marks the end of a string such as a search string or, in this case, a filename. The double Escape executes the entire command string.

Command strings can also be placed in editing buffers and executed. For example, if the above list of commands were loaded into buffer 5, the command

```
.5(Esc) (Esc)
```

from any other buffer would execute the command.

Using two- or three-character buffer management commands, such as B3K, it is possible to empty a buffer, get its contents or copy, append, move or "append move" lines from your current buffer to another.

Files larger than memory

PMATE also manages the issue of memory versus disk access quite nicely. In the latest versions of PMATE (3.37), the 24K PMATE.COM program resides in one 64K program segment, with approximately 60K of additional data segment memory reserved for text. Thus a text file of up to 60K can be held entirely in memory. This really speeds up editing large files, particularly on floppy-disk-based systems.

PMATE can also handle files up to 450K through efficient disk buffering, as WordStar does. There is also a special series of "manual" file control commands which allow you to read "pages" of text in and out from a large file, making it possible to manage files larger than memory in any buffer.

12 buffers

PMATE has 12 buffers and a dynamic garbage stack. Buffer 0 is a scratch buffer used for storing a block of text that is to be moved or deleted; buffers 1-9 are used to store various pieces of text, auxiliary files, macro instructions, help files, etc. Buffer T, the text buffer, is used for the main logged-in file (the only one that can easily exceed available memory). Buffer C is used for editing the current command line string.

The garbage stack can be set to hold up to 30,000 or so previously discarded characters, although the default

PMATE

Continued from page 43

setting is 2,000. The contents of the stack are popped in reverse order. For example, if an entire screen was deleted, it will be restored at once. If it was deleted a line at a time, it will be restored a line at a time.

Using a combination of command strings and file management commands, very sophisticated text manipulation is possible. Drawing on a personal experience, the entire text (450K) for a book on Basic was placed in single file to make it easier to make consistent changes in style.

Such an undertaking, using a supposedly sophisticated WP program such as WordStar, would have taken an operator many hours—if not days—depending upon whether the changes could be made globally, or if certain conditions had to be present before a change could be made.

By using PMATE, it was possible to execute 50- to 100-line macro command files from one of the unused buffers overnight and return the next morning to review a successfully accomplished task. Commands such as

```
ua Appledos (Esc) Apple DOS (Esc)
```

told PMATE to return to the top of the file and make a change throughout.

In addition to standard search and change commands, PMATE has five types of wildcards that allow you to search for any character in a particular position, any character but a specified character, literal characters, such as some control codes normally used by PMATE, or any of several types of word-ending sequences.

This made it possible to adjust boldface, italicized and capitalization for various words and phrases and to automatically create a consistent format for chapter headings where there had formerly been none.

Dynamic variables

The final portion of the task was to create about 25 20K files from the large file. This was done as part of the same command sequence using another of PMATE's features: dynamic variables.

PMATE gives the user up to 99 variables, each of which may be assigned any number less than 65,000. The variables can be automatically incremented or decremented and used in mathematical equations.

For example, the equation:

```
1235v24 @24/4\
```

sets variable 24 to 1,235. This variable is then divided by 4, and the result (308) inserted directly into the text by order of the \ macro command.

Using a variable that was incremented at the appropriate time, it was possible to create sequentially numbered files by sending a specified number of lines to a buffer and saving its contents under a filename that included a number which was automatically incremented each time.

Text command

In PMATE, there are several ways to accomplish nearly any task. First, there are the control codes. Although Aronson's editor has its own most favorite system, a companion configuration program called CONPMATE.COM will allow you to modify the program to your favorite key arrangement in a matter of minutes. My preferred arrangement provides a close emulation to WordStar's control-code command set.

PMATE is more than able to cope with difficult editing and text crunching.

The other means of executing commands is from the command line. For example, 4L (Esc) (Esc) will move the cursor 4 lines forward in your text. These commands are useful for those who enjoy editing from a command line or who have a repetitious task that needs to be automated.

Additional text-oriented commands allow you to move n number of characters, words, or sections of type forward or backward, or to delete n characters or lines.

The command language is also very handy when it comes to managing DOS 2.0 pathname directories from within PMATE. Using the standard DOS backslash, you can view any directory in the DOS tree and/or read, write, save or delete a file on another directory and change the logged-in directory.

Mathematical operators

PMATE can also do math from the command line, including quick conversions from hex to decimal to binary to octal and back again. Although there are no provisions for decimal places or exponents, negative numbers are permitted and remainder values from division can be captured. In addition to add, subtract, multiply and divide, logical OR (1), logical AND (&), logical complement ('), less than (<), greater than (>), and equal (=) can be used with up to 15 levels of parentheses for complex equations.

Operators

About 40 query operators are available to help program editors make more intelligent decisions about their text.

Commonly used operators include:

@c the current character number
@ffile -1 if @file exists
@k ASCII value of key struck
@m amount of working memory remaining
@p absolute memory address to which cursor is pointing
@t ASCII value of text pointed to by cursor Q operators.

Another group of operators—some undocumented—allow customization of PMATE "on the fly." These commands have proven to be particularly useful when using PMATE to create self-running demos illustrating prospective software products, and in creating menus for "turn-key" macros, such as one that can insert typesetting codes for a Compugraphic typesetting system when the user selects options for bold type, italic type and headline style.

Useful Q operators include:

nQD pause for n seconds
0QK do not create .BAK file
QR redraw screen
nQT send ASCII n to printer
Q# exchange tag and cursor
nQ^P set peek and poke to either data or code segment

A third set of operators allows you to: push and pop from a number stack; check for a particular key from the keyboard; insert a string into the text; set auto-indent to the current column; automatically increase or decrease auto indent by four columns; repeat the next keystroke 4 or a multiple of 4 (16, 64, 256...); also set or delete a tab stop, eliminate all tab stops, set tabs every n columns or replace tabs with spaces or replace spaces with tabs.

Structured language

Interesting textual commands, such as those mentioned above, are hardly rare in text editors. What makes them unique in PMATE is the ability to

Two word processors

At least two word-processing programs have been built around PMATE—PS, Murray Sargent's Technical Word Processor, and Bob Brown's Xergo.

PS Technical Word Processor

PS, as the name implies, makes use of the proportional spacing capabilities of the Diablo daisywheel printers. This is no small achievement. Most of the WP programs on the market all but ignore the more powerful features of Diablo-compatible printers. Although there are text formatters that do use those capabilities, one must have large supplies of both patience and paper to go through a series of essentially blind trials until the desired results are obtained. PS is, as far as I know, the first word processor which attempts "What you see is what you get" in terms of truly fancy proportionally spaced printing on a letter-quality printer.

Nor is it just an attempt. PS is a reliable, polished and speedy program with a refined user interface. In providing what its author calls "Screen Preview," PS users can instantly gauge line/page breaks and tabular text, make adjustments, and continue with the previewing.

$$\frac{\partial^2 \mathbf{P}(\alpha,\beta)}{\partial\alpha^2} = \mathrm{a}^3\mathbf{q} + \mathbf{b}\left[\frac{\dfrac{\beta^2}{\mathrm{y}^3+\beta^2} + \dfrac{\alpha^2}{\mathrm{x}^3+\alpha^2}}{\left[\dfrac{\mathrm{n}!}{2\pi\mathrm{r}(2\mathrm{n})!}\right]\exp(\mathrm{r}^3)\left[-\dfrac{\partial}{\partial\mathrm{r}}\right]^{2\mathrm{n}}\delta(\mathrm{r})}\right]^{1/2}$$

PS is a reliable, polished, and speedy program with a refined interface.

PS has an interesting history. Sargent, a perfectionist who leads a double life as a lazer physicist at the University of Arizona, is the coauthor of *The IBM Personal Computer From the Inside Out* (Addison-Wesley). He first implemented PS on a Z80 system four years ago. Then, as the years went by and 16-bit computers came into their own, Sargent fell in love with the Victor 9000 and modified his program so that the user could preview text in graphics mode as well as in preview mode.

This led to the development of BITMAP.EXE, a graphics screen driver that displays text essentially as it will appear on the printer—complete with fonts, boldface, underline, subscript and superscript. A companion program, SCROLLER.EXE drives the daisywheel.

Unlike PMATE, PS is completely menu driven. Text can be centered, left or right justified, and page margins can be redefined at any point to an accuracy of $^1/_{120}$ of an inch for the Diablos.

The program offers a variety of unique aids for the editor, including automatic insertion of the day's date, word counting, user-programmable keys, Greek and symbol characters available through the PC's Alt keys, automatic hyphenation, etc.

A special version of the program allows editors to create and preview academic papers complete with complex scientific equations using an extended character set—which Sargent has programmed for the Victor and for the IBM PC using the Hercules Graphics Card with a specially programmed EPROM.

If you really want to give PS a workout and you have nothing to do on a Saturday afternoon, you can even set your text to print in the shape of a circle, an hourglass, a square or almost any other geometric configuration.

More practically, PS provides for as many as seven type fonts simultaneously. After one pass, PS backs up through the appropriate number of pages (using a bidirectional tractor feed) and prints the next font.

Naturally, PS provides for page headers and footers and automatic page numbering. Different headings and footings can appear on even/odd pages, if desired. And, again using the tractor feed, multiple columns can be typed, viewed and printed.

PS also takes care of automatic footnotes, collecting all the footnotes on a particular page and printing them at the bottom after automatically reserving the required space.

As if all this weren't enough, PS comes with a mail manager (including an envelope addresser), an index generator, a forms processor and keyboard configuration program—all written in PMATE macros. There is even a macro for executing macros that reside on the disk rather than in PMATE's permanent macro area!

The source code for all the macros is available (neither PMATE nor PS allow the encryption or compilation of macro programs) and can be altered to fit the user's taste and needs.

Xergo word processor

Xergo, a creation of Landmark Software's Bob Brown, describes itself as "the new high-end wide-spectrum word processing environment for the IBM PC."

Brown, another perfectionist, has attempted to create the perfect word processor. In Xergo, control and Alt keys are given an ergonomic arrangement that calls for the left hand to control vertical movement of the cursor, while the right hand controls horizontal movement. The more frequently used commands are controlled by the index and middle fingers on their usual home keys. Deletion commands—to the line end, word, character, or the entire line—are controlled independently by the left hand.

Alt commands provide such special features as:

- Alternating between wordwrap, 'super wordwrap', auto indent or none;
- Block move/copy/type/write/delete;
- Column move;
- External PMATE macro execution;
- Help;
- Insert a new file into the text;
- Jump to a particular page number;
- Shift text window to right or left (up to 250 columns are allowed);
- Set margin and tabs;
- View file directory;
- Set up and execute your own commands.

Although the arrangement of commands would take some getting used to, Xergo provides high quality documentation including one of the nicest quick reference cards I have seen.

PMATE

Continued from page 44

put them to work through PMATE's interpreted text management language.

Macro commands can include statements nested up to 15 levels, using any combination of if-then-else, while, do-until, break, continue, return, label and goto statements.

For example, the instruction:

```
[sSECTION(Esc) 2p t p 1 #b4d]
```

will move the first paragraph of each section of your document into buffer 4.

When the individual commands are analyzed, the statement appears as follows: **sSECTION** (Esc) searches through the file for the string; 'SECTION' **2p** moves to the beginning of the paragraph; **t** tags the position at the beginning of the paragraph; **p** moves to the end of the paragraph; **1** moves down one line; **#b4D** duplicates text from the tagged position to the current cursor position and appends it to buffer 4.

The brackets at the beginning and end of the command cause the program to continue execution until an error condition is encountered—in this case when the Search command can find no more instances of SECTION.

If a number—3 for example—had been placed outside the opening brace, the macro would have executed only three times. If a question mark had been placed within the statement, we could have traced through the steps one command at a time using our trusty space bar. If a minus had been placed before the 's' command, the search would have been back toward the beginning of the text.

Because PMATE assumes that everything after the semicolon is a comment, the one-line instruction and the nine-line explanations are both usable macros.

Of course, the ability to write complex macros isn't very interesting unless they can be put to use easily and often. Aronson therefore provides a 'permanent macro area' for storing macros you wish to use again and again. Nearly 200 of these permanent macros can be installed within your customized version of PMATE for execution from the command line or through a function key or an Alt key on the IBM PC.

Macros can be set up to execute other macros, making it possible for the true fanatic to assign various commonly used macro strings to their own macro. This technique has been used extensively by PS and XERGO, two word processors written primarily in PMATE macros (see sidebar).

PMATE's permanent macro area, like its garbage stack, is adjustable up to about 30K on PMATE's MS-DOS version.

When it comes to displaying text, PMATE is extremely flexible. Screen width can be set from a few columns up to 250 and the adjustment is instantaneous following a command such as **132f**. The 'f' stands for format, and does double duty to toggle on or off the hard carriage return symbol.

In format mode, PMATE provides automatic word-wrapping facilities. An additional feature allows you to set independent margins, tab spacing arrangements, and automatic indent within your text as often as the material requires it.

For example, the command

```
^F110;r70;i30
```

will establish a left-hand margin of 10, right-hand margin of 70, and an automatic indent of 30 for any line that is indented to the 30th column.

Using this method, what you see is indeed what you get, although PMATE's printed page management facilities are not nearly as sophisticated.

A word should be said about the current state of PMATE development. The 8-bit version of the product has not kept up with versions released for the IBM PC and other MS-DOS machines. In addition, efforts are under way to convert PMATE to the C language, both for increased portability and in order to give the product windows. Another goal has been to allow PMATE to become a 'background task' for MS-DOS—so that it could always be resident—and to allow other programs to be executed from within PMATE. Such a move is critical for the future of PMATE as a product, since many programs coming to market in the next 18 months will offer these and other advanced features including, undoubtedly, advanced macro facilities.

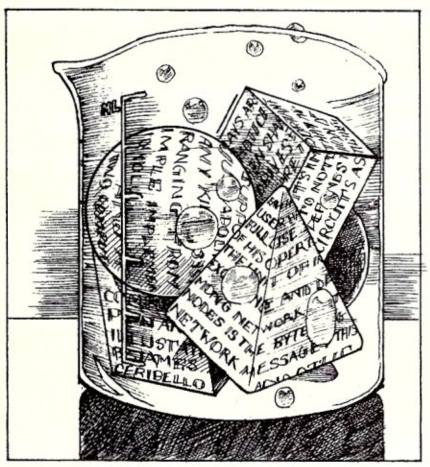
But, to end on a more positive note, the current version of PMATE has, in many hours of use, proven to be a reliable software tool that is more than able to cope with difficult editing and text-crunching tasks. In addition, using PMATE's interpreted macro language has provided a nearly painless way to practice simplified structured programming.

In my opinion, the program would be a valuable asset wherever microcomputers are used to manipulate text—at the programmer's workbench, in the typeshop, and at the office word processing center.

Todd Katz, 318 East 6th St., New York, NY 10003

Technical Formatting with ROFF4

. . . and the functionality of ROFF4.



by Ernest E. Bergman

Word processing has recently become more readily accessible through a number of commercially available software packages that run on CP/M-based microcomputer systems. Unfortunately, these packages are largely intended for nontechnical (mostly business) uses. I shall describe my efforts at achieving the additional capabilities that I need for the preparation of technical manuscripts, which require special characters and equations (I am a physics professor). This work has been placed in the public domain so that others may benefit from it individually, and so that manuscripts may be transferred in computer-readable form between different computers.

I would like to state at the onset that this software was developed to be very flexible and work with CRT displays, dot matrix printers such as the Epson MX-80, and with letter-quality printers such as the NEC 3525. Although I have supplied the source code of my program, which is written in the C language, the user should not need to change it to modify the formatter's output for different output devices. Virtually everything is table driven by files that the user can change at will with any text editor. Also, the input files are standard text files where the user would type a combination, such as ~p to produce the Greek letter, π.

The program has two kinds of output, the standard output (which contains the formatted text) and the STDERR (which contains diagnostic messages that will be sent to the console's screen). The standard output can be redirected in a manner similar to that of UNIX. To have the output go to the printer, it is better not to use control-P but instead to type:

```
A>ROFF4 ENGLISH )
```

The ')' achieves this redirection. Alternatively, we could have the output become a new file on disk, called, for example, PRETTY. This is simply achieved with the redirection symbol, '>':

```
A>ROFF4 ENGLISH >PRETTY
```

As described in Kernighan and Plauger, ROFF4 has reasonable defaults which you can change later, as I shall explain. The defaults relevant here are *filling* and *justifying*.

The formatter assumes, quite reasonably, that a paragraph is better preceded by a blank line or that it starts with an indented line. *Filling* consists of collecting words, possibly from several input lines, until there are as many words as can be fitted into one output line. Thus filled text is what is created by a secretary retyping a letter from a handwritten original. *Justifying* the text means that the spacing between the words is increased so that the last word is aligned flush with the right margin.

Dot commands

Having formatted ENGLISH by default, we may want to change the appearance of the output to suit our needs more closely. We may embed dot commands into the input file to suit our individual tastes. This means of instructing formatters has a long history. It was in use in 1968 on the IBM 360 TSS system at Princeton University (I know this only because my thesis was created there!).

For example, if there is a section in the middle of the text that should be set off by having the left and right margins reduced to, say, columns 10 and 50, and if, furthermore, we want single spacing, all this can be accomplished with the dot commands:

```
.LS 1
.RM 50
.IN 10
[text is here!]
.LS
.RM
.IN
```

Note: the ".IN 10" means "indent to column 10."

The last three (trailing) commands have no numerical arguments. The formatter I have developed interprets these to mean "return to the original values." Each of these variables (right margin, left margin, line spacing, etc.) is treated as a "stack." Thus '.LS 1' causes the line-space stack to receive (push) a 1 (perhaps superseding a 2). The .LS command, with no numeric argument, causes the last value, 1, to be removed (popped), and restores the previously commanded value (perhaps a 2). Default values appear when the stack is empty or underflows.

By the use of this stack mechanism, we can insert a block or module that has its own style and yet can revert easily to the style previously existing before the block.

There are quite a few dot commands (50 at last count). We can add additional customized dot commands by the macro facility that I shall describe later.

Characteristically, many of these commands are placed at the head of the text to create an "environment" and would be the same for many applications that require the same style, use the same output device and, perhaps, use the same kind of special characters and/or boilerplate.

To maximize flexibility, there are two ways to combine several input files.

In physics, manuscripts require special symbols. How do we print these?

To be specific, let us suppose we have created a file, STYLE, which contains a common set of commands that specify line spacing, etc., that we expect to use with many different manuscripts, including our original example, ENGLISH, that contains just text. To format ENGLISH using STYLE on our listing device (printer), we can type:

```
A>ROFF4 STYLE ENGLISH)
```

Analogously, a book might be created from a set of files (each one, say, a chapter called CH.1, CH.2, CH.3, CH.4) using a file specifying a style appropriate for our book, BSTYLE:

```
A>ROFF4 BSTYLE CH.1 CH.2 CH.3
  CH.4 )
```

Large projects should be broken into separate tasks because smaller files are usually easier to edit; the files could be on more than one disk drive if disk capacity were a problem. It is conceptually easier to add or rearrange chapters if they are clearly separate entities. One can rework and retype a particularly troublesome chapter without also having to print the material from satisfactory chapters.

A second way to combine files is with the dot command, .SO (source), which causes the formatter to stop taking input from the current input file and begin reading the file named by the .SO command: upon completion of reading in this new file, the formatter continues reading from the old file from the point where it left off. The operation is reminiscent of the GOSUB command in Basic. For example, a company might frequently place a lengthy disclaimer message somewhere in its reports. If the disclaimer is always the same (boilerplate) it could be a separate file, DISCLAIM.

An input file, say, REPORT, would read in the standard disclaimer at the appropriate place with the line:

```
.SO disclaim.
```

For uniformity and convenience, all filenames are converted to upper case by the formatter.

Special symbols

In physics, nearly every manuscript requires special symbols; for example, ϕ and θ are used often to represent angles. How can we print these?

One solution, which I have used but have found unsatisfactory, is to put them in by hand after the rest of the manuscript has been typed. The advantage of this method is that almost every word processing scheme works for text. The disadvantages are that it is time consuming to put in the symbols later by hand, error prone (since it is easy to overlook omissions!), and it does not look as professional.

The desirable solution, of course, is to print the symbols at the same time (and as automatically) as the rest of the text. The difficulties, which are certainly surmountable, arise in conveniently informing the formatter (in a readable way) which symbol we want and where we want it; and in getting the printer to create the necessary image.

How do we tell the formatter "which and where?" First, we must decide which special symbols are important to us; perhaps it is just a few Greek letters and a 'backwards 6', ∂. We have chosen the convention of using some character, the ~, to signal our desire for a special symbol. Then we could designate, for example, that ~a will be α, ~b will be β, ~g will be γ, etc. (That backwards 6, ∂, could be ~6). Let me emphasize that you can be the boss: if you want to use a flag character other than ~, you could change it to +, for example (and suffer the consequences) by using the dot command .TC (translate character):

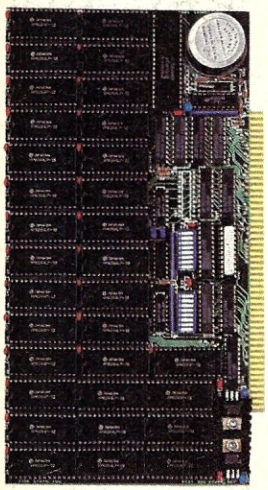
```
.TC +
```

What the formatter tells the hardware to do when you input a ~a depends on what you chose and what is possible. Suppose you want it to be an alpha, α. With a dot matrix printer you may be able to specify where each dot should be placed. With a NEC spinwriter whose thimbles can have up to 125 characters, you may be able to select just the right

SMÖRGAS

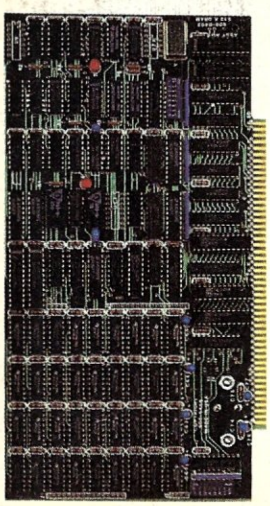
1 CPU 8/16

- Dual processors: 4MHz NSC800 (executes full Z80 instruction set) and 8MHz Intel 8088.
- Onboard floppy controller with 24-bit DMA. Runs up to four 5¼" or 8" floppies in any combination at the same time.
- 8K PROM monitor.
- 2 serial ports (software selectable up to 19.2K Baud.)
- Interrupt controller with 8 vectored interrupts.
- Real time clock interrupt.
- $895 (Manual only: $25)



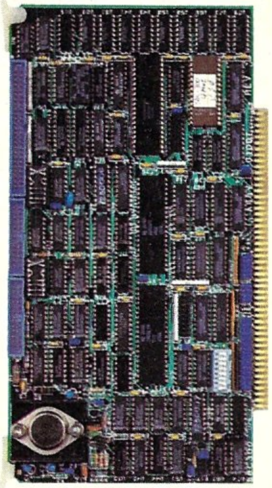
2 256K STATIC RAM/ TIME OF DAY

- Employs fully static CMOS memory chips.
- Accepts either 8-bit or 16-bit bus requests.
- Includes battery-backed-up time-of-day clock and calendar.
- IEEE-696/S-100 compatible.
- $1850 (Manual only: $25)



3 256K/512K/1MB/2MB DYNAMIC RAM

- Configurable as either dynamic RAM or as disk drive emulator.
- Accepts either 8-bit or 16-bit bus requests.
- Uses 256K chips for 1MB or 2MB configurations.
- 150ns. RAM chips.
- IEEE-696/S-100 compatible.
- Low as $850 (Manual only: $25)

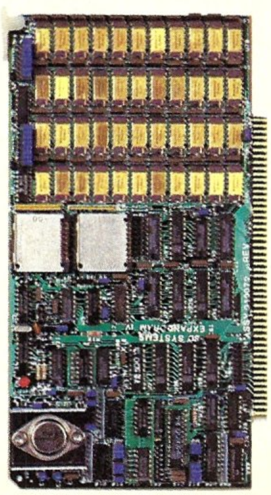


4 SBC-300

- Single board computer able to perform as permanent bus master or slave processor.
- Z80* CPU: 4 or 6MHz.
- 64K of dual-ported RAM with parity.
- 2 to 16K bytes of PROM.
- System memory addressing to 16MB.
- Serial, parallel and counter/timer I/O.
- SASI port.
- Dual programmable serial full-duplex channels.
- Supports CP/M* Plus, MP/M* and TURBODOS.*
- IEEE-696/S-100 compatible.
- $740 (Manual only: $25)

5 VFW-III

- Offers simultaneous control of up to three 5¼" Winchester drives (up to 16 heads) and four 5¼" and 8" floppy drives.
- Floppy drives may be single- or double-sided, single- or double-density.
- Data transfers under DMA or programmed I/O control.
- Phase lock loop data separator.
- 20-bit single and 4-bit double burst detection span on 256 byte sectors.
- IEEE-696/S-100 compatible.
- $895 (Manual only: $25)



6 EXPANDORAM IV

- Capacity of 256K RAM (using 64K RAM chips) or 1MB (using 256K RAM chips).
- DIP switch selectable addressing.
- Supports both 8-bit and 16-bit data transfers.
- Refresh control.
- Parity check.
- Optional error detection/correction.
- IEEE-696/S-100 compatible.
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SBOARDS

7 VERSAFLOPPY II

- Controls up to 4 floppy drives in simultaneous 5¼″ and 8″ combinations.
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- Operates with Z80,* 8080 and 8085 CPUs.
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- IEEE-696/S-100 compatible.
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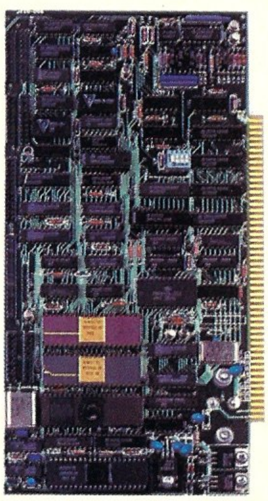

8 HARD DISK CONTROLLER

- 2 serial ports (software selectable up to 19.2K Baud).
- 1 printer port (IBM-PC* compatible).
- Supports up to four 5¼″ Winchester drives (ST506 interface).
- ECC/CRC
- Phase lock loop data separator (requires no timing adjustment).
- Full sector buffering.
- Includes both CP/M 80* and CP/M 86* BIOS.
- IEEE-696/S-100 compatible.
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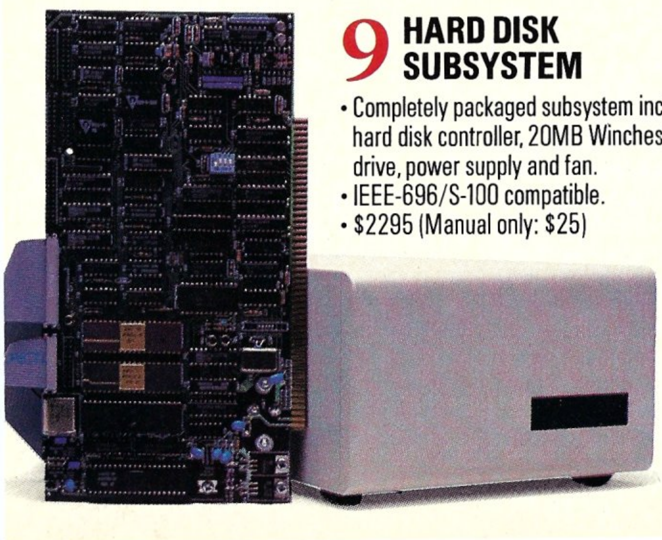

9 HARD DISK SUBSYSTEM

- Completely packaged subsystem including hard disk controller, 20MB Winchester drive, power supply and fan.
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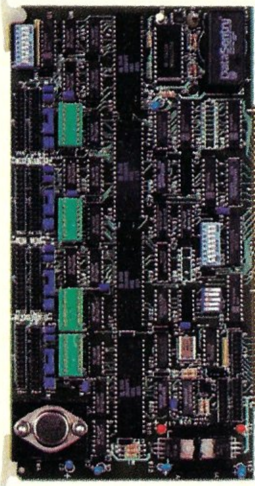

10 I/O 8

- Available in 3 versions: I/O 4 Asynch with 4 asynchronous serial channels. I/O 8 Asynch with 8 asynchronous serial channels. I/O 4 Synch/4 Asynch with 4 serial channels configured for synchronous or asynchronous and 4 asynchronous-only channels.
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CIRCLE 47 ON READER SERVICE CARD

ROFF4

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character. With my Exidy Sorcerer computer I can have 128 user-definable characters for my screen display; these characters are accessed by setting the parity bit. A simple impact printer might be able to "fake" an α by overstriking several characters, perhaps with special positioning. A simple CRT display might never make an α but, perhaps, could produce an "a" with reverse video.

Once you have decided what the output device should do for that α, you should figure out the byte or sequence of bytes that need to be sent to this device to get α. This sequence is placed into a translation table inside the formatter with the .TR (translation) command. Depending upon the circumstances, you may wish to describe the sequence of bytes in decimal (popular with Basic programmers), or in hexadecimal or octal (assembly language enthusiasts), or even in binary (good for dot matrix printers where each dot position is specified directly). The .TR command is followed by the following information:

1) The character that will be translated (e.g., if alpha is to be represented by ~a, then 'a' would be translated).
2) The number base, such as binary.
3) The sequence of bytes to be sent to the device (in binary, or whatever).
4) A "." to mark the end of the sequence; it may be made the start of a word, such as .EN.

Thus I have used the command to produce α on my MX-80 printer (with the Graftrax option installed):

```
.TR a binary; alpha,lowercase
00011011; ESC
01001011; 4B
00000110; 6 BITS
0        ; FOLLOW:
00011100; LEFT TOP,BOT
00100010
00100010
00011100
00100010
00000000; RIGHT TOP, BOT
.EN
```

To complete the explanation, the presence of the ';' and anything that follows on the same line is ignored by the formatter for commands such as this one—these are comments (like a REM in Basic). Comments are not a cure for complicated programming, but they are reminders to oneself (and are essential to give others a chance to figure out what you have been trying to do!).

Writing out commands such as the example above is not particularly fun; it needs to be done only once for a particular output device and symbol. By placing all the .TR commands for a device into a single file and giving that file a suggestive name, such as MX80, we can use that device for special symbols just by remembering the filename. Our previous example of the book would then be produced by the command:

```
A>ROFF4 MX80 BSTYLE CH.1 CH.2
  CH.3 CH.4 )
```

Then, whenever a ~a would occur in any of the input files, the printer

With the freedom to design your own symbols comes the responsibility of keeping track of your choices.

would receive the necessary instructions to produce an α. If you are fortunate enough to have a screen display that can produce an α when sent a suitable set of codes, great! But maybe you can and should settle for a reverse video **a**. In any case, you may wish to create a file with the suggestive name of SCREEN, CRT, or TV, which could be used instead of MX80 when you wish to see your formatted output on the screen.

I have tried to show how my table-driven formatter can be used to handle the thorny problem that arises because every printer and screen has a different way to create special symbols.

It is also possible that a different technical writer would have no interest in α but would like, say, an Å produced in response to an input of ~a. He would not only need different instructions for his output device, but should also make a different "wallchart"—a list showing which characters are translated into which special symbols—for his own use. With the freedom to design your own symbols comes the responsibility of keeping track of those decisions. To this end, the formatter has the option of producing a printed wall chart. This wall chart option is also useful to check the success of the symbol constructions. Options will be discussed in more detail later.

Printer controls

In the previous section I described how to create commands to the output device that produce a character of output. Here I shall describe how the printer is told to do things which do not correspond to advancing by one character position. Those of you who are familiar with WordStar may think of printer controls as "control-P commands."

I decided, in analogy to a translate character flag such as ~, to have a printer control flag. By default, it is ^, but may be changed with the .CF (control flag) command. A few of my choices may look like their analogs in WordStar (I have definitely been influenced by it!). For instance, ^H is used for a backspace, ^D to start doublestriking (double impression for each character), ^B to start boldfacing (triple impression for each character). We input two printable characters, ^ and H for each backspace, whereas many word processors (such as WordStar) use a control-H.

My philosophy is to use printable characters for input files wherever possible. The handling of actual control codes, such as used by WordStar, causes problems because some printers will use them, some will ignore them, and, generally, they are not as clearly visible as ordinary printable characters. Another advantage we gain is that we can define more flexible printer controls than the ASCII control codes provide. I have defined ^b and ^d (not to be confused with ^B and ^D) which *end* boldfacing and doublestriking, respectively. For ASCII control codes there is no separate upper or lower case.

ROFF4 has quite a number of built-in printer controls as tabulated below:

```
^B,^b start, end boldface
^D,^d start, end doublestrike
^U,^u start, end underlining
^X,^x start, end strikout
      (overwrite with '-')
^+    move up a fractional line
^-    move down a fractional line
^H,^h back up one character
      position
^(,^) note position, return to
      position #1
^{,^} note position, return to
      position #2
^(,^) note position, return to
      position #3
```

All these functions are achieved by ROFF4 requiring the printer to do a carriage return for going over the same line more than once. Of course, the printer must also be able to respond to line feeds (advancing a line down the page). It is particularly nice if the printer can be placed in a state where it advances a fraction of a normal line height; then the formatter can achieve a more aesthetic effect with super- and subscripts.

As it turns out, some of the algorithms used by ROFF4 appear to be superior to the built-in ones used by the Epson MX-80 printer with Graftrax added. In particular, the Graftrax enhancement enables the printer to carry out backspacing. There was a commercial formatter that carried out underlining by sending a character, a backspace, and an underscore, the next character, a backspace, an underscore, etc. Well, the fool printer would print the character, return the print head to the left margin, and advance to the old position to print the underscore. Thus, the print head went back and forth all the way to the left margin for every individual character that was underlined. It is a shortcoming of my printer that it always returns fully to the left margin when it receives a backspace.

ROFF4 has eliminated this stupidity. For the underlining example, the formatter would print the complete line without underlining and then do a carriage return (without advancing to the next line) and type the string of underscores. The logical print-seeking function in the printer is so obliging that if the first underlining is to start in the middle of the line, the print head will not return to the left margin, but only as far as needed to start the underlining! Since it is important to have the print head move as little as possible for the best printing speed (the printer is the slowest part of this formatter's execution), I developed algorithms that would optimize the operation of the MX-80 and would assume that my goal is sending it the minimum number of lines and no backspaces.

Backspace and reverse scroll algorithms

Because I had to develop the methods to control the printer effectively without backspacing and without reverse scroll (the printer must not be asked to back up toward the top of the page), I shall detail the algorithms here.

As I discovered, an awful lot of work is needed to add print controls to the text formatter with the print requirements described above. Quite a few aspects of the formatter had to be changed. I had to write routines that determined the printed height and width of the current line. Without this information, the formatter would place lines improperly on the page and the fill and right justification could not be done properly. At this time the formatter can determine how many levels of super- and subscripting will be used.

ROFF4 calls a function, **printout()**, to print out a buffered line including superscripts and other printer controls on the output device. First, this routine calculates "level," which is initialized for the highest superscripts. Printing a line with super- and/or subscripts is divided up into the iterative task of printing the highest superscripts, moving down the page a fractional line and adjusting level, printing the next lower set of superscripts, printing everything in that line and so forth until we have performed with level set at the bottom-most subscripts.

I had to develop methods to control the printer effectively, without backspacing and reverse scrolling.

At each value of level, **printout()** calls **flp()** (fancy line print) as many times as necessary to completely output whatever is supposed to be at that level. Several global buffers are maintained: UBUF, XBUF, and DBUF are needed by **flp()** to make several print passes if there is underlining, strikeout, double strike, etc.

For each new level, **flp()** counts printable characters by calling **lbc()**. A printable character is a letter, a number, a punctuation mark, or a special symbol. It is not a white space or a printer control, and underlining or boldfacing does not increase this count. Whenever this count is reduced to zero and UBUF, XBUF, and DBUF are "empty", **flp()** has finished printing that level. It is possible that there may be nothing to print at all on some intermediate levels!

The crux of my algorithms is to maintain several variables: a memory pointer to where the formatter is in the buffered line it is trying to print, a column count to where it would want to print the next character, and, finally, the actual location of the print head. In printing the line, **flp()** has the printing of each pass done by **prpass()**. The function **prpass()** scans the buffered line, looking at each character. If the character is a blank, it doesn't try to print it; it advances its buffer pointer and its column pointer, but it does not update the position of the print head (it has sent the printer nothing). When a printable character is encountered in the buffer, **prpass()** compares the desired position with the print head's position. If the positions match, **prpass()** prints the character and updates all three variables.

If the print head is to the left of the desired position, the formatter first sends enough blanks to the printer to position the print head correctly, then the character is printed and the variables updated. The third possibility is that the print head is too far to the right to print the character in the desired column. This possibility arises from print control requests such as backspacing; **prpass()** does not print the character on its current pass (it updates all variables except the position of the print head). Often, **flp()** will need to call **prpass()** several times before all of the current level is completely printed.

Every time a character is printed it is replaced in the buffered line by a blank and the count of printable characters is reduced by one. If the character is to be underlined or struck out, appropriate characters are placed in the UBUF and XBUF buffers. If the character needs multiple impressions (such as with double strike) it is copied into DBUF.

At the end of a printing pass, **flp()** checks to see if it needs to print out the UBUF or XBUF buffers (for underlining or for strike out). The buffered line will be printed again if the printable character count is still not zero. If characters had been placed in DBUF (for multiple impressions) they are recopied by **retype()** back into the buffered line, and **flp()** is invoked again.

Perhaps a simple example might help clarify what is happening. Suppose the line to be printed is: 'ab^H2c', which should come out as 'abc' with a '2' on top of the 'b.' On the first pass the 'a' is printed, then the 'b'. The backspace request, ^H, causes the formatter to want to type the '2' where the 'b' is located, but the print head is one location too far to the right. The printing of the 'c' can be done (the print head is in the correct position). The replacement in the buffer of characters already printed by blanks means that after the first pass, the buffer contains '   ^H2 '. On the second pass the formatter sees two blanks followed by the backspace request, so it wants to place the '2' at the

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second ('b') position; it sends out one blank and then the '2'. After the second pass the buffer contains ' ^H ' and the printable character count has dropped to zero; the formatter has completed the line.

The above algorithm has worked out well; the complexity of its implementation is in handling all of the different built-in printer controls—for example, the interaction of boldfacing, underlining, and backspacing. I have chosen to make the underlining bold if the character is bold; also, to underline characters printed in the first pass but not subsequent passes so that the underlining of an overprinted character is not made heavier.

The boldface and double-strike printer requests control a variable, MNCT, which is the number of impressions wanted (the default is 1). Each time a ^B is encountered the number of desired impressions is tripled; for ^D, it is only doubled. Similarly, ^d and ^b divide MCNT by 2 and 3 respectively. All divisions are integer so that $\frac{3}{2}$ becomes 1, etc. If the result of a division drops below 1, the variable is reset to 1. Thus it is possible to produce very bold letters formed with six or nine impressions by ^B^D or ^B^B, and we can stop multiple impressions with ^b^b without worrying that the following text would become invisible (with zero impressions!).

My success with the algorithms for printing a line with backspaces encouraged me to develop a somewhat similar approach for vertical line spacing. ROFF4 uses separate variables that keep track of which line it would like to be on and which line the print head is actually on. When it receives requests for line spacing, it updates the desired location but does not send anything to the printer. Only when it actually needs to print characters does it advance the print head to the line where the printer should be printing. Thus we can specify where the next main.line of text should be and yet back up our desired position after it is discovered that the line has superscripts.

As a last line of defense, if ROFF4 cannot print all the superscripts, it attempts to lower the main line to accommodate them. Failing that, the superscripts will be pushed down as far as necessary to print them out in any case.

Fractional lines

As I mentioned earlier, the formatter may wish to advance the print head vertically a fraction of a conventional line space to create more pleasing super- and subscripts. As I desire to support a variety of output devices, I have created special dot commands, .FR and .WH, that may be used to specify how to change the printer to fractional line spacing (and whether the fraction is $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, or $\frac{1}{5}$) and how to restore the printer to whole line spacing.

I made ROFF4 "table driven" so that any user can supply dot commands and form entries.

If these commands are not used, then all super- and subscripting is done with whole lines. Half-line spacing or third-line spacing generally looks better and should be implemented on printers with fractional line capability.

To use the .FR (fraction) command, specify the number of fractional lines that make up a whole line, the number base of the bytes code, the sequence of bytes to be sent, and, lastly, a token starting with a '.' to complete the sequence. The arrangement of information is reasonably analogous to that of the .TR command that I described earlier for defining special symbols. The .WH ("whole") command is of the same format, except that no number should be given before the number base.

Preprocessor capabilities

We may think of the formatter as passing the input files through three stages. The first stage—the preprocessor—will be described below. The middle stage—the basic formatter—decodes the built-in dot commands and takes text, fills and justifies it, and adds page headers and footers. The last stage—the postprocessor—was just described; it translates special symbol requests and printer controls into specific codes for the output device.

The preprocessor performs certain preliminary but very useful functions to the input before giving it to the main formatter. It is analogous to the routine used for line input from the keyboard, which removes the backspaces or rubs and the characters that were inadvertantly typed. The formatter processes the input line by line. While each line is being input, the preprocessor resets the parity bit on every character, so that input, such as might have been created by WordStar, will not confuse the formatter, which can now assume that all characters are in the range 0 to 127. The preprocessor expands all macros, which I will describe later. It replaces strings and register variables by their values, and will combine input lines if the first line is terminated by an unmatched insert character.

The insert character, whose default value is \, can be changed by using the dot command .IC. However, for definiteness, I shall assume here that it has its default value. This character is used primarily to surround strings and register names that the preprocessor is supposed to replace by their values. For example, a form for a memo might have only two items that vary from use to use: the date and a name, as in the trivial case below:

```
                              \date\
Dear \name\,
     I shall see you for lunch.
                            The boss
```

The boss has used this form for years and each time he uses it the date and name will be changed. The secretary (or the boss) can put the following string definitions at the start of this input file or another input file:

```
.DS /date/July 15, 1984/
.DS ,name,Joe Blow,
```

These definitions are delimited by whatever printed character first appears after the .DS command, here / and ",".

The preprocessor will convert the above form to:

```
                       July 15, 1984
Dear Joe Blow,
     I shall see you for lunch.
                            The boss
```

If either of these two string definitions is missing, then when the preprocessor encounters the undefined string name, it sends a message to the console inviting the user to define it by typing in the missing string value. Thus we have a quick way to fill out forms.

Primarily as an aid for enumeration, we can define named registers that can hold numerical information. The contents of these registers can be changed as the program progresses. For example, we might wish to number each equation from a register named e#. To create this register with the initial value of 1, we supply:

```
.RG e# 1
```

Subsequently, the equation

```
x=y+z (\e#\)
```

would be converted during the preprocessing phase to:

```
x=y+z (1)
```

Of course we want the next equation number to be one number larger, so we use the command:

```
.RG e# +1
```

which could be thought of as: e#=e#+1.

There is one reserved register name, #. It is used to access the current page number:

```
I am on page \#\
```

This convention enables us to create a table of contents or an index (as we shall see later).

Macro substitutes are the means by which several lines may be substituted for a user-defined dot command. The definition of .EN (equation number) could be done as follows:

```
.DM EN
(\\e#\\)
.BJ
.RG e# +1
.EM
```

The commands .DM and .EM are used to define macro and end macro. The \\ on input is converted to \, which means the evaluation of e# is deferred until the .EN macro is used (we do not want it to be evaluated at the time the definition is being created!). Later, any input line that is .EN will be replaced by the three lines:

```
(\e#\)
.BJ
.RG e# +1
```

At this time the \e#\ will be replaced by the current value of e#. Thus we can have automatic equation numbering, and our earlier example of equation formatting can be now written:

```
.BR
# x#=#y+z
.EN
```

It is also nice to have automatically numbered references (footnotes) and figure captions. Generally, these have to be collected together somewhere and reproduced at the end of the manuscript. The collection process is accomplished using the .DI (diversion) command to append text to the diversion buffer.

For example, we might wish to describe the illustrations as we encounter them as follows:

```
.DI FIGS
.LS 1
.CE
ILLUSTRATIONS
.SP 2
.ED
[later on...]
.DI FIGS
Fig. 1. Here is my pet pig...
.SP 1
.ED
[still later on...]
.DI FIGS
Fig. 2. Here is my cow...
.SP 1
.ED
[and so on...]
```

The above example is creating and adding to a file, FIGS, which contains:

```
.CE
ILLUSTRATIONS
.SP 2
Fig. 1. Here is my pet pig...
.SP 1
Fig. 2. Here is my cow...
.SP 1
...
```

This file can be formatted and output during the same run by having its name (FIGS) in the original command line that was used to invoke ROFF4, or by invoking it with the .SO command. In general, whenever a file is about to be accessed a check is made to see if it is a diversion file being built up; diversion files are closed for writing before they are to be accessed for reading. Details such as these must be considered in the construction of elaborate yet flexible formatters such as ROFF4.

Remember our book example? Here are two possible extensions to it if each chapter is generating references that are being diverted to REFS:

```
A>ROFF4 BSTYLE CH.1 REFS CH.2
    REFS CH.3 REFS CH.4 REFS)
A>ROFF4 BSTYLE CH.1 CH.2 CH.3
    CH.4 REFS)
```

In the former case, each access to REFS will show the accumulation produced by a single chapter; in the latter, the references from all four chapters will be collected together and printed at the very end.

The preprocessor alters the input text that goes to the diversions as well as to the main formatter. It is possible to use the string substitutions, registers, and macro definitions to alter what is being placed in the diversion files. Using the special register, \#\, (page number) is particularly convenient for diversions that will become a table of contents or, when sorted, an index.

I have touched upon the preprocessor's capabilities and suggested that macro definitions can be used to make

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custom dot commands that automatically do what would otherwise take a lot of extra keyboarding. Macro programming is as complex as any computer programming; I have certainly not gone into all of the details.

Command line options

I shall finish my description of ROFF4 by mentioning the options that may be specified on the command line. These options serve a variety of needs and provide diagnostics in case you are experiencing difficulties or want to experiment.

Options are specified by a '-' and a character. For example, to cause the formatter to stop at the end of each page and wait until the operator hits a key on the console, use the -S option:

```
A>ROFF4 -S STYLE ENGLISH )
```

This option is mostly used with printers that are being loaded with separate sheets of paper; the formatter waits for you to load each sheet. This same option can be requested from within an input file with the .ST (stop) command.

If you wish to send a form feed character to the printer so that it will eject paper to the next top-of-form (not all printers will properly honor this request), use the -F option. This option is handy at the start and at the end of a job when the printer uses continuous forms (fan-fold paper).

Most of the remaining options provide information such as the following:

-B turns on the "debug" flag so as to print out lots of diagnostics to the STDERR[console]. Probably only useful for those who are trying to trace the operation of the formatter for elusive bugs.

-D causes a list of diversion files to be typed on the console. Its main virtue is to remind the user what files are being generated and their approximate size.

-G causes a glossary of defined translated characters to be printed on the output device. It is useful to check the appearance of all special definable characters and to produce a wall chart of special characters available.

-I causes a list of string insertions to be typed on the console. This option is useful for macro writers, as is the -M option, described below; also, for noting the settings of standard substitutions, such as "today's date."

-M causes a list of macro definitions to be typed on the console. It is a useful tool for debugging complex macro packages where the preprocessor's expansions are too subtle for humans.

-R causes a list of number registers to be typed on the console (useful to find the number of footnotes, etc.)

The default option, -*, (the '*' could be any unassigned option) means keyboard input (buffered line by line with a prompt with the character used in the option, here '*'). Typing a control-Z indicates an end-of-file; the formatter will continue with the next named file. It is intended as a learning aid, since one can try out tricky input such as equations. As with standard CP/M, a control-P can be used to toggle the printer to display output that would normally be sent to the console; also, one can edit the keyboard input with the backspace key.

Summary

I have designed a text processor, ROFF4, for my needs as a physicist. Now I can conveniently prepare manuscripts with equations and special symbols. As I did not want to rework the software for different possible output devices, I have made the software "table driven" so that any user can supply dot commands to form entries.

Its use is convenient and understandable; I hope others will agree. If you have comments or questions about this formatter, contact me.

Availability

ROFF4 is being distributed as public domain software on a single-sided, single-density, 8" soft-sectored CP/M disk through *SIG/M* (as Volume 126); contact the *Amateur Computer Group of New Jersey* (ACGNJ), *Box 319, South Bound Brook, NJ 08880* and through the *C Users' Group* (CUG), *Box 289, Yates Center, KS 66783.* Both these groups distribute much good software at nominal charge.

Notes

Kernighan, B.W., and Plauger, P.J.: *Software Tools,* Ch. 7 (Addison-Wesley, 1976); also Kernighan, B.W., and Plauger, P.J.: *Software Tools in Pascal,* Ch. 7 (Addison-Wesley, 1981).

WordStar is a trademark of MicroPro International, Inc.

Ernest E. Bergman, Dept. of Physics, Building #16, Lehigh University, Bethlehem, PA 18015

Customizing WordStar 3.3

Become familiar with the new patch areas

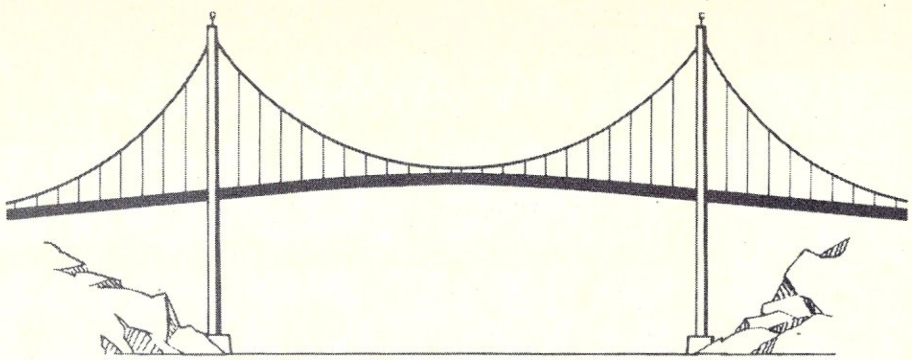
by Joseph Katz

Perhaps the most notable feature of WordStar 3.3 is the considerable increase in speed over previous versions. This has been achieved by tightening and optimizing the code, especially in the most frequently accessed routines. Other changes offer more help for the beginner, including an index to the commands; this added help has enlarged the program size by about 2K to a total of 18K.

As one would expect, the increased size has affected code locations, so that previously published WordStar patches are now unreliable as guides to version 3.3—especially when they deal with cursor movement and other keystroke command dispatch matters. WINSTALL.COM, a new installation program, further complicates matters for anyone trying to get version 3.3 running on a terminal and printer that are not on the installation menu, or trying to customize the new version for any equipment once the program has been installed. The problem is that MicroPro has programmed WINSTALL.COM to be so failsafe that using it to make extensive patches is a tedious job. Fortunately, there are ways to circumvent this.

The keystroke command dispatch table for both versions of WordStar is part of the USER3 area of WS.COM. Its label is VTAB, and in version 3.0 it occupies the space from 0481h thru 0647h; in version 3.3 VTAB starts eight bytes higher at 0489h. However, using that information, some simple mathematics, and an old set of patch listings will do you absolutely no good—and is, indeed, a recipe for disaster. The reason is that when version 3.3 was coded, MicroPro used the occasion to clean up the source. In version 3.0, for example, the keystroke dispatch code for ^L ("repeat the last find using the same arguments") was at 050Dh, sandwiched between two ^Q commands: SpellStar's "find and replace," and "start scrolling down." In V3.3, those two ^Q commands are in logical sequence and the ^L is defined elsewhere. Thus you cannot simply add 8 bytes to the V3.0 location of a patch and expect it to bring you to the same patch in V3.3.

The patch list PATCH33.ASM, shown in Listing 1, should make things clearer. It is designed to patch WordStar 3.3 for Radio Shack's TRS-80 Model II using Pickles & Trout CP/M. The idea was to make WordStar use much the same command logic as Radio Shack's word processing program, Model II Scripsit. That logic is



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WordStar 3.3

Continued from page 58

impeccable for the Model II keyboard, which has only two function keys, neither of which is programmable: F1 transmits 01h, the ^A that WordStar uses to move the cursor one word left; F2 transmits 02h, the ^B that WordStar uses to reformat paragraphs. So in Scripsit the ESC and HOLD keys—which transmit, respectively, 1Bh (the ASCII Escape code) and 13h (^S, ASCII DC3, or X-OFF)—carry a heavy burden.

They carry it well, and they do just as well in WordStar. The implementation in PATCH33.ASM uses the ESC key as the substitute for WordStar's ^K sequences, and the HOLD key as the substitute for its ^Q sequences. Those are the sequences that activate the so-called "Block" and "Quick" commands, which are the most frequently used triple-key commands. Reducing them to double-key commands—using keys that need not be depressed simultaneously—makes WordStar much easier to use with the Model II.

The Model II also has a set of arrow keys, so of course PATCH33 activates those. Moreover, any command that prefixes an arrow key with the HOLD key gives the cursor greater movement: to either end of the line, or to the beginning or end of the file.

One problem with patching any version of WordStar is that after the patches have been applied, the program's help screens no longer reflect the actual commands. That is not much of a problem for a Scripsit user who has seen the light and has converted to WordStar: the Scripsit emulation produced by PATCH33.ASM is good enough to make the transition relatively painless. One aid for that is the rekeying of the Block and Quick help screens so they are invoked with the ESC and HOLD keys. That is inelegant because the screens still display the old ^K and ^Q commands. If you alone will be using the patched WordStar, a few times of seeing the Block and Quick screens appear in response to the new commands should make the cause-and-effect relationship clear.

If you are patching WordStar as a consultant, however, your client has the right to expect more elegance. Certainly the screens should match the commands. Making them match is a nuisance, but with some time and ingenuity it can be done. The screens are in WSMSGS.OVR. Using DDT on it, you can easily figure out the locations of things that need changing, and then you can write a PATCHMSG.ASM to change them. Or you can use DDT itself

LISTING 1

```
;PATCH33.ASM              By Joseph Katz            30 October 1983
;  These patches are for WordStar 3.3. The target system is a
;Radio Shack TRS-80 Model II using Pickles & Trout CP/M. To adapt
;the patches for another system, change the code in the section
;marked ''+ + +  SYSTEM DEPENDENT EQUATES  + + +''
;  To use PATCH33, first assemble it using ASM.COM:
;         A>ASM PATCH33
;  Assuming you haven't changed any code, you will see:
;         CP/M ASSEMBLER - VER 2.0
;         05E6
;         000H USE FACTOR
;         END OF ASSEMBLY
;  Next, use DDT.COM to insert PATCH33.HEX into a WordStar .COM
;file, such as WS.COM:
;         A>B:DDT WS.COM
;  Again, assuming you haven't made large additions to the code,
;you will see:
;         DDT VERS 2.2
;         NEXT  PC
;         4600 0100
;         -IPATCH33.HEX
;         -R
;         NEXT  PC
;         4600 0000
;         -G0
;  Now, you are ready to save the patched WS.COM under an assumed
;name, so you can test it before erasing the old WS.COM and
;renaming the patched version. So, what we do is this:
;         A>SAVE 69 WSX.COM
;  If you have made large additions to the code, be sure to check
;the proper number of pages for saving the patched version.
;  Be sure to use a backup copy of WS.COM on a backup dis, and
;then test the patched version to make certain it is safe.
;
;  + + +  SYSTEM DEPENDENT EQUATES  + + +
BLOCK EQU    1BH            ;Char to call BLOCK cmds: replaces ^K
QUICK EQU    13H            ;Char to call QUICK cmds: replaces ^Q
UP    EQU    1EH            ;Up arrow
DOWN  EQU    1FH            ;Down arrow
RIGHT EQU    1DH            ;Right arrow
LEFT  EQU    1CH            ;Left arrow
;  + + +  END OF EQUATES: PATCHES FOLLOW  + + +

;  Coordinate the help screens:
      ORG    0489H          ;Start at VTAB
      DB     QUICK          ;Change QUICK help screen caller

      ORG    048DH
      DB     BLOCK          ;Change BLOCK help screen caller

;  Arrow keys:
      ORG    049DH
      DB     LEFT           ;Cursor left

      ORG    04A5H
      DB     RIGHT          ;Cursor right

      ORG    04B1H
      DB     DOWN           ;Cursor down

      ORG    04B5H
      DB     UP             ;Cursor up

      ORG    04B9H
      DB     QUICK,LEFT     ;Cursor to beginning of line

      ORG    04BDH
      DB     QUICK,RIGHT    ;Cursor to end of line

;  Change the way we do QUICK things:
      ORG    04C9H          ;Cursor to beginning of marked block
      DB     QUICK

      ORG    04CDH          ;Cursor to end of marked block
      DB     QUICK
```

WordStar 3.3

Continued from page 61

to make the changes if you know the ASCII code well enough to make the job less than staggering: there are, after all, lots of references to the commands to be changed by PATCH33.ASM, and DDT does not accept ASCII input. The simplest way to do the job on a one-shot basis probably is to use a byte-changing utility like Ward Christensen's DU, which does accept ASCII. With DU it's time-consuming but not difficult to adapt the screens in WSMSGS.OVR. That is where ingenuity plays a part.

In my installation I changed the cursor movement section of the Main Menu to read "Use the arrow keys as usual" and deleted (changed to 20h) everything else except the information about ^A and ^F, which still are used to move the cursor a word to the left and a word to the right. Then, because the Model II has no DEL key, I changed the delete "chr lf" indicator to ^-. As for references to ^Q and ^K, I simply changed those to "HD" and "ES": terse but reasonable.

Although the Model II is the specific target for PATCH33.ASM, it should be easily adapted to most machines. Just change the code at the equates with which the program begins. Then assemble it. Do not LOAD the resulting .HEX file, but instead use DDT to overlay it on a copy of the installed WS.COM file. The instructions for doing all this are in the heading to PATCH33.ASM.

The increased size of WordStar 3.3 has affected code locations.

Two more things to watch out for. First, use PATCH33.ASM *after* WordStar has been installed. Second, watch out when using WINSTALL.-COM to automatically install WordStar for a terminal: it seems to be buggy. If WS.COM does not function properly when installed from the menu, reinstall WS.COM using the "custom" options in WINSTALL.

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

```
        ORG     04D1H           ;Cursor to where last cmd began
        DB      QUICK

        ORG     04D5H           ;Cursor to where search or move began
        DB      QUICK

        ORG     04D9H           ;Cursor to marker 0
        DB      QUICK

        ORG     04DDH           ;Cursor to marker 1
        DB      QUICK

        ORG     04E1H           ;Cursor to marker 2
        DB      QUICK

        ORG     04E5H           ;Cursor to marker 3
        DB      QUICK

        ORG     04E9H           ;Cursor to marker 4
        DB      QUICK

        ORG     04EDH           ;Cursor to marker 5
        DB      QUICK

        ORG     04F1H           ;Cursor to marker 6
        DB      QUICK

        ORG     04F5H           ;Cursor to marker 7
        DB      QUICK

        ORG     04F9H           ;Cursor to marker 8
        DB      QUICK

        ORG     04FDH           ;Cursor to marker 9
        DB      QUICK

        ORG     0501H           ;Cursor to beginning of file
        DB      QUICK,UP

        ORG     0505H           ;Cursor to end of file
        DB      QUICK,DOWN

        ORG     0509H           ;Find
        DB      QUICK

        ORG     050DH           ;Find and replace
        DB      QUICK

        ORG     0511H           ;Do SpellStar's find & replace
        DB      QUICK

        ORG     0515H           ;Start scrolling down
        DB      QUICK

        ORG     0519H           ;Start scrolling up
        DB      QUICK

        ORG     051DH           ;Delete to beginning of line
        DB      QUICK

        ORG     0525H           ;Repeat next command until stopped
        DB      QUICK,QUICK

        ORG     0529H           ;Cursor to marker 0
        DB      QUICK

Change the way we do BLOCK things:
        ORG     056DH           ;Hide or display markers
        DB      BLOCK

        ORG     0571H           ;Mark beginning of block
        DB      BLOCK

        ORG     0575H           ;Mark end of block
        DB      BLOCK

        ORG     0579H           ;Write marker 0
        DB      BLOCK
```

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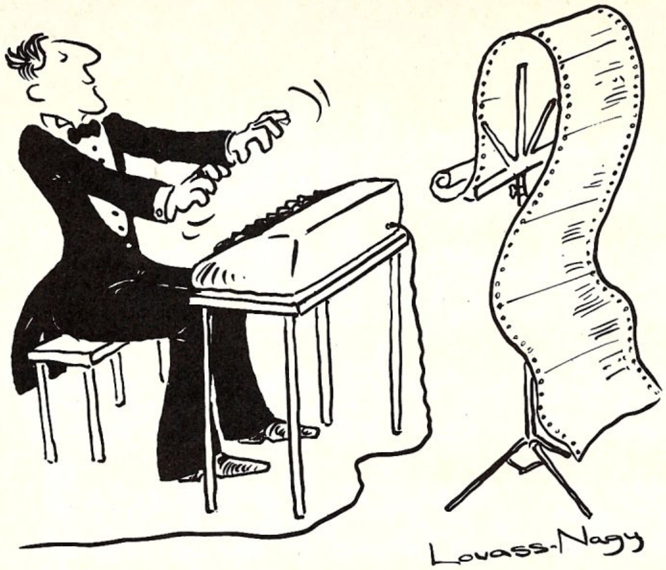
WordStar 3.3 *Continued from page 62*

```
        ORG     057DH           ;Write marker 1
        DB      BLOCK

        ORG     0581H           ;Write marker 2
        DB      BLOCK

        ORG     0585H           ;Write marker 3
        DB      BLOCK

        ORG     0589H           ;Write marker 4
        DB      BLOCK

        ORG     058DH           ;Write marker 5
        DB      BLOCK

        ORG     0591H           ;Write marker 6
        DB      BLOCK

        ORG     0595H           ;Write marker 7
        DB      BLOCK

        ORG     0599H           ;Write marker 8
        DB      BLOCK

        ORG     059DH           ;Write marker 9
        DB      BLOCK

        ORG     05A1H           ;Move marked block
        DB      BLOCK

        ORG     05A5H           ;Copy marked block
        DB      BLOCK

        ORG     05A9H           ;Delete marked block
        DB      BLOCK

        ORG     05ADH           ;Toggle column mode
        DB      BLOCK

        ORG     05B1H           ;Don't know what this does, but it's in
        DB      BLOCK           ;  the BLOCK code, so we change it

        ORG     05B9H           ;Save file and exit WordStar
        DB      BLOCK

        ORG     05BDH           ;Save file and done editing it
        DB      BLOCK

        ORG     05C1H           ;Save file and continue editing it
        DB      BLOCK

        ORG     05C5H           ;Abandon edit
        DB      BLOCK

        ORG     05C9H           ;Read from a file
        DB      BLOCK

        ORG     05CDH           ;Write marked block to a file
        DB      BLOCK

        ORG     05D1H           ;Delete file
        DB      BLOCK

        ORG     05D5H           ;Toggle directory on and off
        DB      BLOCK

        ORG     05D9H           ;Print file
        DB      BLOCK

        ORG     05DDH           ;Select disk drive
        DB      BLOCK

        ORG     05E1H           ;Copy file
        DB      BLOCK

        ORG     05E5H           ;Rename file
        DB      BLOCK

        END     PATCH33.ASM
```



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Include files supported—

Listing Control—allows listing of sections on the program with convenient assembly error detection overrides, along with assembly run time commands that may be used to dynamically change the listing mode during assembly.

Hex File Converter, included—for those who have special requirements, and need to generate object code in this format.

Cross reference table generated—

Plain English Error Messages—

System requirements for all programs: Z-80 CP/M 2.2 System with 54k TPA and at least a 96 column printer is recommended. Or 8086/88 256k CP/M-86 or MSDOS (PCDOS).

Cross Assembler Special Features

Z-8—User defined registers names, standard Zilog *and* Z-80 style support. Tec Hex output option.

8748—standard Intel *and* Z-80 style syntax supported.

8051—512 User defined register or addressable bit names.

6800 Family—absolute or relocatable modes, all addressing modes supported. Motorola syntax compatible. Intel Hex or S-Record format output.

6502—Standard syntax or Z-80 type syntax supported, all addressing modes supported.

8086 and Z-8000 XASM includes Source Code Translators

	Z-80 CP/M®	ZILOG SYSTEM 8000 UNIX	IBM P.C. 8086/88 MSDOS	IBM P.C. 8086/88 CP/M 86	OLIVETTI M-20 PCOS
8086/88 ASM			$ 99.50	$ 99.50	
8086/88 XASM	$199.50	$750.00			$199.50
80186 XASM *new*	199.50	750.00	199.50	199.50	199.50
16000(all) XASM *new*	199.50	750.00	199.50	199.50	199.50
68000 XASM *new*	199.50	750.00	199.50	199.50	199.50
Z80000 XASM *coming soon*	199.50	750.00	199.50	199.50	199.50
Z-8000™ ASM		750.00			299.50
Z-8000 XASM	199.50		199.50	199.50	
Z-800 XASM *coming soon*	199.50	750.00	199.50	199.50	199.50
Z-80 ASM	49.50				
Z-80 XASM		500.00	99.50	99.50	99.50
Z-8 XASM	99.50	500.00	99.50	99.50	99.50
6301(CMOS) *new*	99.50	500.00	99.50	99.50	99.50
6500/11 XASM *new*	99.50	500.00	99.50	99.50	99.50
6502 XASM	99.50	500.00	99.50	99.50	99.50
65CO2(CMOS) XASM *new*	99.50	500.00	99.50	99.50	99.50
6800,2,8 XASM	99.50	500.00	99.50	99.50	99.50
6801,03 XASM	99.50	500.00	99.50	99.50	99.50
6804 XASM *new*	99.50	500.00	99.50	99.50	99.50
6805 XASM	99.50	500.00	99.50	99.50	99.50
6809 XASM	99.50	500.00	99.50	99.50	99.50
8748 XASM	99.50	500.00	99.50	99.50	99.50
8051 XASM	99.50	500.00	99.50	99.50	99.50
8080 XASM	99.50	500.00	99.50	99.50	99.50
8085 XASM	99.50	500.00	99.50	99.50	99.50
8096 XASM *new*	99.50	500.00	99.50	99.50	99.50
1802 XASM	99.50	500.00	99.50	99.50	99.50
F8/3870 XASM	99.50	500.00	99.50	99.50	99.50
COPS400 XASM	99.50	500.00	99.50	99.50	99.50
NEC7500 XASM	99.50	500.00	99.50	99.50	99.50
NSC800	99.50	500.00	99.50	99.50	99.50
Subtotal	$ ______	$ ______	$ ______	$ ______	$ ______

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The AT&T 6300 Micro — It's More than a Clone

An in-depth review of the new AT&T entry

by Hank Kee

There is an old adage, "If it works, don't fix it." But competition is never far behind when you are the leader. Or, as Satchel Paige put it: "Never look back, someone may be gaining on you."

On June 26th of this year, AT&T announced with fanfare the Model 6300 PC. The news media had, prior to the announcement, reported it to be just another pretty clone. Some had predicted a possible demise of the product. But these rumors of an early death are gross exaggerations based on unconfirmed pre-release information.

The Model 6300 is manufactured by Olivetti for AT&T, and has a smaller footprint than the IBM PC. The system unit differs from that of the IBM PC in a number of very important, if less than obvious, ways. First, the system board is a big mother containing up to 256K of memory in the first two rows of memory chips (64K chips soldered into position). At a future date it will be possible to populate the third and fourth rows (which are socketed) with 64K chips, 256K chips, or an intermix of both. Currently, separate memory expansion boards are being delivered to bring the total memory space to 640K.

Second, the motherboard has the following *standard* items: a built-in clock and calendar with battery backup; a built-in diskette drive controller; an 8MHz 8086 microprocessor with a DIP socket for an 8087 coprocessor; one parallel port and one serial port.

Third, there are five 8-bit data bus connector slots and two 16-bit data bus connector slots to provide facilities for expansion. An eighth expansion connector is used for the dual mode display adapter. This connector and the other two 16-bit bus connectors each have two sockets per slot, somewhat resembling the Multi-bus board structure. The slot used by the display adapter is located at the edge of the motherboard. The 16-bit slots could be used for boards with an 8-bit data bus, provided that these stand clear of the second socket.

A close examination of the AT&T PC system board layout reveals an empty DIP socket adjacent to the 8250 I/O chip; this socket is reserved for future I/O enhancements. The ROM bootup routine examines the system for equipment availability before turning control over to the disk operating system. This procedure eliminates the nuisance of having to reset memory and drive configuration switches (including selection of hard disk drives) each time an optional function card is either inserted or removed. This makes the time required for cold boot considerably shorter than on the IBM PC.

No space is allocated for the addition of Basic ROM's. GW Basic is supplied on the system diskette; it appears to be a fully functional Basic, compatible with GW Basic as supplied for the IBM PC. As in the latter version, the undocumented SHELL command is included. The IBM Basic (of which GW Basic is a clone) traps MS-DOS function calls so that you cannot address screen and cursor control sequences via the operating system. GW Basic for the AT&T 6300 also traps function calls in the same way. Oh, well—if you want a clone system, you can't ask for more; you have to accept the deficiencies as well as the good features.

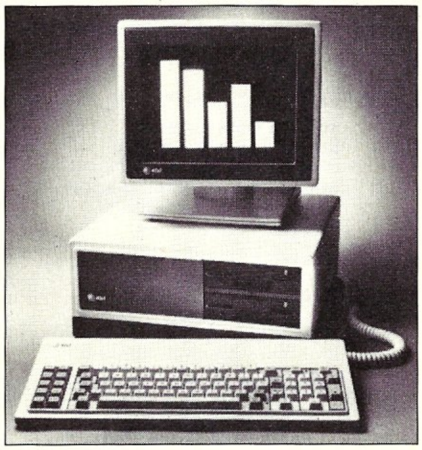
The system unit accommodates two half-height Toshiba floppy diskette drives or one floppy drive with a half height 10M fixed disk. The Toshiba diskette drives are very quiet and are properly shielded inside the system chassis. They are somewhat unconventionally placed, drive B: being located at the top and drive A: at the bottom.

A reset switch for cold boot restart is located on the lower front right hand side of the unit. Pressing this switch is much more convenient than turning system power off and on again when keyboard interrupt is lost; it also causes less wear on the PC since it eliminates the electrical surges caused by interruption of the 115VAC supply.

A detachable keyboard with three adjustable positions plugs into the system unit; it may also be plugged into the display unit, thereby minimizing the tangling of wires. The appearance and layout are similar to those of the IBM keyboard, except that LED lamp indicators have been added for NUM LOCK and CAPS LOCK. The responsive touch of the keyboard is similar to that of the IBM keyboard. The difference is that the Model 6300 keycaps are not sculptured—for the touch typist this may create a problem. To the rear right of the keyboard is a connector for either a joystick or a mouse.

AT&T offers a dual mode monochrome/color display adapter. The color resolution, with a modified operating system (supplied separately), is 640 x 400 pixels. The Model 6300 can be booted up with the standard IBM PC-DOS offering and runs without difficulty. The anti-glare display screen has a green phosphor capable of displaying graphics in monochrome. The display unit is mounted on a tilt and swivel base. Unlike the IBM PC, there is no flickering when scrolling in the 80-column color mode. The blinking of the IBM color monitor screen during scrolling has been a major annoyance.

With the exception of Context MBA (which requires the UCSD operating system) and programs dependent on the IBM Basic tokens, all available software seems to run without discernible differences other than speed. The Model 6300, with its faster internal clock, is quite noticeably more processor-efficient than the IBM PC when working with such applications as large LOTUS spreadsheets.



The 6300 cold boot takes considerably less time.

A context switch software option (available at an additional cost of $100) allows the user to suspend one task and initiate another. The primary purpose of this is to switch the mode of the 6300 from operation as a self-contained workstation to operation as a remote terminal of a 3Bx UNIX machine or vice versa, without loss of data.

A PC-Interface option board is available to link both Model 6300s and IBM PCs to a machine of the AT&T 3B Series in a LAN providing virtual diskette storage access. Peripherals attached to the 3B system can also be shared across the network. A PC user signs onto the 3B system as a UNIX 4400 terminal. Each PC terminal user signs onto the 3B system by entering user-ID and password. At setup time, file attributes can be defined to match user-ID.

The AT&T 3B Series are UNIX-based and are intended for office automation use. Rather than introduce another office automation software system, AT&T plans to market PC software that is written in C and ported onto the 3B Series. To many PC users, this permits upward extension of processing capability as the PC grows in system requirements. This is a welcome offering. Software systems available at press time are Ashton-Tate's dBASE II, Microsoft's MultiPlan and Microsoft's Word. Digital Research is currently migrating their software development systems onto C. This will serve to quickly expand the base of software for an office automated operating environment with PC-developed application programs.

The press has, in general, given the 6300 a very cool reception, probably because of a deplorable lack of understanding of the 6300's place in AT&T's overall plans. One major complaint is that the 6300 is "just another IBM PC clone" because it is only an MS-DOS or PC-DOS system rather than being UNIX-based. If it had been UNIX-based, the complaint would have probably been a lack of software. And far too little weight has been given to the features that give the 6300 both a cost and a functionality edge over the IBM: the standard 256K of memory, clock/calendar, and parallel and serial output ports; the 16-bit bus; and the context switch option.

Will the Model 6300 make it on the marketplace? I think it will. Having had the opportunity to put an AT&T-supplied demonstration unit through its paces since announcement date, I am impressed with the system. The list cost of a Model 6300 with 128K, two diskette drives and a dual mode display adapter and display is $2745. There is value added in that a complete system can be purchased in which there is dependence on only a single vendor. To many corporations, any requirement for maintenance by multiple vendors is a major (and threatening) issue. Over 60% of IBM PC's and over 85% of IBM XT's sold today are in the corporate environment, mainly because of single-vendor maintenance of the complete system. The issue of maintenance is not trivial, even for the single user—and where many systems are involved the nuisance of multiple vendor maintenance grows geometrically rather than linearly.

The Model 6300's ability to accommodate future 16-bit bus architecture is a major plus. Functionally, this machine appears to be near 100% PC-DOS compatible. A faster processor clock improves efficiency of compute-bound jobs. The hardware clock/calendar with battery backup automatically updates the system clock, thereby eliminating

Model 6300

Continued from page 69

the need to enter date and time on cold boot, and ensuring accuracy of file date/time stamping.

Moreover, the availability of a high-resolution color adapter compatible with the IBM color adapter provides additional functionality. We have also found that a number of add-on cards for the IBM PC work in the 6300 without any problems.

IBM may have created a de facto standard for personal computing by providing the technical umbrella. But clone units can gain market share merely by offering value-added functions. A primary example of this is the Compaq, which offers a dual mode display system: now we have a major competitor on the market presenting a virtual IBM clone with substantial value-added enhancements.

For more information, please contact *AT&T Information Systems*, 2 World Trade Center, New York, NY 10048; (212) 839-7433.

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DEC PRO/350: A Mini in Micro-Fleece

A powerful microcomputer for system development

by David Fournier

The secret is out. There are those who have claimed that the DEC Professional series represents a major advance in professional microcomputer development systems. This can only be true if the DEC Professional 350 is, in fact, a microcomputer. However, it is easy to see that this is all a hoax. The DEC Professional is really a minicomputer in disguise.

The fact that the PRO/350 sits on a desk top, has a user-friendly menu-driven operating system, and is priced competitively with some of the better microcomputers may fool the unsophisticated user into believing that this is a microcomputer. But once you have seen its computing power, realized that the menu structure is merely a disguise for its RSX-11M-PLUS multitasking operating system, used a few of your favorite programs from the PDP-11, and seen its extensive documentation, you will realize that you are getting the power and professional support that you have come to expect from minicomputers, but for the price of a microcomputer.

Packaging

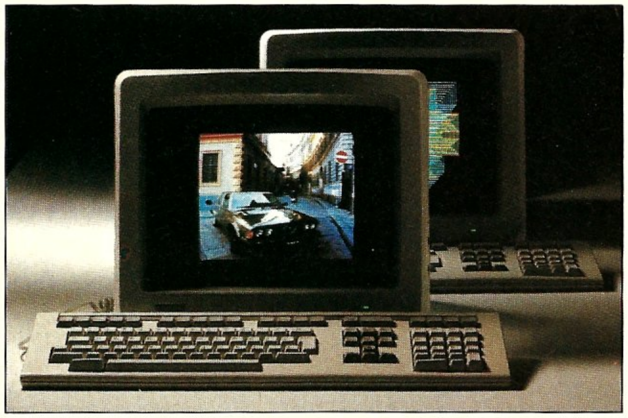
The basic system is composed of three units: a system unit, a monitor, and a detached keyboard. The system unit contains the two floppies and the Winchester hard disk, in addition to the CPU, memory, and other system options. Its physical size gives evidence of the amount of hardware inside. It is able to be used as a desktop unit, if you have a large desk (the unit is 22″ long x 14.3″ wide x 6.5″ high) or it can be stood on its side under a table if you buy the optional floor stand.

In either orientation, the system power switch and the two floppy disk drive doors are easily accessible. Moreover, the rocker switch for the power is recessed so that you do not have to worry about kicking it if you do stand it under your desk.

Access to the internal card cage for adding options is rather easy. The case has two latches, one on either side, which allow the cover to be lifted off easily. Inside is a fairly crowded but well-laid-out space. Everything is separately enclosed in sturdy metal protective coverings and grills, and all sections are mounted in a modular fashion for easy replacement. In fact, it is already practically a legend that no tools are required for either assembly or disassembly of the PRO/350.

At first glance, the card cage itself

resembles a fortress. It is entirely enclosed in metal, with only a single grill on the side even vaguely movable. However, this is all the access needed. The cards are mounted in an unusual way, which allows them to attach along their bottom edges, but still be easily removable from the side. Each card has a lever that can be pulled out and rotated 90° to free the card easily from its connector; then the lever serves as a handle to slide the card out of the cage. After initial shock at the appearance, I found the cards extremely easy to deal with. Reputedly, early units had transient failures caused by a tendency for this type of connection to loosen, but more recent units have a change that fixed this.



The detached keyboard is extremely large, with separate areas for standard alphanumerics, cursor keys, numeric keypad (also used as special functions for editing), and six separate groups of special function keys. The alphanumeric portion has a layout that is fairly standard. The only annoying factor was that the '<' and '>' keys were on a single key between the 'Z' and the Shift keys, rather than in their accustomed places above the comma and period. However, there is a good reason for this, as it eliminates the common problem of typing periods and commas with the shift depressed and getting something else. The feel of the keys for typing is fine. Keyclick was selectable on or off under setup menu control.

The CRT text display has many features selectable under control of the setup menu. These are accessible from the menu at any time via the Set-up function key and, include 80 or 132 columns x 24 rows, color or monochrome, normal or reverse video, configurable tab stops, selectable smooth scrolling, and other features. Taken together, the display, keyboard, and setup menu emulate a VT102 terminal, including the printer port option features.

The only problem I had with the display had to do with its color modes. If the system has a color monitor, it defaults to a tiring white-on-black color scheme. This can be defeated by selecting monochrome operation on the setup menu, in which case you get a very eye-pleasing green-on-black color scheme. Combined with its well-formed text characters, this makes a terminal that is easy to use for long periods of time.

The drawback is that in this mode, color cannot be displayed even by graphics programs. All graphics appear in green on black. And if you start running an applications program that requires color, you cannot then change back to color mode, since the terminal

PRO/350 gives you the power and support you'd find in a mini.

setup menu is not available from inside an application. The other approach, leaving the monitor always in color mode and setting the default foreground and background colors used by the menus to green on black, also does not work. Every time the application returns to the menus, it restores the original glaring white on black. The result was that I found myself using it in monochrome mode most of the time and to switching to color just before entering any color application, which was extremely tedious.

Hardware and options

The basic PRO/350 system comes equipped with a 16-bit F11 CPU chip set, graphics and text display interfaces capable of generating 960 x 240 pixel resolution monochrome graphics (or 24-row x 80- or 132-column text), 512K of system memory, two 400K floppy disk drives, and two RS-232/RS-423 serial ports (a communications and a printer port).

The CPU chip set is the same as that running in the PDP-11/23, 23+, 24, and the Micro/PDP-11, giving the PRO/350 unusually high processing power for a single-user system. It also has several features, such as memory management and hardware floating-point support, that are not very common in the microcomputer field.

Additional required hardware includes the keyboard and monitor. In addition to monochrome monitors in white, green, and amber, an RGB monitor is available for color graphics. This extremely high-quality analog RGB monitor sells for only $950 as a result of DEC's high-volume purchasing discounts from the original manufacturer.

Winchester hard disks are available in either 5 or 10 MB sizes, installed internally. Many software options require a hard disk, including the native toolkit described below. In fact, most of what is described below is not possible without it. This uses up one of the PRO/350's three available expansion option slots.

Adding an option called the extended bit-map option allows graphics to be displayed in the same 960 x 240 resolution, but in up to eight simultaneously displayed colors out of a palette of 256. This uses up another of the PRO/ 350's three expansion slots.

Other expansion options include a realtime interface module that has an IEEE port, two serial ports and a parallel port; memory expansion in 256K units up to 1 MB; and an additional CPU board to allow CP/M program execution. Obviously not many of these can be added to a system that has only three expansion slots.

The system reviewed had the hard disk, extended bit-map option, and the color monitor.

System integrators may be interested in a few other options. DECnet and Ethernet are both supported. DECnet, in fact, is supported in the operating system in the form of node names as part of a file or device specification to allow transparent network operations. Additional software is still required to enable operation, however. Ethernet support software is also available. This allows the PRO/350 to be interfaced to many large systems, especially DEC's own line of minicomputers and mainframes, far more easily than are most microcomputers. This could lead to much faster development time and greater flexibility in configuring large networking systems for business or financial applications.

Also, an option called IVIS for $4575 adds a videodisc interface that allows videodisc images, both frames and full-motion video, to be displayed on the normal PRO/350 color monitor in bet-

DEC PRO/350

Continued from page 73

ter-than-broadcast quality. All of the features of the videodisc player, including fast and slow motion and freeze frame, as well as addressability of the entire disc, are under complete program control. Furthermore, graphics and text generated by the PRO/350 can be overlayed over the video images on the screen.

This allows full interactive design that uses combined programming and videodisc capabilities to produce remarkable products. The applications stressed by DEC are primarily educational and training courses. In fact, DEC uses these systems in its own internal training. Other applications include informational systems such as in museums, or interactive ordering systems for automobiles, real estate, or other large items. Certainly the technology will spawn new types of applications as yet nonexistent.

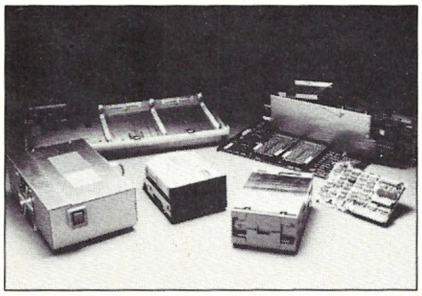
The price mentioned above gives you only the videodisc electronic interface. In addition, DEC offers complete systems with integrated software support for IVIS development, at prices ranging from $16,600 to $18,600, depending on whether you want the DECtouch touch-screen capability as well. Beyond even this, DEC offers a software package for the VAX called VAX PRODUCER for designing courseware to be run on an IVIS.

Software

The PRO/350 is available with a wide variety of operating systems. Those supported by DEC include P/OS, RT11, and the UCSD p-system. In addition, VenturCom offers Venix, a version 7 implementation of Berkeley UNIX. The system reviewed here had only P/OS.

P/OS, the standard operating system for the PRO, is a menu-driven operating system running under a version of RSX-11M-PLUS. The system is rather unusual, in that the system boots up and is self-contained within a menu system sufficient for most user needs, but has a command language available as an applications program from the menus.

The menus are well organized and very easy to use. Choices can be made in several ways. All menus are vertically oriented lists of choices, with an arrow indicating the current selection (initially, the arrow is located above the first choice, pointing to nothing). Within each selection, a key word or phrase is highlighted. Selections can be made by using the up and down arrow keys on the cursor keypad to move the selector arrow next to the desired choice. Alternatively, typing the first few characters of any of the bold phrases will also move the selector arrow to a choice as soon as the typed characters unambiguously indicate that choice. In most cases, this is a single character. Errors from typeahead are avoided by rejecting any character not part of a valid key phrase.



The system unit contains two floppies with a hard disk option.

Some menus have more selections than fit on a single page, or rarely used options that would only clutter the screen in most circumstances. These are denoted by a prompt which states that additional options are available, and are accessed by hitting a key called Additional Options.

Help is generally available via the Help key. Except in some applications, it is generally not context sensitive. The menu structure accessed by Help provides a list of topics that greatly resembles the structure used to access those topics from the main screen. Help is always exited with the Resume key, which returns the user where he started.

The menu system makes extensive use of the special keys on the keyboard, which, in general, is a good thing. After a short period of learning where all the special keys were, I found it refreshing that exiting a menu always required the Exit key. Resuming operation after requesting help always required the Resume key. Asking the computer to act on a selection always required the Do key. In fact, the system will generally take either Return or Enter in place of Do, but I tried to avoid the confusion arising in cases where it did not—and besides, the Do key was usually nearer and more convenient.

Within the menu system, you have access to most of the functions you would ever need. You can do standard file maintenance activities, including changing directories, backing up files to floppy, and copying floppies; you can print files and install, remove or run applications programs from the hard disk.

The PRO/350 has the same command line interpreter, called the Digital Command Language (DCL), that runs on other RSX-11M-PLUS systems. P/OS comes equipped with a subset of this language, which can be installed as an application. Purchasers of the Native Tool Kit described below get a complete version.

DCL gives the user the full command language structure normally available on RSX-11M-PLUS. As this is a sophisticated multitasking operating system, its command language needs to be powerful and flexible, and it is both. Fortunately, it is also easy to use.

The Native Tool Kit

If you wish to develop your own application programs for the PRO/350 and do not happen to own a PDP-11 or VAX, you need to buy the Native Tool Kit. For only $295, this has to be one of the best bargains in the industry. In addition to a full implementation of the DCL command language, you get the Macro-11 assembler and a whole host of utilities that you would pay a fortune for on other systems.

The full version of DCL provided with the tool kit includes standard file maintenance operations with far greater flexibility than is usually available on microcomputers. It includes commands to suspend, resume, and abort tasks and alter their priorities; commands to install, remove and run applications, including the ability to schedule them to run at specific times or after specific intervals; commands to run tasks or commands in background, to query system resources and status in many ways, to create logical names and assign them to devices, and to perform many other functions.

In addition, the tool kit comes with many of the following standard utilities, with which RSX users will be familiar:

DIFFERENCES allows files to be compared, with many options to allow certain types of differences to be ignored, or to change the criteria for how much must match before the contents are again considered the same. The differences can be stored optionally in a format that another utility, EDIT/SLP (pronounced "slip," for Source Language Input Program), can use to regenerate a later version of the file from the original and the file of differences. This may not seem very useful at first, but it forms the basis of DEC's standard system of maintaining, distributing, and installing software updates on its minicomputers. Although this method is not actually used by DEC to update releases of P/OS, it provides a powerful applications function for the user.

DUMP allows files to be dumped in a variety of forms, including various formats which decode the file system information stored in the file headers of each file. This can be important, since P/OS uses RMS file structures and can handle many file formats and attributes, including sequential, relative, and indexed file structures, fixed and variable record lengths, and many other attributes. The CONVERT utility allows files to be converted among these many formats.

EDIT would be familiar to DEC users as EDT, a full-screen text editor with a separate command line mode, on-screen help, extensive configuration and redefinition abilities (which can be initialized from separate setup files to allow differently configured editors for different applications), and edit command procedure execution abilities which allow sophisticated text processing programs to be written as EDT command files. Despite all this power, EDT is very easy to use for those who merely want to do some standard editing, and it is possible to learn the advanced features one at a time, as you need them. Of the dozens of text editors I have used, EDT is my personal favorite, with no reservations.

The PRO/350's memory management uses overlays to great effect.

EDIT/PROSE is an applications program that allows access to the PROSE editor supplied with P/OS. This is a much simpler editor, with far less flexibility than EDT. One of its main virtues is that its functions can be called by applications programs, as described below.

LIBRARY allows the user to create and maintain his own library files containing elements of many types. Several of these types can be automatically searched by various of the system programs provided. For example, macro libraries will be automatically searched by the assembler if specified in the command line. Similarly, the linker will search object module libraries.

LINK is another name for the standard RSX Task Builder, here called the Professional Application Builder. This is both the most powerful linker I have ever used, and one of the most difficult. To make things easier for the PRO/350 user, DEC has provided a command file called PROBLD which will build all of the files needed to link and install a simple task. If you do nothing fancy, there is no further work, and if you are only a little fancy, you can just do very simple edits to these files.

The main reason you need such a powerful applications builder is that the PRO/350 can address only 64K of memory at any one time. However, its memory management allows overlays

DEC PRO/350

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to be used to great effect. Most of the available system libraries used by a task, for example, are permanently resident somewhere in the PRO/350 system memory of 512K or more. These are all shared in a single area of your 64K task image by using the memory management hardware support to swap libraries in and out as needed. Similarly, user programs can create overlays to allow task image sizes greater than 64K; the extra code can then remain resident in another block of memory, or can be loaded from disk. All this allows programs that are much larger than 64K and use many system resources to run in 64K without much overhead. However, the penalty is that structuring large applications overlays and resident libraries can be a lot of work.

Program support

Even this impressive list of commands and utilities is not nearly the end of the support you receive for the $295 tool kit price. In addition, you get support at the programming level in many ways. For instance, you get the full capabilities of the RMS file system for handling all of the various file formats described above, including access to indexed files, for which you would need to write your own file handlers on most microcomputers. In addition, with the tool kit, you also get DEC's telephone hotline support.

For graphics programming, you get both a subroutine library for the ACM CORE Graphics and access to the GIDIS graphic virtual device interface, both of which will be described in greater detail below.

In addition, P/OS provides access to many of the functions provided or used by the menu systems. Programs requiring user text input can call the PROSE editor functions. Programs needing to communicate with other systems can make use of communications and call services, including the user's phone book of telephone numbers of other systems. Programs can use all of the facilities of print services to control printing of files.

Note that all of these services, including file, graphics, and operating system services, are supported in resident libraries that can all occupy the same space in the user task, due to memory management. The program will be no larger or slower than if the user had written all these routines himself.

Needless to say, all of these available functions can greatly speed program development time, since they represent common functions the programmer would often otherwise have had to write himself. In addition, this can serve to standardize the interface to the user, since the use of these same routines would cause your program to act much like the functions with which he is already familiar.

High-level languages are supported by the tool kit. Most of the functions described can be accessed from any of the various languages supported by DEC,

The PRO/350 has greater speed, greater resolution, and better color capability than most microcomputers.

including Fortran-77, Pascal, C, BASIC-PLUS-2, Cobol, and DIBOL. These are not, however, included in the price of the tool kit. They are available for $495 each. All of these languages are compiled.

In addition, DEC offers an interpreted PRO/BASIC language for $195. The graphics support for PRO/BASIC uses the same graphics routines as the compiled languages, and therefore runs about as fast; thus the interpreter can be useful for developing simple applications, or to quickly investigate how to do something.

Applications

In addition to the features and support of the operating system described above, DEC offers many applications packages.

Applications software specifically designed for the PRO/350 includes PRO/Communications, TK!Solver and several application packs, the MAPS/PRO financial modeling system, a spread-sheet called SUPERCOMP-TWENTY, PRO/Datatrieve and RS/1 data management systems, and several terminal emulators.

I had several problems with the first version of PRO/Communications that I received, but these arose because I got a prerelease version and did not have a manual. Once I received a properly working version, I found it very easy to use and quite powerful.

The only further problems I had were some annoyances in dealing with my Hayes SmartModem. The communications program did everything I needed, but I had to continually reenter the communications setup menu to switch modes from "modem," in which I could autodial, make connections, and talk to other systems, to "hard-wired," where I could talk to the modem itself. In modem mode, the program will not let you send characters out the communications port until a phone connection is made. In hard-wired mode, the program will not allow you to use the autodial features. This is inconvenient for situations where you have to send commands to the modem (e.g., for slow pulses) to set up dialing characteristics before having it dial. However, DEC does provide a configuration setup function to handle this.

In general, the interactions between PRO/Comm and operating system services such as call services were very convenient. This allows you to maintain a phone book of system telephone numbers and autodial them, then switch back to PRO/Comm or another communications package to actually talk to the other system, do file transfers, or whatever is desired. One problem might be the several layers of menu choices this mode switching requires. Some systems which hang up after a certain time without any input might hang up before you could establish communications.

In addition to PRO/Comm, there is a package called PRO/NAPLPS, which allows the PRO/350 to function as a videotex terminal. It requires PRO/Comm version 1.8 and operating system services to make its connection to a host videotex database. It can then function as a videotex terminal by passing frame requests to the host, and then decoding and displaying the returning NAPLPS graphics and text. It provides, with a few exceptions, the entire NAPLPS specification for minimum supported features for a videotex terminal.

Most of the exceptions are in areas not completely defined in the specification, such as proportional spacing and the interaction between user keys and system macros. One other major exception is in color capability. The minimum NAPLPS videotex requirements specify 16 colors out of a palette of 512, whereas the PRO/350 hardware only supports 8 out of 256. The difference between 256 and 512 shades is not really noticeable, but the difference between 8 and 16 simultaneous colors occasionally is.

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Of about 100 frame pages from the Viewtron database that I saw displayed on this system, several had misaligned text, since Viewtron depends on the proportional spacing capabilities of their particular hardware and requires greater support from their terminals than the standard really allows. The only really badly distorted frame was one that used more than eight very close shades, in combination with blink processes, to produce an animation effect; that frame did not work at all.

A related product, PRO/Videotex, allows the PRO/350 to function as a standalone videotex system. It allows the user to insert frame pages into videotex databases, extract and modify them, or view them on the screen. In addition, it provides management functions to maintain statistics on database accesses and produce reports. It can also be updated from remote databases in several ways. It can periodically call into remote systems and update its information automatically as a background task. This can reduce communications costs in heavy use videotex systems.

In addition to software produced and distributed by DEC, there are various packages produced and distributed by third-party vendors. The only application I saw from this group was 20/20, a new version of the SUPERCOMP-TWENTY spreadsheet package from Access Technologies. This is an amazingly powerful, flexible, easy-to-use integrated spreadsheet package with graphics capabilities. It has some very nice user interface characteristics, especially the ability to switch back and forth from spreadsheet to graphics, make modifications to either and see the results in the other. A menu structure similar to Lotus 1-2-3 allows you to select options for graphics and see the results of the graphics as you modify them. Previously, the minicomputer field, of which the PRO/350 is a descendant as far as software goes, did not have a spreadsheet to rival the best available in the microcomputer field. Now it does.

In addition to the packages currently available, you can expect to see a large number of programs migrated from RSX systems, since the operating systems are so compatible. MS-DOS, PC-DOS, CP/M, and the p-system are available for the PRO/350 as well.

Documentation

Unfortunately, I did not receive any of the user manuals normally shipped with the systems. Therefore, I am unable to comment on them directly. One rather indirect comment I can make, however, is that I managed to use the system quite nicely without them. Once a user is familiar with some of the basic concepts involved, the system is really very easy to run. After a relatively short period of time, I would expect that even a relatively naive user would put away his manuals and seldom open them again.

I finally did receive the technical manuals, and I am also very familiar with DEC's technical manuals from PDP-11 minicomputers. For better or worse, they are the same. Along with the developer's software for the system, I received six very large three-ring binders, several spiral-bound books, five or six loose three-hole-punched manuals, one boxed minibinder, and several loose sheets. The documentation is almost as voluminous as the system itself, and the system is not small.

This much documentation can be a bit overwhelming, but my experience with this and similar DEC technical manuals is that *everything* you need to

ATHENA/graph

ATHENA/graph is a presentation and decision support business graphics application program that accepts data from data base inquiry or spreadsheet programs and draws pie charts, bar charts, and line graphs. ATHENA/graph is available as Digital Classified Software, and may also be acquired directly from the developer, Ship Analytics, Inc.

ATHENA/graph was designed by Ship Analytics for the DEC PRO/350 with several objectives in mind. We wanted to build a highly interactive chart-making product with a minimum of typing demanded of the operator and a maximum use of graphics to ease the user interface. Secondary goals included providing an extensive on-line HELP facility, on-line editing of chart data, and support for a wide variety of graphical output devices—screen, printers, and plotters in monochrome, grey-scale, and full-color variations. Finally, we wanted to build the product to be portable to other Digital environments—VAX, Micro VAX, and Micro/PDP-11, and we wanted it to meet Digital's requirements for foreign language translation.

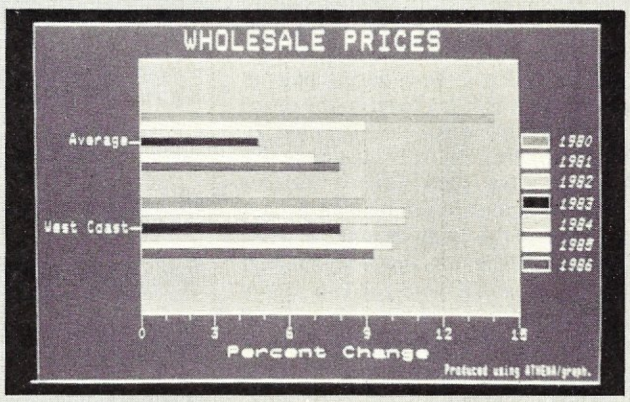
We chose the PRO/350 because of the rich set of tools available to the developer, and because of our familiarity with RSX-11M (the PDP-11 operating system that forms the basis of P/OS) and Fortran '77 (a programming language common to VAX, PDP-11, and PRO computers). For tools, we used FMS, a Digital-supported forms management package, to mediate the user interface and to provide the HELP function. We used the callable PROSE screen text editor to allow the user to enter new data or to change old data read in from a file (for example, a file containing the results of a PRO/Datatrieve query). We used RMS to support direct-access files that made the process of saving and restoring product chart templates and charts created by the user more efficient. We also used logical names as well as named directories and devices—features associated more with VAX/VMS than with RSX-11M. Within P/OS itself, we used such RSX multitasking capabilities as starting and stopping tasks, sending and receiving messages, and creating and mapping to dynamic regions of memory.

Our graphics display needs were diverse: rapid preview on the screen and both draft and presentation-quality hardcopy output, in color and black-and-white. These requirements place a demanding load on any graphics applications program. CGL provided a rich, device-independent programming environment. Its output primitives and attributes were sufficiently varied to let us create high-quality graphics output. We used CGL's support of user-defined character sets, and its ability to fill an area with any character from any character set to provide patterned fill of pie segments, bars, and filled areas under a curve on a line chart. When coupled with the PRO's extensive device inquiry capabilities, CGL allowed us to tailor the visual display requested by the user to the actual device selected for output. For example, the segments of a colored pie chart on the screen will automatically be converted by ATHENA/graph to associated patterned segments when routed to the LA50 black-and-white printer, thus preserving distinguishability without requiring any operator intervention.

CGL's HPGL device driver allowed us to produce high-quality plotter images either on paper (at high speed) or on overhead transparencies (at a slower speed). We were able to use the fill patterns on the plotters directly, through CGL; no software pattern emulation code was required. Because of the device-independent structure of CGL, the additional device support is provided with only a small amount of additional code. P/OS and CGL version 2.0 will provide us with a virtual device metafile for picture exchange, only minor changes being required in our code to initialize the metafile generator device driver.

CGL is modelled after the Core System, which has also heavily influenced the forthcoming American National Standard Graphical Kernel System (GKS) for programming graphics. GKS will be available with many systems, including an implementation for VAX/VMS developed by Digital.

So that ATHENA/graph could be used across various systems in the developing area of LANs, clusters, and distributed data exchanges, we decided to move the product to



the VAX/VMS environment. Our decision to use Digital- and industry-standard tools like FMS, RMS, CGL, and Fortran '77 allowed us to migrate to the VAX fairly easily. We had to convert P/OS machine-dependent functions to their VAX/VMS equivalents, and we converted all of the graphics to use GKS. The conversion went smoothly, but we look forward to GKS availability on the PRO to ease future development of products supported on these multiple-host environments.

We did most of our development using the Professional Tool Kit on a Digital PDP-11/34 minicomputer. We used Professional communications to send data files, task images, message files, and FMS libraries to the PRO. During most of our development phase, the Native Tool Kit was not available. Although we could have done the work entirely on the PRO, it would have been less convenient, because on the PDP-11 we had eight times as much disk space available, and because the PDP-11 under RSX-11M is a multiuser system.

In the future, we intend to develop new products in the ATHENA product line that take full advantage of the hardware and communications products that Digital is introducing. We will rely upon Digital to supply and support the tools; we can then concentrate on *our* strengths: designing and implementing integrated, user-friendly applications programs that provide cost-effective solutions to common business problems.

For more information, contact *Ship Analytics, Inc., Box 410, North Stonington, CT, 06359.*

Dr. Peter R. Bono was a principal designer of ATHENA/graph. He is Chairman of the American National Standards Institute Technical Committee on Computer Graphics, and is Chief US Delegate to the International Standards Organization Working Group on Graphics.

James T. Foster is a systems analyst for Ship Analytics, responsible for graphics applications product development on the PRO.

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know is in there somewhere. Organizing such a massive set of documentation is a difficult job at best, so finding the information you need is sometimes more difficult than determining it by experimentation.

The manuals are well written, but suffer from an almost unavoidable problem. In order to understand one part, you must use terms defined in other parts and make reference to still other parts. If you attempt to use these manuals as a reference, you must either already know much of the system intimately or follow a bewildering path of cross-references to try to learn the terms to understand what you originally looked up. Fortunately, it generally takes only a few such massive searches to gain sufficient familiarity to understand most of the manuals without reading almost all the rest. Probably the best way to approach it would be to actually read them all cover-to-cover once, and then use them as a reference. However, I have never met anyone who claimed willingness to do so.

The volume of these manuals is not unwarranted. There is not a great deal of extraneous information, nor long-winded or redundant explanations or examples. The problem, if you consider it a problem, is that DEC gives you so much software support and access to so many facilities of their system software that it takes all these volumes to explain it all. Personally, I think the unwieldiness of the documentation is a small price to pay for its completeness and the level of support provided.

Interfacing

Until a few months ago, the CTI bus used by the PRO/350 was proprietary and not available for licensing. Now it can be licensed, and several companies have done so, but sufficient time has not yet elapsed for products to reach the market.

The only problem I see with other vendors making expansion options for the PRO/350 is that it has so few slots available. The system reviewed had only standard hardware for a professional graphics system, but only a single expansion slot was available because the hard disk controller and color option took up two of the three slots provided.

Graphics

One of many ways in which the PRO/350 surpasses most microcomputers is in its graphics capabilities and support. Compared to most systems, the PRO/350 has greater resolution, greater speed, better color capability due to color mapping, and certainly far superior software support.

Graphic hardware capabilities

The PRO/350 comes either with monochrome or color graphics at an overall price difference of about $1600. Both the monochrome and the color version support graphics at a 960 horizontal x 240 vertical resolution. The color version allows up to eight colors to be displayed simultaneously out of a pallette of 256.

The Native Tool Kit lets you develop you own applications programs.

The curious decision to provide four times as much resolution on the horizontal axis as on the vertical axis allows the PRO/350 to display legible text characters in a 132-column format, but it also yields a graphics display rather difficult to characterize in terms of quality. In its vertical dimension, it belongs to the realm of "low resolution," while in its horizontal dimension it classifies as "high resolution." This difference is easily noticeable on the screen. Circles, for example, look well formed on their sides, but are noticeably flat and jagged on the top and bottom. This generally lends a quality of appearance somewhat less pleasing than a medium-resolution system with a similar number of pixels distributed more evenly between the two dimensions.

The color capabilities, however, turn this into a system capable of creating far more pleasing images than almost any other microcomputer product. In addition, the floating-point hardware support plus the rich instruction set and speed of the CPU make the performance of this system rival those with graphics hardware support in all but the simplest primitive functions. Rather than attempt to be the best at any one area and neglect the others, the PRO/350 attempts to be among the best in all areas. The PRO/350 is likely to be the best microcomputer graphics system available for all but the most specific of applications requiring extremes of ability in a given area, regardless of performance in others.

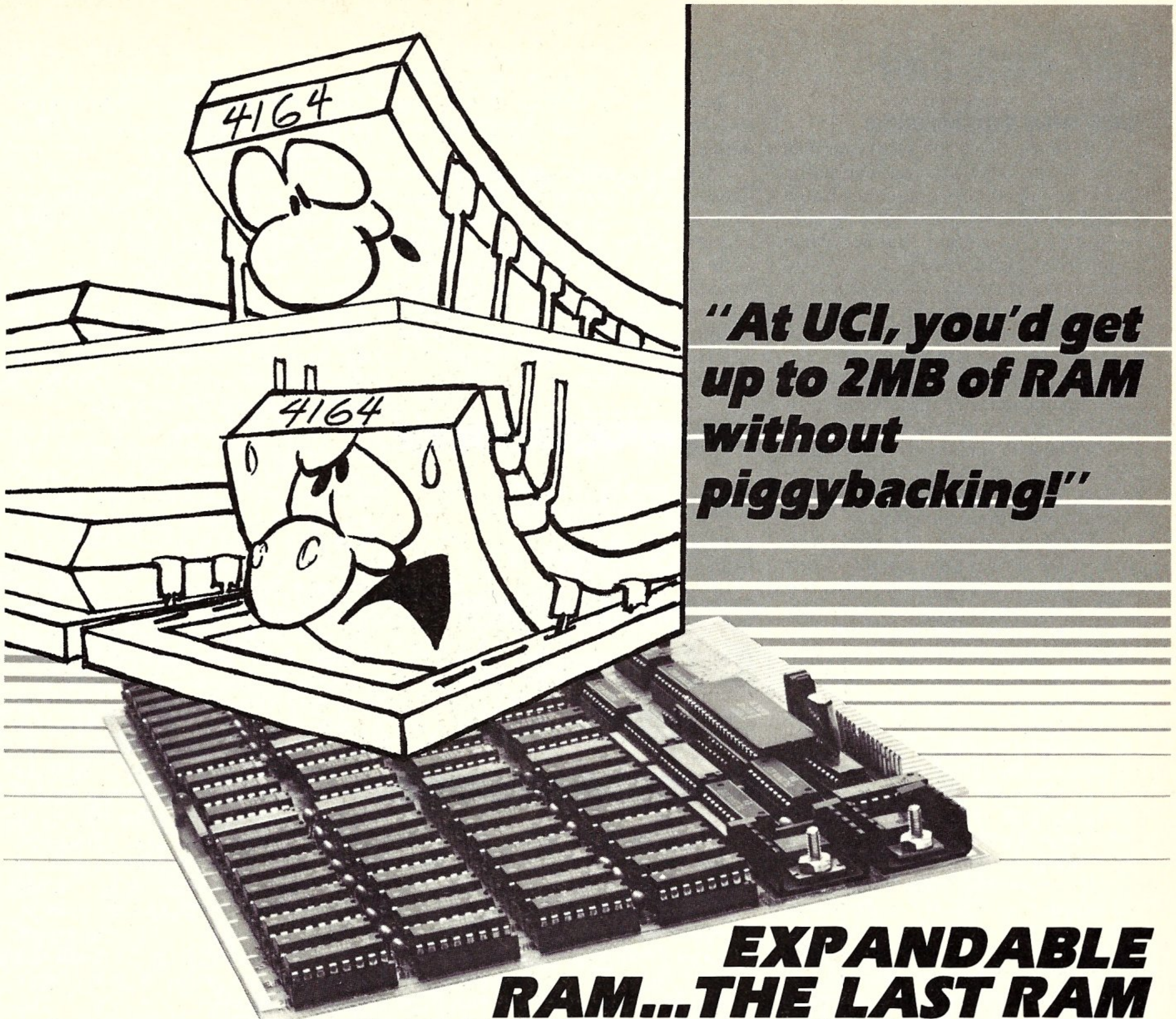
The earlier segment of this article, comparing the PRO/350 with two other systems (*Microsystems*, July 1984, p. 66), presented the results of several benchmark programs on the PRO (reprinted here). These results show clearly the performance power of the PRO/350. In all but one case, the PRO/350 is comparable to or exceeds the performance of the other systems, despite the other systems having hardware graphics support. The only case in which the PRO/350 loses severely is one in which almost no calculations are performed and the graphics functions are very simple primitives supported directly by the 7220. The PRO/350 is even competitive in the benchmark comparing the drawing of circles, despite the fact that this is a primitive supported in hardware by the 7220, because the performance of the PRO/350 was so superior with respect to the calculations in the remainder of the benchmark program.

Graphics software support

Perhaps the area in which the PRO/350 excels most is software support, and it is no different in the case of graphics software. The tools provided by the PRO/350 to support use of its graphics, not only on the screen, but in the form of several other output devices, are truly awesome. They are definitely unmatched anywhere else in the microcomputer field.

Table 1. Benchmark times, interpreted and compiled (in seconds)

	NCR PC		DEC/PRO 350		Mindset
Benchmark	Int.	Comp.	Int.	Comp.	Int.
Sieve of Eratosthenes	27.1	0.35	24.4	0.30	15.3
Circles	124	14	27	23	9.0
Quadrilaterals	265	1.0	25	20	5.8
Filled quadrilaterals	4450	83	62	57	102



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GIDIS virtual device interface

Virtually all graphics that ever take place on the PRO/350 pass through a low-level virtual device interface called GIDIS. What this represents is a graphic standard so robust that all other graphics or graphic standards implemented on the system form a subset of the GIDIS commands. All other graphics functions, including the functions of PRO/Basic, the Core Graphics Library, NAPLPS, ReGIS, and Tektronix 4014 emulation, are implemented in GIDIS. They consist of a set of routines which translate commands in their own individual formats into GIDIS commands, and then hand them to the GIDIS virtual device interface.

The programs are not concerned with which device their graphics commands are to be displayed on. They merely "display" their graphics on the GIDIS virtual device. GIDIS itself contains drivers for multiple devices. It is capable of taking those same graphics commands and displaying them on the video display (monochrome or color), on the LVP16 six-pen plotter (which is totally compatible with the Hewlett-Packard 7475), or on the LA50 or LA100 dot matrix printers. In addition, it can store the GIDIS commands in a file to be displayed at a later time on any device.

These possible options for where the graphics can go are under either software or user control in several ways. Both the Core Graphics Library and the GIDIS interface contain commands to select one of the available supported hardware devices as the current 'viewing surface.' Then all subsequent graphics commands passed to GIDIS will be executed on that device.

Note that several features must work differently on various devices. Area fills on a plotter must be done by hatching, rather than solid fills, to avoid soaking the paper. Colored lines must be distinguished in some other way on a monochrome display or dot matrix printer. The good news is that GIDIS does these things for you. It will do the best job it can of retaining the visual characteristics of a graph on a different display device than it was intended for. Your graphs will be identical on two different devices if possible, but if not, they will still be as similar and as legible as possible.

Starting with version 2.0 of P/OS, which should be available by the time you read this, the user will have an additional way to choose his display device. If you use the GIDIS "choose alternate viewing surface" command and select the "file" option, GIDIS will save an image in a file as a command display list. The image can subsequently be output to any of the supported peripherals, as many times as desired. The file can also be moved to another system for output there.

GIDIS therefore provides two different levels of portability for graphics. You can either port the source code to another system with the same source code graphics standard (examples would be CORE programs written in a high-level language and NAPLPS frame pages), or you can port the finished image to another system supporting GIDIS and any of its display devices.

The PRO/350 offers high graphics power and unusual new expansion slots.

Still another interesting feature of version 2.0 print services will be its ability to print what is called a virtual device metafile. A metafile is like a "filespec," the contents of which can include text to call in a GIDIS file. For example, a metafile may define an image as being created by drawing the graphics from GIDIS file A and filling the image with text from document file B. This will allow much of the cutting and pasting involved in putting documents together to be done electronically by those producing the document.

The ability to subsequently print the metafile on any device connected includes being able to preview it on a display device. Of course, the prior restrictions on what is possible to represent on which devices applies more strongly here. For example, the graphic portions will be totally blank on a nongraphic printer, while proportionally spaced text will appear normally spaced on a terminal that doesn't support proportional spacing. Once again, however, the software will worry about such things for you.

Sources of software graphics

The other component which requires support is the actual writing of programs which produce GIDIS graphics. Here again, DEC risks giving too much support, rather than too little. In the current version of P/OS, the user has four ways to produce graphics using the GIDIS interface: directly through the GIDIS interface, through the CORE Graphics Library, through PRO/BASIC, or through the ReGIS interpreter acting on ReGIS commands sent from an external host. The CORE Graphics Library and the GIDIS interface are included in the native tool kit. Version 2.0 will include support for Tektronix 4014 commands received from a host and NAPLPS commands either received from a host or generated locally. The Tektronix 4014 and NAPLPS packages are available as options.

The CORE Graphics Library is almost a full implementation of the current CORE Graphics standard produced by ACM. It, along with GKS, is one of the strongest contenders for a world standard in graphics software and is the strongest in this country. It provides such functions as coordinate transformations from world coordinates, through a normalized coordinate system, to the real device coordinates. This allows the user to establish his own preferred coordinate set to represent the viewing surface. It also performs clipping, which allows the user to contain the graphics within certain areas of the viewing surface. This additional level of coordinate transformation makes the graphics commands device independent. Other functions include drawing and filling graphics figures in a variety of colors, fill patterns, and line styles including points, lines, text, polygons, arcs, and smooth curves. Text can also be handled in a variety of styles, slants, and orientations.

The CORE Graphics Library is implemented as a library accessible via the linker to programs in any compiled language. The actual code for the routines is present in a memory-resident library that can be installed to share the same address space as other library functions. This is handled via the memory management hardware, producing little overhead.

PRO/BASIC also works through a fairly substantial subset of the CORE Graphics primitives. As can be seen from the benchmarks described previously, this means that it executes purely graphics applications nearly as quickly as a compiled language such as Pascal.

The ReGIS, Tektronix 4014, and NAPLPS host software function effectively as terminal emulators. They take command streams from host systems that generate the appropriate type commands and interpret them onto the screen. The standalone NAPLPS interpreter is available as a product, but the NAPLPS interface for local applications is still under development, and

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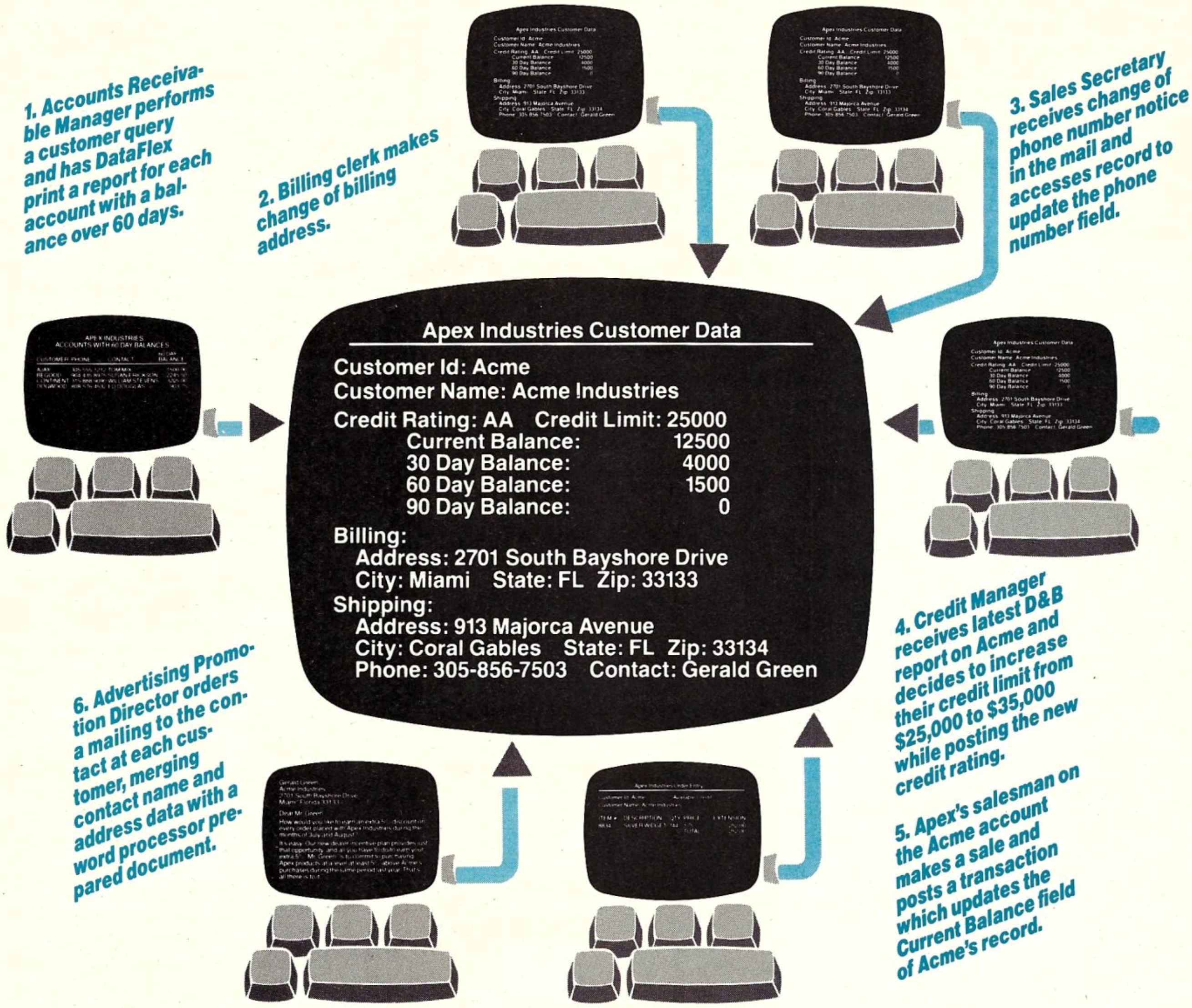

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only the host software and documentation were available for review.

Graphics application software

In addition to support software, the PRO/350 also has a fairly strong base of graphics applications software. Many of these are packages that existed under RSX on PDP-11 systems and migrated fairly easily to the PRO/350, but some are new products designed for the PRO.

Short descriptions of several such packages are given below. With the exception of Palette, all are available directly from DEC. Palette is available from *Palette Systems, 2 Burlington Woods, Burlington MA*. In the case of new products, prices were not available.

Note that the most common microcomputer application packages are represented, including business graphics, engineering and scientific applications, CAD, and Videotex. Lacking are more artistic packages for applications such as advertising, simple animation, and other such areas that the resolution and color mixing capability of the PRO make extremely attractive.

Summary

The DEC Professional 350 is too powerful and professional to be considered in the same league as microcomputers, although it is in the same price range as some of the best microcomputer systems. It offers truly excellent software support and the complete documentation needed to use it, making it an excellent system for systems integrators to configure specialized products and applications around.

Compatibility of P/OS with the RSX operating systems and use of graphics standards will produce a great deal of software compatibility with larger systems, which will lead to a large base of available software. Networking support and other software products and compatibility make interfacing to larger computers easier than for most systems. High graphics power and unusual new expansion options and peripherals will make unique applications and systems possible.

Overall, the system is ideal as a basis for developing custom software products around. It is especially valuable for major applications that need the power of the system and can justify its price.

David Fournier, 1030 Hudson, Apt. #3, Hoboken, NJ 07030

Graphics packages

ATHENA/Graph—*$450.* Many formats of business presentation graphics (see sidebar). Requires hard disk; supports color if equipped with extended bit-map and color monitor; supports dot matrix printer and plotter.

DESIGN GRAPHIX/Executive—*$595.* Two-dimensional CAD and drafting package allowing complex figures to be created, edited, stored in symbol libraries, recalled and modified later. Geometric functions including lines, rectangles, polygons, circular and elliptical arcs in various line styles, colors. Figures may be moved, modified, deleted, stored in and recalled from symbol libraries. Text annotations can be inserted in several text sizes. Requires hard disk; supports color monitor, plotter, and Summa Graphics bit pad.

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DEC PRO/350

Continued from page 84
matrix printer.

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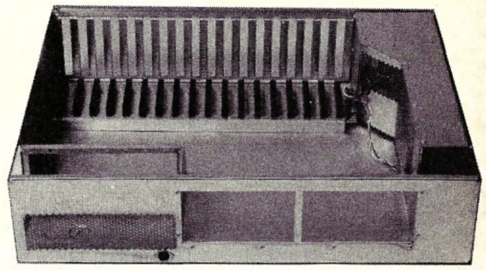

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How to Interface with the IEEE-488 Bus

Practical information on the timing and procedures

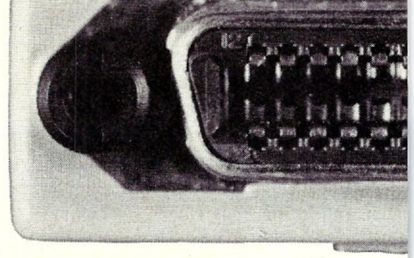
by Peter L. Andresen

Situations often arise where laboratory instruments may have to be portable and connected to more than one computer, or computers of different types. Since many instruments are sold complete with a built-in IEEE-488 interface, and the bus controller can handle many different types of instruments, it is no longer necessary to design a special computer interface for each instrument and for each computer. Only the bus controller needs to be specific for any given computer, though of course the software drivers may have to be different also.

The characteristics and use of the IEEE-488 bus, designed for controlling laboratory equipment, will be described in this article. Readers may wish to augment this with the official ANSI/IEEE Standard [1] or with more readily digestible information available from various manufacturers [2,3]. I will discuss the 10 basic functions or capabilities of the bus, the purpose of the 16 signal lines, the types and effects of bus commands issued by the Controller, device-dependent characteristics of the bus, and will give an example of a simple data acquisition program in Basic.

Some distinguishing features of the IEEE-488 bus are:

- It is highly standardized.
- It has universal commands to which all devices respond.
- It transmits 8 data bits in parallel with full handshaking at rates up to 1 MB (rarely achieved and automatically determined by the slowest active device).
- It permits up to 15 devices to be connected at one time, using up to 31 addresses. ("Secondary" addressing potentially permits 961 addresses. "Excess" addresses are useful, since some devices use more than one address. Devices can also be swapped onto the bus without concern for conflicting addresses.)



Weaknesses of the bus include:

- Restrictions on total cable length of 2 meters times the number of devices (maximum of 20 meters).
- No standardization of the operational characteristics of the bus (cf. interpretation of data such as ASCII, binary, BCD, etc., device program codes).
- Potential competition for access to the bus if there are a large number of slow devices.
- Generally, about two-thirds of the devices must be powered up to ensure proper bus operation. However, if power-down devices do not load the bus, the number of active devices is unimportant.
- Further restrictions on cabling (plus a lack of fast devices) make it difficult to attain transfer rates even remotely close to the maximum.

Additionally, the IEEE-488 specification itself is quite complex. This has resulted in subtle errors in its implementation and description (to which this article may not be immune).

The power and flexibility of the 488 bus reside predominantly in the Controller, which can dynamically reconfigure the bus participation and is itself generally equipped with Talker and Listener functions. For example, a Controller can send commands to address a device to talk, listen, be inactive, or cause either some selected devices or all devices to perform a common function (e.g., trigger). Controllers can be purchased as standalone dedicated devices or added onto general-purpose computers (as, for example, with Hewlett-Packard computers or as hardware additions to S-100 computers).

Several manufacturers offer LSI chips that perform the 488 interface functions (with varying degrees of capability and speed) and are used by most 488 devices (including the S-100 based controller) manufacturers. The 488 interface boards available for S-100 computers have grown markedly to include Cromemco, Dylon, D & W Engineering, I/O Technology, National Instruments, Pickles & Trout, and others. (Note to Osborne owners: errors in the 488 drivers in the (early) single-density ROM BIOS were corrected in the double-density version. In single density, either avoid using the Control Out routine with REN TRUE, or follow it by going to Standby, then Take Control.)

I have used some of these boards (such as Pickles & Trout) extensively. Most come with machine-language source code to drive the board, and many offer software that easily interacts with Microsoft Basic and various compiled languages. Some also offer S-100 interrupt capability. Since the S-100 processor must interact with the 488/S-100 interface board, transfer rates on the 488 bus that involve the 488/S-100 interface board are generally limited to a maximum of 5 to 50 K/sec.

IEEE-488 bus

There are only three basic participants (Table 1) on the bus: Controllers (only one may be in charge at a time); Talkers (only one at a time); and Listeners (limited by the 15-device maximum of the bus). Coupled to these functions are the Source and Acceptor Handshake functions necessary to ensure error-free transfers on the data lines. There are five remaining bus functions, which provide special optional capabilities. Devices usually specify their 488 capability in a code printed next to the connector.

The Controller orchestrates the activities on the bus and generally identifies its unique status on the bus by asserting TRUE on the Attention (ATN)

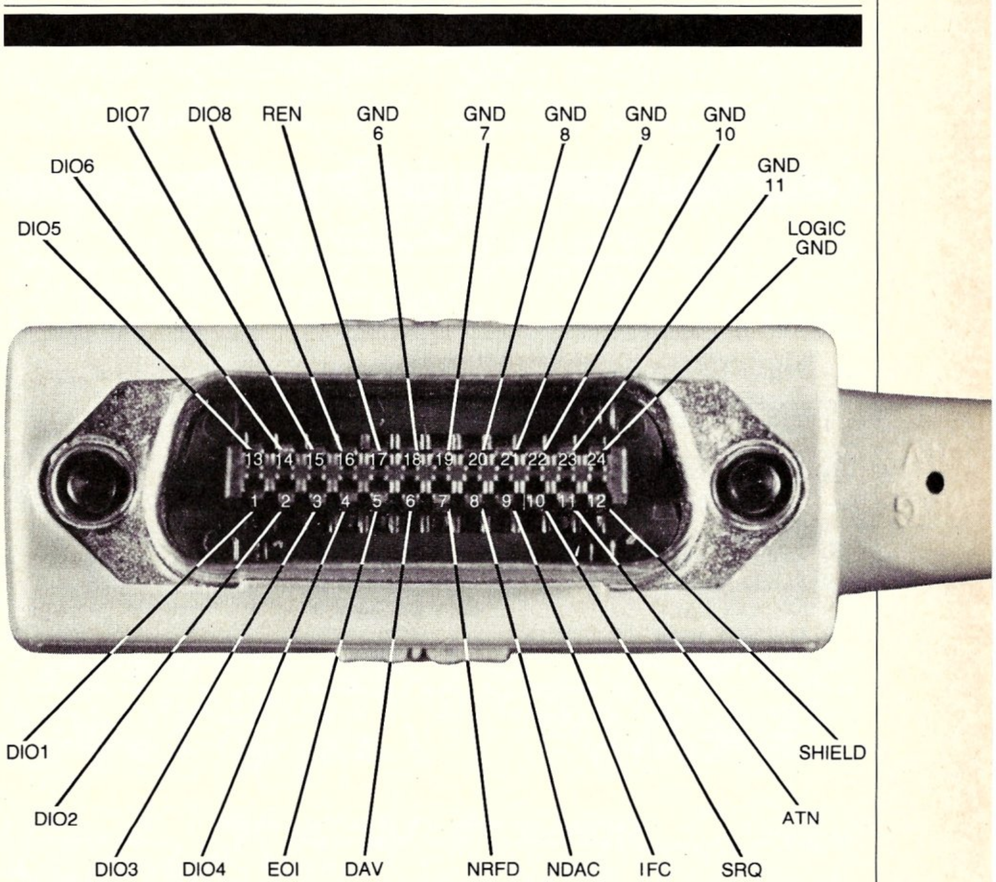


Figure 1. *Photograph of an IEEE-488 connector showing both male and female sides and the corresponding signal pinout.*

IEEE-488 BUS

Continued from page 89

line, at which point all other bus activity must cease and all devices must "listen" to it. This places the interface in the *command* mode, where all devices handshake data on the data lines and interpret them as (Multiline) commands. When the ATN line is FALSE, the interface is the *data* mode, where data (whose significance is device dependent) are sent by a Talker and received only by Listeners.

There are really two categories of commands: Uniline and Multiline. *Uniline* commands are so named because only one (Interface Management) line is used. *Multiline* commands use the data lines (and the ATN Interface Management line). They are further broken down into five basic groups: Addressed, Universal, Listen Address, Talk Address, and Secondary commands, which are distinguished by the three or four most significant bits (Table 2). These commands are subsets of Uniline and Multiline *messages* that describe all types of transmissions over the bus other than handshaking.

Most Controllers also have the capability to participate as normal Talkers or Listeners. This multiplicity of roles and abilities must be clearly understood, since the bus will not function at all well if the Controller's presence is felt when you want other bus transactions to occur.

Whenever a device is connected to the 488 bus and powered on, its interface module is monitoring the ATN (and other) lines to determine whether the Controller is issuing a command. Initially a device is inactive (except for Talk- or Listen-Only devices, which power up as fixed participants) in terms of participating in exchanges of data on the bus, although it can still be operating in a useful, independent manner.

The transition to bus participation comes when the Controller sends out a command that assigns a role (Talker or Listener) to the device. Each device has a 5-bit binary address that is switch settable and is sent along with a 2-bit code to indicate whether it is to be a Talker or Listener (Table 2). It is important to distinguish between a device that has been assigned and functions as a *Listener* (involved in data transfers), and a device that "listens" when the Controller speaks (which is something that all devices must do).

Finally, the remote versus local description of a device's operation can be confusing. Remote/Local capability refers to a device's ability to be programmed (for range, triggering, etc.) over the bus, and is not a description of its participation or lack thereof on the bus. A device can be in Local mode and yet be acting as a Talker or Listener.

IEEE-488 functions

The Standard defines 10 *interface functions* (Table 1). These are distinct from the device's internal functions, like range, "trigger" mode, etc., which are set on its front panel (and may be programmable over the bus). The use of the commands related to the 488 functions will be detailed in the section on Multiline Commands. Each of the 10 functions has different levels of implementation (Table 1) ranging from implemented (SH1) versus not implemented (SH0) for the Source Handshake, to many different levels of capability for Controllers. (Functions C1-C4 can be chosen in certain combinations and coupled with one of the C5-C28 functions for a total of approximately 193 possible variations.)

A device is not required to implement all functions. A signal generator may be equipped as a Listener with Remote/Local and Trigger (bus) capabilities, while a digital voltmeter might also include Talker, Service Request, Parallel Poll and Device Clear capabilities. A minimum capability would have to include a Listen function (with Acceptor Handshake). A simple bus configuration could consist of a digital voltmeter operating in a Talk-Only mode and a printer in a Listen-Only mode, where no Controller is needed.

The core of the Standard is a description of each function in terms of allowable *states* (Table 1) and the conditions under which transitions occur from state to state—for instance, from Talker Idle (not a Talker) to Talker Active. The number of allowable states depends on the level to which a function is implemented (a Talker with Serial Poll capability has five states; without, only three states). In general, on power-up, all bus functions are in an idle or equiva-

Table 1. IEEE-488 interface functions

Function	Implementation codes*	Allowable states†
1. Source Handshake	SH0-SH1	6
2. Acceptor Handshake	AH0-AH1	5
3. Talker	T0-T8 TE0-TE8	3-8
4. Listener	L0-L4 LEO-LE4	3-5
5. Service Request	SR0-SR1	3
6. Remote/Local	RL0-RL2	2-4
7. Parallel Poll	PP0-PP2	3-5
8. Device Clear	DC0-DC2	2
9. Device Trigger	DT0-DT1	2
10. Controller	C0-C28	up to 20

E1 = Open collector drivers
E2 = Tri-state drivers
** "O" indicates no capability*
† Depends on implementation

Table 2. Categories of multiline commands

Mnemonic	Message name	Type	Class	DIO 8	DIO 7*	DIO 6*	DIO 5	DIO 4	DIO 3	DIO 2	DIO 1	ATN
ACG	address command group	M	AC	×	0	0	0	×	×	×	×	1
UCG	universal command group	M	UC	×	0	0	1	×	×	×	×	1
LAG	listen address group	M	AD	×	0	1	×	×	×	×	×	1
TAG	talk address group	M	AD	×	1	0	×	×	×	×	×	1
SCG	secondary command group	M	SE	×	1	1	×	×	×	×	×	1

M = Multiline
U = Uniline
1 = Logical one
0 = Logical zero
× = Don't care or not relevant.
L = 5-bit listen address
T = 5-bit talk address
AC = Addressed command
AD = Address (talk or listen)
DD = Device dependent
SE = Secondary command
ST = Status
UC = Universal command

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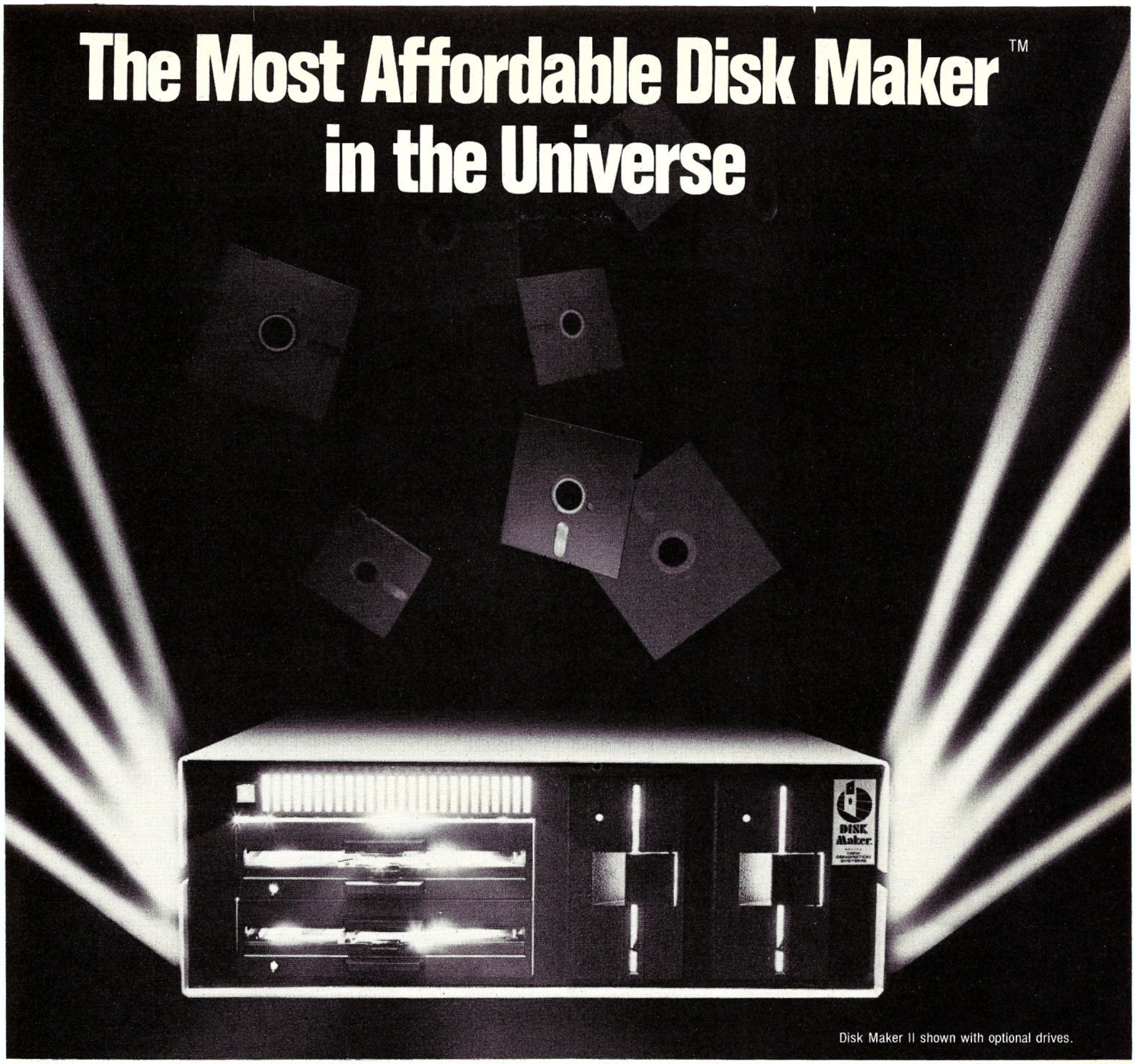

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IEEE-488 BUS

Continued from page 90

lent state. While not necessary for its use, a thorough understanding of the bus requires familiarity with these state diagrams [1]. The 10 functions are:

1,2. Handshaking (SH and AH). An interlocked handshake sequence is used to guarantee proper transfer of each byte on the data lines (DIO1-DIO8). The transfer cannot be initiated by the Source until all Acceptors are ready, and any Acceptor will delay the the termination of the transfer (or Multiline message) until it has fully accepted the byte. Thus, the slowest participating device determines the pace of the handshake. See "Hardware Details: Handshaking Lines" below.

3. Talker or Extended Talker (T, TE). All Talkers (only one permitted at a time) must be capable of Source and Acceptor Handshaking, since they must also be able to receive Multiline commands from the controller. Capabilities vary with a device's ability to *(1)* respond to Secondary (or extended, if more than 31) addresses (T vs. TE); *(2)* provide a Talk-Only mode (T & TE 1,3,5,7); *(3)* respond to a Serial Poll (T & TE 1,2,4,5); and *(4)* unaddress (unbecome a Talker) when its listen address is sent (T & TE 5,6,7,8). Talkers (except Talk Only) must also cease being Talkers if a Universal UNTalk (UNT) command or Other Talk Address (OTA) is sent by the Controller. The Standard requires the Talk-Only mode to be activated by a manual switch, which causes the device to power up and permanently occupy the Talker role on the bus (it won't UNTalk). Note that the Serial Poll capability is not a separate function, but a subset of the Talk function.

4. Listener or Extended Listener (L, LE). Listeners differ with respect to their ability to *(1)* respond to Secondary addresses (L vs. LE); *(2)* provide a Listen-only mode (L & LE 1,3) and *(3)* unaddress (unbecome a Listener) when their talk address is sent (L & LE 3,4). The Listen-Only capability is similar to Talk Only. Primitive Listeners (L & LE 1,2) require only Acceptor Handshake capability.

5. Service Request (SRQ). Devices with this capability (SR1) can request service from the Controller at any time by asserting TRUE on the SRQ Interface Management Line. They must also be able to respond to a Serial Poll (T & TE 1,2,4,5). See "Multiline Commands: (Universal) Serial Poll Enable."

6. Remote/Local (RL). Devices with this capability (RL1,2) can select between two sources of programming input (for range, function, triggering, etc.): *(1)* front panel control (local) or *(2)* 488 interface (remote). A device's programmability in Remote may be less extensive (or more so) than in Local. A device goes into Remote when the Controller sends its Listen address while asserting the REN line. In Remote, the front panel controls, except power on/off and bus-related controls (manual SRQ and Go To Local) are inoperative. RL1 differs from RL2 in its ability to permit Lockout (Local Lockout—LLO) of the Go To Local front panel button.

7. Parallel Poll (PP). Provides a device with the ability to convey its status over one of the data lines to the Controller. Devices are individually configured and can then be simultaneously polled by the Controller much more quickly than with Serial Polling. PP1 signifies that the device's response to a Parallel Poll is remotely configurable; PP2 signifies that it is locally configurable. See "Multiline Commands: (Addressed) Parallel Poll Configure."

The transition to bus participation comes when the Controller sends a command that assigns a role to a device.

8. Device Clear (DC). DC1 provides the ability to clear (initialize) devices individually or as a group using an Addressed command (Selective Device Clear) or a Universal command (Device Clear). DC2 omits Selective Device Clear. Generally, Device Clear places the device's functions (voltage scale, triggering, etc.) in the power-on state (this is not identical to power on in terms of placing the device's 488 interface in a quiescent state). However, a manufacturer is free to clear the device's functions to any condition.

9. Device Trigger (DT). DT1 is an Addressed command that triggers the operation of devices individually or in groups. Once an operation has been started, a device will not respond to subsequent Device-Trigger commands until its first operation is complete.

10. Controller (C). Only Controllers have the ability to assert the ATN, IFC or REN lines and are therefore uniquely able to create Talkers or Listeners, as well as send Addressed (e.g. Group Trigger) or Universal (e.g. Device Clear) commands. Controllers vary widely in their ability to perform a Parallel Poll, respond to a Service Request, perform Talk and Listen functions, pass or take control from a second Controller, etc. With the exception of the latter, many Controllers have all of the above capabilities.

Hardware details

For those experienced with the vagaries of setting up RS-232 interfaces, the 488 bus will come as a pleasant surprise. All 488 cable connectors incorporate both male and female (stackable) connections with locking screws (Figure 1), so that adapters are never necessary and both linear and star configurations are easily set up. (Watch the screws! Black threads are metric; silver are English.) Also, there are no ambiguities regarding baud rate, stop bits, which signals appear where, etc.

The 488 bus employs eight Data lines, three Handshaking lines, and five Interface Management lines. Lines are generally at 2.5 to 3.7 volts until an open collector line driver pulls the line to ground (tri-state drivers are optional on some of the lines; see Table 1). This results in a wired ORing scheme, whereby any device(s) can maintain a line low. The 488 Standard uses a negative TRUE logic convention, meaning that TRUE (logical 1) equals low (< 0.8 volts) and FALSE equals high (> 2.0 volts).

Data lines (DIO1-DIO8). The Data lines are used to transmit data (including "normal" data, device status and device program codes) between a Talker and Listeners, as well as Addressed commands (between a Controller and Listeners) and Universal commands (between a Controller and all devices).

Handshaking lines (NRFD, DAV, and NDAC). The three Handshaking lines operate under a fairly complex set of rules to provide a fully interlocked handshake for transmitting over the Data lines. The detailed sequence of events is described in Figure 2. It is again worth noting that the pace of the handshake (i.e., any transmission over the Data lines) is controlled by the slowest participating device (Controller, Talker or Listener).

Interface Management lines (ATN, EOI, IFC, REN and SRQ). Five lines are used to manage the 488 bus, and the information conveyed on

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Continued from page 92

these lines is usually known as *Uniline* messages, since only one line is involved (i.e., in general, the data lines are not used). These can take the form of commands from the Controller (e.g., IFC), but also include messages to the Controller (e.g., SRQ) or to Listeners (EOI). The five interface management lines are:

ATN. Attention is asserted low (TRUE) *only* by the Controller, indicating to all devices that the Data lines will contain a special command to tell devices to become Talkers or Listeners or perform a Secondary, Addressed (to Listeners) or Universal command.

EOI. End Or Identify is used to signal the last byte of a string sent on the Data lines asserted by a Talker (ATN FALSE) as the last byte is placed on the Data lines. It is also asserted (with ATN TRUE) by the Controller to initiate a Parallel Poll.

IFC. The Interface Clear line is asserted low (TRUE) only by the controller and places the bus (i.e., the 488 interface modules in all devices) in a known quiescent state. For example, all Talkers and Listeners go into the idle state (UNTalk and UNListen), although devices do not Go To Local (GTL), nor are they cleared (DCL or SDC).

REN. The Remote ENable line is asserted TRUE only by the Controller to permit remote programming of devices on the bus. Devices with Remote/Local (RL1,2) capability (and providing they are Listeners and REN is TRUE) are able to be remotely programmed by receiving Multiline messages (usually sent by the Controller acting as a Talker). Generally, remote programming mimics (some or all of) and disables the front panel controls (except those which relate to the bus, like Service Request or Go To Local buttons—see Universal Command: Local Lockout). On power-up or if REN becomes FALSE, all devices will shift to the Local state. See "IEEE-488 Functions: Remote/Local and Device-Dependent Messages."

SRQ. The Service ReQuest line is asserted TRUE by a device(s) capable of Serial Polling (a Talk function subset) to signal a need for attention. Some devices can be programmed (using a status mask) to define the conditions under which they will generate an SRQ. Some devices also permit SRQ to be generated from front panel (operator) input. The Controller must sense the SRQ line and perform a Serial Poll to determine which devices need service. See "Multiline Commands: (Universal) Serial Poll Enable."

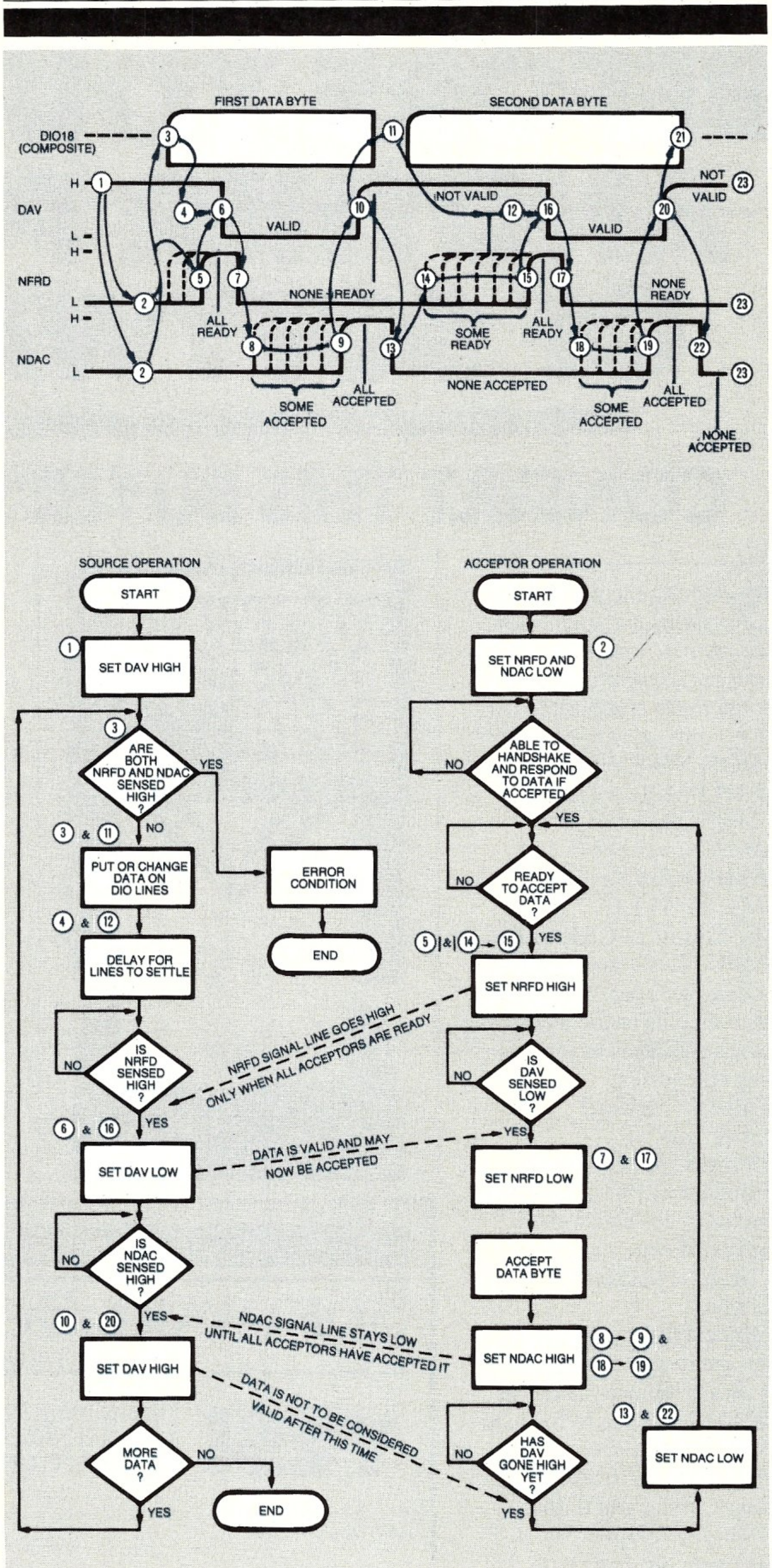

Figure 2. *The detailed sequence of events involved in handshaking process. Reprinted with permission from reference [1].*

IEEE-488 BUS

Continued from page 94

Multiline commands

Multiline commands (ATN TRUE—see Tables 2 and 3) are an artificial subset of Multiline messages, which are simply bus transactions that use the data lines and therefore involve handshaking. The Controller sends a Multiline command by asserting ATN TRUE and simultaneously placing a byte command (a 2-byte sequence is used for Secondary commands) on the data lines. The type of command is determined by the three most significant bits (Table 2), with the lower bits specifying the particular address or command. The Controller also uses Multiline messages by acting as a Talker (ATN FALSE—after first placing a device into the Listen state) to send a series of data bytes that program the device for voltage scale, triggering mode, etc. These noncommand messages are sent while ATN is FALSE and are called *device-dependent messages* (to be discussed in that section).

Talk and Listen (Addressed) commands. The Talk and Listen address commands are characterized by the three high bits (X10 for talk, X01 for listen—see Table 2). Devices can share a Listen address, although a Talk address cannot be shared by other Talkers. Devices which have both Talk and Listen capabilities often use a common address for both functions. The address of a device is set by five switches (usually at its rear), which select an address between 0 and 30 (binary 00000 to 11110) and correspond to the low 5 bits of the Talk (MTA) or Listen (MLA) address command (Table 3).

A device with a binary address of 01001 would recognize its Talk address (i.e., become a Talker) by seeing X10 01001 (ASCII 'I') on the data lines (with ATN TRUE), while its listen address would be X01 01001 (ASCII ')'—where 'X' means the bit isn't used). Upon hearing its Talk or Listen address, a device will assume its function once the ATN line is released. The one remaining address, 31 (binary 11111), is reserved to UNTalk (ASCII '_') or UNListen (ASCII '?') all devices. Note exceptions and limitations described in the IEEE-488 Functions section.

Secondary commands. This group (SCG—see Table 2) is distinct from the primary command group (PCG, which includes all other commands in this section). Table 2 indicates the characteristic bit pattern (X11) of Secondary commands. These are sent as a 2-byte

Table 3. Remote message coding*

Mnemonic	Message name	Type	Class	DIO LINES 8 7 6 5 4 3 2 1	ATN	EOI	SRQ	IFC	REN
ATN	attention	U	UC	× × × × × × × ×	1	×	×	×	×
DAB	data byte	M	DD	D D D D D D D D	0	×	×	×	×
DCL	device clear	M	UC	× 0 0 1 0 1 0 0	1	×	×	×	×
END	end	U	ST	× × × × × × × ×	0	1	×	×	×
GET	group execute trigger	M	AC	× 0 0 0 1 0 0 0	1	×	×	×	×
GTL	to to local	M	AC	× 0 0 0 0 0 0 1	1	×	×	×	×
IDY	identify	U	UC	× × × × × × × ×	×	1	×	×	×
IFC	interface clear	U	UC	× × × × × × × ×	×	×	×	1	×
LLO	local lock out	M	UC	× 0 0 1 0 0 0 1	1	×	×	×	×
MLA	my listen address	M	AD	× 0 1 L L L L L	1	×	×	×	×
MTA	my talk address	M	AD	× 1 0 T T T T T	1	×	×	×	×
MSA	my secondary address	M	SE	× 1 1 S S S S S	1	×	×	×	×
PPC	parallel poll configure	M	AC	× 0 0 0 0 1 0 1	1	×	×	×	×
PPE	parallel poll enable	M	SE	× 1 1 0 S P P P	1	×	×	×	×
PPD	parallel poll disable	M	SE	× 1 1 1 D D D D	1	×	×	×	×
PPR1	para. poll resp. 1	U	ST	× × × × × × × 1	1	1	×	×	×
PPR2	para. poll resp. 2	U	ST	× × × × × × 1 ×	1	1	×	×	×
PPR3	para. poll resp. 3	U	ST	× × × × × 1 × ×	1	1	×	×	×
PPR8	para. poll resp. 8	U	ST	1 × × × × × × ×	1	1	×	×	×
REN	remote enable	U	UC	× × × × × × × ×	×	×	×	×	1
RQS	request service	U	ST	× 1 × × × × × ×	0	×	×	×	×
SDC	selected device clear	M	AC	× 0 0 0 0 1 0 0	1	×	×	×	×
SPD	serial poll disable	M	UC	× 0 0 1 1 0 0 1	1	×	×	×	×
SPE	serial poll enable	M	UC	× 0 0 1 1 0 0 0	1	×	×	×	×
SRQ	service request	U	ST	× × × × × × × ×	×	×	1	×	×
TCT	take control	M	AC	× 0 0 0 1 0 0 1	1	×	×	×	×
UNL	unlisten	M	AD	× 0 1 1 1 1 1 1	1	×	×	×	×
UNT	untalk	M	AD	× 1 0 1 1 1 1 1	1	×	×	×	×

** This listing is complete except for codes for Handshake and DAB variations. See Table 2 for code key.*

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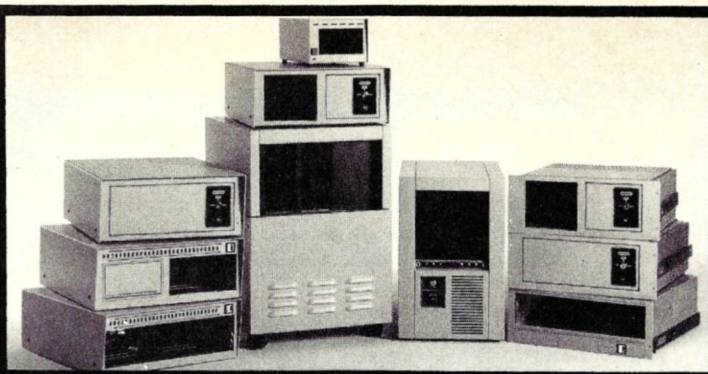

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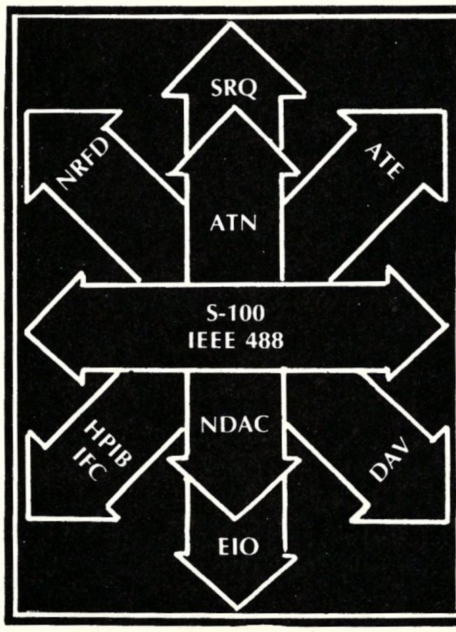

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sequence, the first byte of which is a Primary command such as Talk address (MTA), listen address (MLA), or Parallel Poll Configure (PPC).

SAD. The Secondary ADdress command is essentially a 2-byte address and is implemented only by extended Talkers (TE) and Listeners (LE). It permits 31 secondary addresses for every one of the 31 primary addresses, although its implementation is device dependent, and few devices have the capability.

PPE and PPD. The Parallel Poll Enable and Parallel Poll Disable Secondary commands are required for Parallel Poll capability (PP1,2—only occasionally implemented). The first byte of the sequence is the Addressed command: Parallel Poll Configure, followed by the PPE or PPD 'byte' (Table 3). See "Multiline Commands: (Addressed) Parallel Poll Configure."

Addressed commands (GET, GLT, PPC, SDC, and TCT). These Addressed commands (bit pattern X000—see Tables 2 and 3) are performed *only* by devices currently assigned as Listeners. Recall that the Standard does not require these devices to perform every bus function, although they must adhere to a specific, well-defined level of capability (Table 1).

GET. Group Execute Trigger (last 4 bits: 1000; ASCII 'cntrl-H') causes devices with the DT1 capability to be triggered simultaneously. See "IEEE-488 Functions: Device Trigger."

GTL. Go To Local (last 4 bits: 0001; ASCII 'cntrl-A'). A device with this capability (RL1,2) returns from Remote to Local (front panel programming control) upon receiving this command. A device will only go (back) to the Remote state when the Controller sends its Listen address (MLA) with the REN line asserted. If REN is released, all devices Go To Local. Remote and Local do not describe the device's participating on the bus; they indicate the source (front panel or 488) of its programming (for voltage range, triggering mode, etc.).

PPC. Parallel Poll Configure (last 4 bits: 0101; ASCII 'cntrl-E'). Parallel Polling is a complex capability (PP1,2), often not implemented, which is complimentary to the Serial Poll capability. In a Serial Poll the request for service is initiated by the device (using the SRQ line); a Parallel Poll is always initiated by the Controller and permits the status of many devices to be determined simultaneously and quickly. Conceptually and in contrast to Serial Polling, Parallel Polling is used for high throughput

Listing 1. A program to set up and acquire data using a DVM and scanner.

This section contains a canned routine which sets up the "hooks" from MBasic to the Pickles & Trout routines that drive the 488/S-100 board. First set aside (create) variable space in MBasic. The first CALL requires location (from CP/M) of P&T routines. It, in turn, passes the addresses of all of the variables to P&T for its access.

```
100 CNTL%=CNTLC%+TALK%+TALKC%+LSTN%+LSTNC%+SPOLL%+PPOLL%+DREN%
110 REN%=STATUS%+IFC%+BRSET%+IOSET%+PROTCL%+ECHO%
120 ERCODE%=TIME%+EOT%+EOS%+LENGTH%+POLL%+BUS%+ECHOIN%+ECHOOUT%
130 X=256*PEEK(7)+PEEK(6)+9
140 IF X>32767 THEN X=X-65536!
150 SETUP%=CINT(X)
160 CALL SETUP% (CNTL%,CNTLC%,TALK%,TALKC%,LSTN%,LSTNC%,SPOLL%,PPOLL%,DREN%,
  REN%,STATUS%,IFC%,BRSET%,IOSET%,PROTCL%,ECHO%,IOPORT%)
170 CALL IOSET%(ERCODE%,TIME%,POLL%,BUS%)
180 CALL PROTCL%(EOT%,EOS%,LENGTH%)
190 CALL ECHO%(ECHOIN%,ECHOOUT%)
200 CR$=CHR$(13) :  REM Assign contants:
210 SDC$=CHR$(4) :        REM Selective Device Clear = ^D
220 TRIGG$=CHR$(8) :      REM Group Execute Trigger = ^H
230 LLO$=CHR$(17) :       REM Local LockOut = ^Q
240 UNTALK$=CHR$(95) :    REM UNTalk address = ASCII "_"
250 UNLSTN$="?" :         REM UNListen address = ASCII "?"
260 DVM$="FL1Z0R3T3" :    REM String contains DVM program codes for:  Filter on;
270                       REM    Autozero off; 1 volt range; & single trigger.
```

We now can use the 488 bus to clear and set up the bus and devices.

```
300 CALL IFC% : REM Send Uniline message to cause InterFace Clear.
310 CALL REN% : REM Send (& maintain) Remote ENable Uniline message.
320 A$="6"+SDC$+LLO$ :  REM String has DVM Listen Address, Clear and Lockout
330 CALL CNTL%(A$) :    REM Act as Controller (ATN TRUE) & send string A$.
340 A$=DVM$ :           REM String contains DVM program codes.
350 CALL TALK%(A$) :    REM Act as Talker, send this set up message.
360 A$=UNLSTN$:CALL CNTL%(A$) : REM Act as Controller & UNListen all devices.
```

Obtain time/date from scanner clock and print and save it.

```
500 AC$="TD":GOSUB 800 :     REM "TD" prepares Scanner to send time/date.
510 A$="I":CALL CNTL%(A$) :  REM Scanner Talk address (tho remotely programmed
520   REM to send time, Scanner was not addressed to be a Talker in line 500).
530 CALL LSTN%(A$):TIME$=A$: REM Controller to act as Listener to hear time.
540   REM Data on the 488 bus will be stored in A$ by the P&T routines, & its
550   REM contents will change if the P&T LiSTeN routines are called again.
560 PRINT TIME$
```

Here we take DVM readings from Channel 0 and 1 of scanner. ERCODE% (line 700) is set by the P&T routines to various nonzero values which represent eight possible "error" conditions, such as the presence of an S-100 reset, another controller in the system, bus timeout error, Service Request asserted, no (handshake) Acceptors on the bus, etc.

```
600 AC$="AC0":GOSUB 800 :            REM Send "AC0" to Scanner: Close Channel 0
610 A$="6":CALL CNTL%(A$) :          REM "6" is the Listen address of the DVM.
620 A$=TRIGG$:CALL CNTL%(A$) :       REM TRIGG$ = addressed command: trigger.
630 A$="V":CALL CNTL%(A$) :          REM "V" is the DVM Talk address.
640 CALL LSTN%(A$) :                 REM Controller acts as Listener for DVM.
650 R(1)=VAL(MID$(A$,4,6)) :         REM Convert data from ASCII to numeric.
660 AC$="AC1":GOSUB 800 :            REM Send "AC1" to Scanner: Close Channel 1
670 A$="6"+TRIGG$:CALL CNTL%(A$) :   REM Condensed version of lines 610-630
680 CALL LSTN%(A$) :                 REM Controller to act as Listener for DVM.
690 R(2)=VAL(MID$(A$,4,6)) :         REM Convert data from ASCII to numeric.
700 IF ERCODE%>0 THEN GOSUB 1000 :   REM If 488 bus error goto error routine.
```

Note that we take the precaution of UNTalking all devices before we have our 488/S-100 interface act as a talker (TALK% - line 820, which requires only a software command and does not involve sending a new talk address over the bus). The two-Talker conflict can be created by controllers or talk-only devices. It is permissible for the 488/S-100 interface to act as a controller while the DVM is a talker, since all devices release the bus and pay attention when the controller asserts ATN.

```
800 A$=UNTALK$:CALL CNTL%(A$) :       REM UNTalks DVM.
810 A$=")":CALL CNTL%(A$) :           REM ")" is Listen address for Scanner.
820 A$=AC$+CR$:CALL TALK%(A$) :       REM Send prgm code string AC$ to Scanner.
830 A$=UNLSTN$:CALL CNTL%(A$):RETURN:REM Send UNListen command and return.
```

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devices requiring a fast response (such as disk drives).

The Secondary command, Parallel Poll Enable (PPE), enables the device's response to a Parallel Poll by telling it how and under what conditions to respond. (The "how" is a 3-bit code sent on DIO1-DIO3 during PPE, which specifies which of the eight data lines the device should assert if it needs service when polled. The "what condition" tells a device to respond to a poll if its internal status "bit" matches the value of bit 4—DIO4—also sent during PPE.) Once enabled, a device will respond to Parallel Polling until it receives a Parallel Poll Unconfigure (Universal) command or the Parallel Poll Disable (secondary) command.

The actual poll is initiated by the Controller when it asserts TRUE on both the ATN and EOI lines, and all enabled devices will respond by sending a Parallel Poll Response (PPR) message by asserting TRUE on their assigned data line if they need service. Thus the status of up to eight devices can be uniquely determined simultaneously, and more than eight devices can be handled by data line sharing (a second Parallel Poll following reconfiguration would be necessary to identify which specific devices need service).

SDC. Selective Device Clear (last 4 bits: 0100; ASCII 'cntrl-D') is a capability (DC1 only) that will initialize a device's functions to a condition somewhat similar to power-on. See "IEEE Functions: Device Clear."

TCT. Take ConTrol (last 4 bits: 1001; ASCII 'cntrl-I') is a method for passing bus control among multiple Controllers. This command is unique in that the new Controller is first addressed to Talk (not Listen) prior to sending this command. Since few 488 systems employ more than one Controller, this is rarely used (or implemented).

Universal commands (DCL, LLO, PPU, SPE, SPD). Universal commands are received by all devices on the bus (not just those addressed to Listen), and are acted on if the device implements the specific function. Recall that the first several bits (X001) distinguish between the Addressed and Universal commands (Table 2).

DCL. Device CLear (last 4 bits: 0100; ASCII 'cntrl-T') is identical to the Addressed command Selective Device Clear, except that it affects all devices on the bus with this capability (DC1,2). See "IEEE-488 Functions: Device Clear."

LLO. Local LockOut (last 4 bits: 0001; ASCII 'cntrl-Q'). Requires RL1 capability and is primarily designed to augment the remote programming capability by inhibiting the front panel Go To Local button present on some devices. Note that during remote operation (RL1,2 capability), devices will not respond to front panel programming,

The Controller can dynamically reconfigure bus participation.

although the Go To Local button will remove them from Remote and restore front panel (Local) programming. Local Lockout must be issued with REN TRUE and will take effect whether the device is in Local (called 'Local With Lockout' state—all other front panel controls *will* be operative) or in Remote ('Remote With Lockout' state), permitting greater security against tampering. Note that if REN goes FALSE, all devices will exit both the Remote and Lockout states and return to the normal Local (without Lockout) state.

PPU. Parallel Poll Unconfigure (last 4 bits: 0101; ASCII 'cntrl-U') turns off the entire Parallel Poll capability of all devices and is the condition of the bus on power-up. See "Addressed Command: PPC."

SPE. Serial Poll Enable (last 4 bits: 1000; ASCII 'cntrl-X') is used by the Controller to determine the Source of an SRQ (Service Request). The proper sequence involves sending an UNListen command (to prevent other devices from listening to the Serial Poll response) and an SPE. The controller then sends a Talk address and listens (ATN FALSE) for a byte response, ending this sequence by sending Parallel Poll Disable when it finds the source (there may be more than one) of the SRQ. An UNTalk command should be sent to disable the last Talker. The Serial Poll capability is a Talk function subset (T & TE 1,2,5,6).

The response from a device asserting SRQ will be a data byte with bit 6 (DI06) asserted (known as a Request Service (RQS) response—see Table 3).

IEEE-488 BUS

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The other bits can represent a variety of internal status conditions (such as data ready, error, or front panel SRQ button pressed), permitting the reason for the SRQ to be determined along with the requestor's identity. Some devices have a programmable mask to determine which of the status conditions will result in an SRQ.

SPD. Serial Poll Disable (last 4 bits: 1001; ASCII 'cntrl-Y') ends a serial poll initiated by the SPE.

Device-dependent messages

Device-dependent messages are simply bytes sent in parallel by a Talker (ATN FALSE) and received by one or more Listeners. This byte can represent:

1. Normal data (measurements by a voltmeter sent to a printer; floppy disk data sent to a microprocessor; etc.)
2. End-of-string indication
3. Device status information (e.g., a Serial Poll status byte)
4. Program codes (usually sent by the Controller acting as a Talker) which alter the internal operation of the device (range, triggering, etc.).

The device dependency comes in as a result of the different forms and uses to which data can be put. The data can be normal data or device programming codes. Data can be binary, ASCII, packed BCD, etc., and it is up to the Talker and Listeners to be in agreement. Devices also differ in their response to or handing of leading or trailing spaces, a negative zero ('-0'), inconsistent use of upper- and lower-case letters, rounding or truncation of digits, etc. Not all devices handle these situations thoughtfully or gracefully.

End-of-string indicators. The Standard does not specify what a device must do to indicate the end of a string. Generally, one or both of the following techniques are used by most devices: *(1)* The EOI line is asserted by the Talker when the last byte of the string is put on the data lines; *(2)* A <cr> (carriage return) or <cr> <lf> (line feed) terminates the string; and *(3)* the string is assumed to be a predetermined length. Some Controllers (or associated software) also have a timeout mechanism that is generally used to break the microprocessor out of its wait loop should something go awry.

This ambiguity can pose problems. For example, I use a HP 3456A system voltmeter which, fortunately, offers several options. Normally, it sends 12 ASCII data bytes followed by a <cr> <lf>, with the EOI line raised when the <lf> is sent. EOI can be disabled. If multiple readings (up to 350) are acquired and then sent on the bus, the ASCII readings are separated by commas, with the end-of-string indication at the end. A packed format is also available, which sends 4 bytes and uses only EOI (no <cr> or <cr> <lf>). In the multiple reading mode, no delimiters or EOI are used until the last byte is sent. Those with a passing familiarity of Microsoft Basic can readily conjure up interesting effects.

Fortunately, most devices provide some flexibility in adapting to this situation. For example, some devices have switch or software options. Also, the software that comes with the Pickles & Trout interface contains explicit commands that determine what it should listen for and send to represent the end of the string.

Device program codes. Program codes are generally sent by the Controller (acting as a Talker) to a device addressed as a Listener. There is no standard regarding how a device will respond to a program code sequence of 'FLOR4T3'. The recent IEEE Standard 728-1982 [4] contains "Recommended Practice for Code and Format Conventions," but adherence is not required,

Powering up a device like the Controller can disrupt the bus.

and many existing devices do not conform. However, this will be a problem only for those who wish to remember the program codes for a variety of devices.

To provide an example: the HP 3456A DVM can be programmed over the 488 bus for function (F1-F5), range (R1-R9), auto zero off/on (Z0-Z1), filter off/on (FL0-FL1), various internal math functions (M0-M9), trigger mode (T1-T4), and a variety of other miscellaneous instrument functions. Sending the ASCII character sequence of 'F1R3Z1FL1T3' to the DVM (previously addressed as a Listener) would cause it to be set for DC volts, 1 volt scale, auto zero and filter on, and single Trigger. The DVM will implement each change as soon as it receives a single complete code (e.g., 'F1').

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The same codes sent to an HP 3497A scanner are entirely meaningless, although no bus errors will result (the scanner, although not the DVM, will beep at you to notify you of its distress under these circumstances).

An example in Microsoft Basic

To convey a better feeling for the operation of the bus and the 488/S-100 interface, an example is in order. Let us imagine that we have a HP 3456A DVM and a HP 3497A scanner with clock. We wish to power up the devices, program them remotely, and gather data. First, however, some preliminary information.

Powering up a device (especially the Controller) can disrupt the bus, so it is wise to have (and leave) all devices turned on that will ever be needed during a sequence of bus operations. Note that the DVM can be remotely programmed to wait until its current reading is transferred over the bus before continuing with another reading (other devices may be made this way by default). The lack of a Listener to handshake the current reading will put the DVM in limbo. Thus the following general sequence is usually necessary:

1. Power up all devices that will be needed. Act as a Controller and send out an IFC and then REN (if the devices are to be remotely programmed).
2. Act as a Controller and send out the Listen address for each device. Then, acting as a Talker, send out program codes for that device.
3. Act as a Controller and configure the bus with a Talker and Listeners, then become inactive or participate in the bus (as a Talker or Listener). Note that as a Listener, the Controller can receive a data byte and (while holding up the final step of the handshaking process), go and process or store it to ensure that no data are missed. When inactive, the Controller will not assert any of the handshaking lines, and thus the bus proceedings will continue without its participation.
4. Be prepared to re-address a Talker and Listeners, respond to a Service Request (SRQ), etc., as needed.

A program to accomplish this is shown in Listing 1.

Final comments

My experience with the 488 bus has been excellent. My system employs a Pickles & Trout 488/S-100 interface board and has performed laboratory instrument control and data acquisition on an essentially continuous basis for four years. About a year ago I switched from CDOS (a CP/M derivative from Cromemco) to Cromix (a UNIX-like multiuser, multitasking operating system from Cromemco); the few problems encountered were very short lived.

The ease and viability of the transition attests to the versatility and excellent design of the 488 and S-100 buses, as well as the particular components I have used. ■

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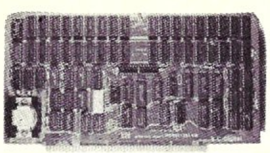

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The Tecmar Graphics Master Color Card

Full IBM compatibility—or 16-color enhancement

by Dov Jacobson

Figures 1a-1d. The same image in four different modes.

The structure of a graphics board reveals the esthetics of its designers. Decisions are made: some features will be incorporated, others must be left out. These decisions add up to a sense of what's useful, what's marketable, and what's beautiful.

In examining the Tecmar Graphics Master, we'll approach it from the outside. Starting with the video signals it emits, we'll work our way inward, into the chips and upward to the controlling software.

Video

The Graphics Master can replace, augment or accompany the standard IBM display boards—the monochrome and the color adaptors. Fifteen different hardware configurations allow every permutation of Graphics Master(s) and Monochrome and/or Color Adaptors. (These configurations are realized by resetting a dozen of the scores of tiny blue jumpers that are sprinkled across the board.)

Figure 1a. 720 x 704 monochrome (IBM monitor).

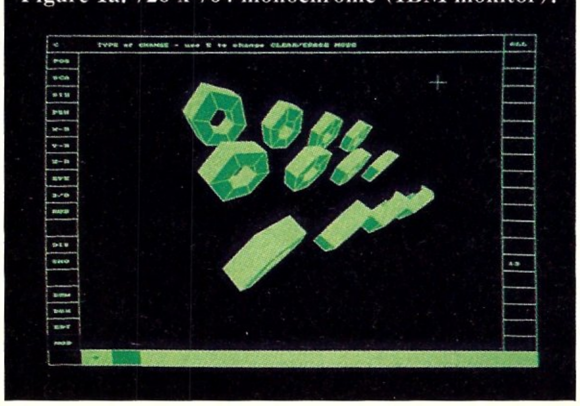
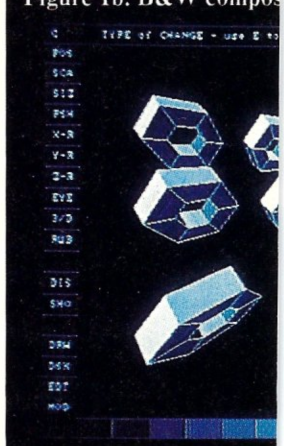


Figure 1b. B&W compos



In order to do this, the card has to

provide the proper signals to four different types of monitors: the IBM RGBI color monitor, the IBM monochrome monitor, black and white video monitors and NTSC color monitors. Each of these monitors is treated differently by the Tecmar.

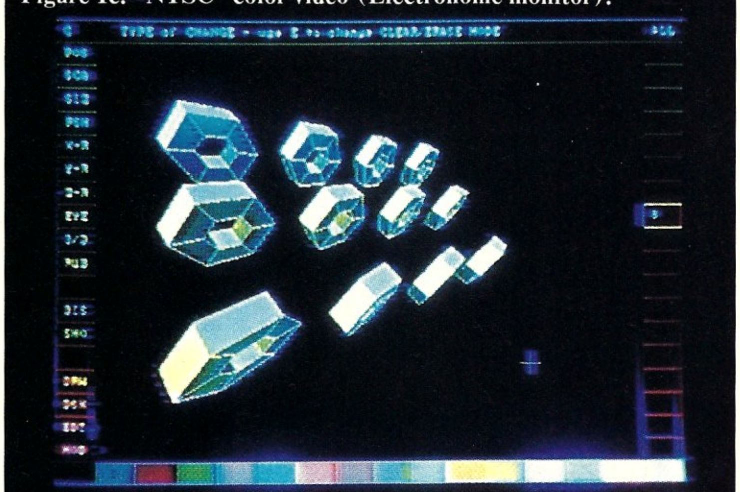
1. RGBI. The standard IBM-style color display is a TTL-level RGBI monitor. This monitor recieves six distinct simultaneous signals from the 9-pin D connector. Two wires carry the synchronization signals. (One indicates the start of a new field, the other triggers the start of each scan line.)

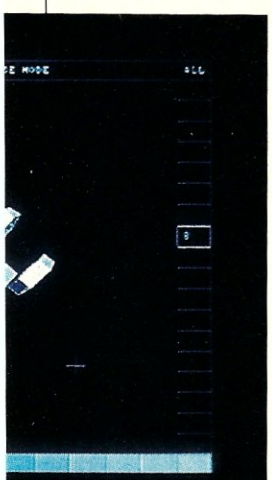
The other four lines supply the graphics information. Three wires power the red, green and blue guns of the monitor. In the TTL world, a signal is either on or off. Likewise, the guns of a TTL monitor. While its analog cousins can modulate through a few million shades of red, the digital RGB monitor has only RED.

Figure 1d. 640 x 400 RGBI (Amdek Color II monitor).

Images created with Artwork software

Figure 1c. "NTSC" color video (Electrohome monitor).





This situation is improved somewhat by the final signal, Intensity, which doubles the range of colors. We now have, for example, two shades of red, one brighter than the other. The same is true for all the other colors. Adding this 'I' to make 'RGBI' means we have four bits of information—16 colors.

These are 'hard' colors with simple names: red, green, blue, cyan (blue+green), yellow (red+ green), magenta (blue + red), grey (red+blue+ green). Each color comes in dark and light. No "apricot," no "burnt sienna." Nothing fancier than light magenta.

The Graphics Master puts out an excellent RGBI video signal. Its solid blacks and crisp pixel boundaries were a bit startling. I've had my color monitor for a a year and a half, using a different display board of similar resolution. When I first plugged in the Graphics Master, I was surprised at how good my monitor became! Though the resolution was the same, the display was sharper and richer.

The major disappointment here is that Tecmar chose to remain in the crude world of digital RGB, with its 16 hard colors. With a few DACs, and 48 bytes of look-up tables, Tecmar could have produced a board with soft (user-definable) colors. This is decidedly the trend in modern display boards. It is becoming clear that one of the easiest paths to sophisticated graphics is to allow artists to break out of the digital palette which produces 'computer-like' images.

2. Monochrome. The same 9-pin jack can supply a signal for the IBM monochrome display, and the same two sync pins drive vertical and horizontal timing. The Intensity wire still boosts the brightness. But instead of R, G & B signals, there is a single Video line.

Despite the similar pinouts, the synchronization signals are very different from those for the RGBI monitor. So different, in fact, that it is quite possible to blow out your monochrome monitor by feeding it the color signal. (The Graphics Master User Guide makes mention of this.) Rather than 262.5 lines per field at 60 fields per second, the monitor is driven at 352 lines per field at 50 Hz. This is what gives monochrome displays their higher quality—the pitch of the scan lines is finer. A character on the normal RBGI display is formed in an 8-scan-line-high row (only 200 scan lines are visible). In monochrome, the characters sit in a 14-line row (350 lines are visible). The increased quality of the letterforms is obvious.

The Graphics Master takes this one step further by allowing you to interlace this monochrome signal, so that the number of scan lines can be doubled to a magnificent 704 visible lines.

Using the Graphics Master with an IBM monochrome monitor in this mode is quite exciting. There are twice as many pixels (506,000) as the 640 x 400 dimensions generally accepted as high resolution. In particular, it is the closely spaced scan lines that make the image so lovely. You've never seen video like this on a micro—or anywhere.

TECMAR

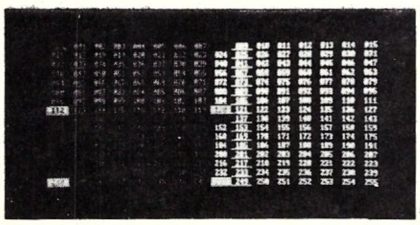
Continued from page 107

Standard monitors, even $2000 studio monitors, display about 500 lines of image. With 700 lines, the scan lines are finer; there is a reduction in video artifacts such as aliasing (the staircase effect of straight lines breaking as they cross the video scan lines).

The long-persistence phosphors of the IBM monochrome display add to the luxurious smoothness of this mode. For example, a common problem in high-resolution interlaced displays is the single-pixel-wide horizontal line. Such a line will be displayed on only one field. If it is on line 21, say, it will show on the field that displays the odd lines. The next field will show only even-numbered lines. Line 21 will not display. What you have, then, is a line on the screen which flashes on and off 30 times a second. On a normal display tube, this is irritatingly obvious (such as in the 640 x 400 color mode). In high-end CAD systems, special long-persistence screen phosphors time-blur this jitter out of existence. The IBM greenscreen does exactly the same thing. High-speed motion will leave 'trails,' but some of us find that attractive.

3. Composite black and white. This is the baseband video that can drive a video monitor. It is the same kind of signal produced by a black-and-white VCR or TV tuner. There is only one signal line (which comes out from an RCA jack). This complex analog signal contains an amalgam of the two sync rhythms superimposed over the luminosity information.

Notice that now there is only a single channel for the brightness which is to paint the video image. However, it is



Figures 2a-2b. The 256 available video attributes. *(Each three-digit number is the attribute in decimal.) 2a: standard IBM display.*

an analog signal, so it can assume a range of values. It is at this point that the designers of the Graphics Master made an interesting decision. They decided to map the 16 colors of the RGBI spectrum that stagger from green to cyan to red, etc., into a smoothly ascending range of grey tones. Thus they opened a path for beautiful black and white video. But they burned some bridges—these black and white video shades do not correspond to the four monochrome shades. Nor do they correspond to the relative brightness of the RGBI colors. Even more drastic, as we'll soon see, are the constraints this puts on color video.

The intent is clear. You can easily distinguish any of the 16 colors on a black and white monitor. With a chart or a diagram, the ability to simply distinguish is all that's important. However, the relative brightness of the colors has not been maintained. Sometimes this is important: shaded illustrations and many other types of artwork rely on a known tonal range. Software and imagery that exploit the fine scale of greys available in black and white will look absurd in RGBI. Likewise, imagery that

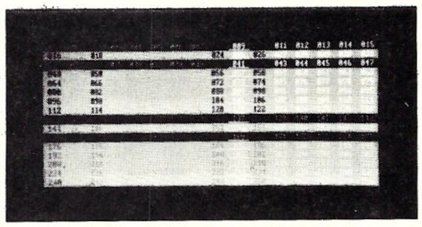
When I first plugged in the Graphics Master, I was surprised at how good my monitor became.

looks good on the computer monitor may have an unexpected appearance in black and white.

4. Composite color. This signal is the same as the black-and-white composite video, with the addition of color information. NTSC color is controlled by phase shifts of the chrominance frequency. This is, inevitably, a crude way to represent color, with far less resolution than is available in RGB, or even in black and white. No NTSC-compatible display board or monitor can exceed the limitations of the standard itself.

Tecmar's designers have opted for clarity over color. More importance was given to putting in additional modes than to having a composite color mode that will never look very good. The grey scale that is built into the black and white dominates the tonality of the color image. The result is that the relationship of the RGBI colors to the composite colors is very strained.

The color signal itself seems slightly substandard. In certain displays (large areas of black, for instance) the chroma signal gets very hard to lock onto. Only by minutely adjusting my Electrohome could I get a color picture. This problem does not exist in pictures



2b: Tecmar Graphics Master. *Display showing various video attributes.*

with large areas of color, or with software, such as the Flight Simulator, that creates artifact chrominance.

Incoming video

One interesting but unexplored feature is a connector on the board that can accept external sync signals to drive its internal clock. The significance of this is that it makes possible the overlay of graphics from the Tecmar board onto other video sources: disk, tape, camera, etc. (The mixing must be done externally.) Unfortunately, the connector requires separate horizontal and vertical sync. This will no doubt provide a challenge for most of us.

Memory

The mass of any display board is brute memory. Every pixel on the screen corresponds to a particular set of bits in RAM. The number of bits per pixel is equivalent to the number of colors supported. A strictly monochrome (on or off) display requires a single bit. A 256-color screen would require a byte. With the Tecmar board, the highest resolution supported is 640 x 400 (horizontal and vertical, respectively) with 16 colors. This is 640 x 400 x 4 bits = 1,024,000 bits = 128,000 bytes (125K).

This is a fairly large amount of memory to squeeze into the address space of the PC, particularly since Tecmar would like you to put two or three of these boards in your system. It is commendable that the designers tackled this problem, even more so because they solved it so deftly. First, you can relocate the starting address of the board at A0000h, C0000h, or E0000h. Even better, the memory is banked—only 64K appear on the bus at any time. Bankswitched video RAM is a feature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only beginning to appear on other boards (such as the elusive Number 9) which maintain far more memory.

Switching the banks does not affect the video image—it only changes the 8088's view of video RAM. This is because the video RAM is addressed independently by the 6845 (video display chip) and the 8088. This concept of dual-ported memory, essential to a video frame buffer, presents an important issue. To put a dot on the screen, the 8088 must write to the appropriate RAM chip. The same chip must be read by the 6845 in order to display the dot. The problem is, the chip cannot be written to and read from simultaneously.

An important concern is arbitration of access to the Video RAM. In the standard IBM display, it is the responsibility of the software to avoid collision. The 8088 watches a register on the 6845 and waits for a horizontal retrace before writing to the screen.

On this board, there seems to be assistance from hardware. I wrote a rude little program that writes to the screen without waiting for a retrace. On the IBM monitor, this causes snow, but on the Tecmar board, it caused none. This protection doesn't seem to function in the higher resolution—some snow was visible in the 640 x 400 x 16 color mode.

Software interface

A display board is fairly worthless without software controls. You can approach the board directly by moving your own bits around in the video RAM, or you can display images using the supplied graphics functions. For the former, the road is rough—Tecmar's manual does not deign to supply more than slim clues as to the arrangement and location of video memory. I/O addresses are kept secret, as are the mechanisms of bankswitching. This kind of obscurity on the part of manufacturers about the details of their products is terribly frustrating—and ultimately, it is self-destructive. Apparently, Tecmar has finally come to the same conclusion—a spokesman there says a technical reference manual is now being prepared for release.

For the programmer, Tecmar provides a somewhat confusing collection of little routines whose functions all seem to mysteriously overlap (including a number of .BAT files beginning "echo off"). On the other hand, they also provides a very useful package called the General Terminal Emulator. [*Editor's note: Tecmar has announced a major new version of the software for the Graphics Master, for release by the time this issue goes to press.*]

General terminal emulator

The Emulator is delivered as a device driver, called *GM:*, which is loaded by CONFIG.SYS on bootup. As a device driver, it can be treated with considerable flexibility. For instance, with

Tecmar's designers have opted for clarity over color.

two monitors, you can have one as CON: and the other as GM:. You can copy a file to GM: while you work on CON:, and see both files at once. In programming for the Graphics Master, the GM: driver can be addressed as if it were a file.

The Emulator seems plagued by Tecmar's attitude of anxious generosity. The user is swamped by scores of commands which more or less duplicate one another. Actually, the driver aims to fulfill several goals at once. It interprets VT-100 CRT formatting escape sequences. It interprets, as well, the VT-52 series of sequences and the ANSI standard escape sequences. Over this salad of generalized screen manipula-

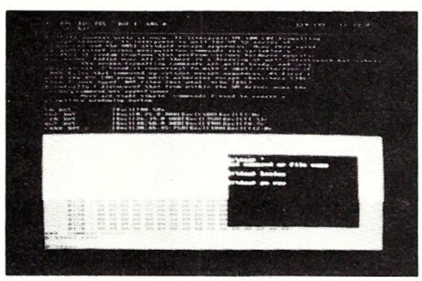

Figure 3. 50-line display, with windows.

tion commands is sprinkled a handful of random croutons that perform various hardware-specific functions. Ladled over all of these is a dressing of well-intentioned but unbelievably sluggish graphics commands.

The screen formatting commands are quite handy and very easy to use. At first I used the ESC.COM program, which sends an escape character (1Bh), followed by whatever was entered after the **ESC** command on the DOS command line, to the GM: driver. Then I tried creating .BAT files in the format "echo Esc xxx," where 'Esc' is the literal escape character, 1Bh, and 'xxx' is a string of literal characters. (You must have an editor, such as PMATE or XyWrite, that allows a literal Esc to be entered into a file.) I discovered that, from within the GM: driver, even the **echo** command was superfluous. Finally, I found it convenient to make a small collection of .BAT files that summoned up various escape sequences.

The following is a group of six simple escape sequences that can be used to create a primitive windowing system. Note that this windowing is based on a 50-row screen, double the normal height. This mode is surprisingly legible, especially on the monochrome screen (please note that, in the following sequences, 'Esc' represents the literal character, '1Bh.'):

50.BAT—Esc[!80;50a

The command **'50'**, throws the display into 80-column, 50-row display mode.

BOT.BAT—Esc[40;50;0;80R
Esc[49H Esc[!0;7c

BOT sets up a 10-row, full-width window on the bottom of the screen. The first escape sequence (Esc[. . . R) establishes the window—it extends from row 40 to row 50, and all the way from column 0 to column 80. (The driver will include the first coordinate and exclude the second—0;80 is 0 through 79). The second sequence (Esc[. . . H) positions the cursor at the bottom of the window. This is done so that whatever information is in this window from previous use will be scrolled up, not overwritten. The final sequence (Esc[!. . . c) sets the foreground and background attributes, or colors in a color display. This setting calls for 'normal' reverse video.

CEN.BAT—Esc[26;40;0;80R
Esc[39H Esc[!1;11c

CEN establishes a full-width window just above BOT and below TOP (rows 26 through 39). It sets the cursor down at the bottom of this window, and sets up high-intensity, underlined reverse video, a very nice effect that looks like lined legal paper.

CRNR.BAT—Esc[30;45;45;75R
Esc[44H Esc[!12;0c

CRNR sets up a small window in the lower right-hand corner of the screen that overlaps parts of both BOT and CEN. The window is 15 rows high (30 through 44), and 30 columns wide (45 through 74). Since the two windows it overlays are reverse-video fields, this window has a black background and a high-intensity foreground.

TOP.BAT—Esc[0;25;0;80R Esc[25H Esc[!7;0c

TOP reserves the entire top half of the screen as its window, and uses the normal video attributes. My first window arrangements were more clever and designy than simply lopping the top half of the screen off. I ended up with this, however, for some functional reasons. Many programs (BASIC, Wordstar, PMATE, etc.) perform their video I/O by directly writing to video RAM rather than making DOS calls, which would be channelled through the GM: driver. In this 50-row mode, however, the normal video RAM ends up at the top of the screen. Therefore, this window exactly overlaps the unchangeable 'window' used by these screen editors, and by many other programs.

25.BAT—Esc[!80;25a

The command **'25'** resets the screen to the standard 25-character mode. This will clear the screen as well.

Graphics programmers can use GM: escape sequences to implement several useful graphics primitives. The sequences include some moderately sophisticated commands—'smart' lines, XOR drawing style, and dithered color, for example. However, these commands, as a group, are far from being a package which will satisfy the ACM CORE specification—or a serious graphics programmer. For instance, there is no filled polygon available, yet. The worst problem with these sequences is that they are painfully slow.

On the other hand, the advantage to these graphics escape sequences is that they can be treated like text—they can be included in files, written directly to the GM: driver, or delivered over phone or terminal lines to anyone with the GM: driver and a Tecmar board. Sort of like NAPLPS, but without its elegance, brevity and integrity. It does, however, share with that teletext/videotex standard the crippling concept of one-way communication with the display. (For instance, there is no way to read the current cursor position.)

An alternative for programmers of interactive graphics is Halo, a proprietary library of graphics primitives that includes Tecmar in the display boards it supports.

Halo is by far a superior package, both in terms of its wealth of useful functions, and the skill with which these functions are implemented. They are very fast, and generally use sophisticated standardized interfaces, such as 'world coordinate' systems. Full communication between your software and the graphics drivers is aided by a raft of 'INQuire' functions.

Its disadvantages are that, unlike the GM: driver, its files require Halo executing in the foreground, as well as linking a lot of code into your program (30 or 40K, with modest use of Halo). And, unlike the GM: driver, it doesn't come free with the hardware.

The long-awaited port of Halo to the Tecmar board has some nice features—and a few compromises. Halo supports 11 different graphics modes: 7 color, 4 monochrome. This contrasts with 19 monochrome and 18 color modes supported by the General Terminal Emulator. Of course, the greater number includes quite a few obscure and fairly useless variations, but it does represent better support of low-resolution modes. They may not be very sexy, but they do have their place.

Halo prevents you from entering a color mode if the Tecmar switch indicates monochrome. This is sure to save some monitors. It also prevents the reverse from happening, which will prevent at least some confusion.

One slight disappointment in the Tecmar version of Halo is that, in the high-resolution mode, it has to write so much to the screen that it doesn't wait for the horizontal retrace—and there is no hardware control over access in high-resolution mode. Consequently, there is a little snow during writes. Software that constantly maintains a cursor will have a few flicks of snow. This,

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however, seems to be a small price to pay for the resulting speed.

Bugs. The GM: software seemed to reveal an occasional minor bug: the VT-100 **Set Scrolling Area** command is less reliable than the equivalent **Set Page** command. An occasional aberrant background color also crept its way back into existence after I'd thought it was banished for good.

More frustrating is an erroneous (or, at any rate, non-standard) interpretation of some monochrome attribute codes. This seems to be a bug in the display firmware, rather than in the GM: software. The sophisticated displays of some of my favorite software are rendered incorrectly, and not necessarily legibly. (See the photos showing attributes as displayed by the Graphics Master and by the IBM board.) Each three-digit number indicates the attribute byte (in decimal) with which it is colored.

Summary

We have seen, in the Tecmar Graphics Master, a well-thought-out and well-executed board whose design proceeds from certain assumptions. For instance, the dominance of the IBM standard RGBI and monochrome displays has been taken for granted, as well as the insignificance of composite monitors.

Working with the Graphics Master has given me more than just a nice color display. It has allowed me to play with 50-line screens, simple windowing, and redirection of screen output. Best of all, it has allowed me to rediscover the beauty of black and white—or, more precisely, green and white.

Stop the presses! A new disk has arrived from Tecmar. As usual, they're trying to drown the user—there are two dozen pieces of software on the disk. There isn't time to sort them out, much less conscientiously review them.

However, Tecmar users can apparently look forward to a more interesting and thorough set of resident drivers for both graphics and screen control. One particularly nice program, GMBIOS, allows you to snap from one display to another, even while within a program. (I found this quite handy while working on my own software, which must look good in both color and monochrome.)

This seems to be a taste of the future—the computerist surrounded by a number of screens. For those who own only a single monitor, the Tecmar board and GMBIOS will allow you 64 virtual monitors! You can jump at will to any of (up to) 64 video "pages"—full independent screens.

GMBIOS has a number of other neat tricks—you can use the idiosyncratic IBM greenscreen with any color board, and vice versa. You can make all kinds of intimate adjustments to any

There is a reduction in video artifacts such as aliasing.

display at any time—turn on interlace, for instance, or adjust the position. It provides a "screen saver"—after five minutes of inaction, the screens go blank until any key is struck. This part I found incomplete—the only keys that would restore my screens were Ctrl, Alt, and Del—depressed simultaneously. While this may have been saving the screen, it didn't do the rest of my system much good.

Dov Jacobson, 157 Pelton Ave., Staten Island, NY 10310.

Co-Power-88: The SWP 8088 Coprocessor

Add MS-DOS to your CP/M-80 system

by James G. Owen

Co-Power-88 is an enhancement that can be installed inside various Z80 computers, including the Kaypro models 2 and 4, to provide 8088/MS-DOS capabilities. Made by SWP, the package comes with 256K of RAM that can be used as a RAM disk when the computer is being operated in the Z80 mode. A new version of the Co-Power that will hold up to 1 MB of RAM has been announced by SWP, and should be available by the time you read this. Kaypro markets a version of their model 4 (the Kaypro 4 Plus 88) that has the Co-Power option installed; owners of the Kaypro model 2 or model 4 can purchase the cardset for $500 and install it themselves—this is the package reviewed here. There is also a version of Co-Power, priced at $600, for the Kaypro 10 computer with hard disk, as well as versions for Kaypro 2/82 and 4/84, Morrow, Osborne I, Bigboard, Zorba, and SWP ATR8000 computers.

The hardware

SWP recommends "that the Co-Power-88 circuit boards be installed by a qualified service technician"—and this should be taken seriously. While the basic idea is straightforward and the installation requires no soldering, any project of this kind can present problems. And, of course, opening the Kaypro box could void the warranty.

The Co-Power hardware consists of two cards: an 8088 CPU card with 256K of memory, which is about 7″ x 6″ and mounts on a supplied bracket; and a much smaller card that plugs into the Kaypro board in place of the existing Z80 CPU chip. The Z80 chip, in turn, plugs into this small card. When I attempted to install the small card, the disk bypass capacitors on my Kaypro board prevented a tight fit. I gently bent them over, assuming that SWP had not anticipated this kind of capacitor. As it turned out, this was not the case: SWP had already encountered the problem and solved it by supplying an extra socket to be installed between the card and the Kaypro socket. Unfortunately, this socket was missing from my shipment, and for the first few readings the directions did not make any sense without this missing part. In situations like this, experienced service technicians (such as this writer) just plow ahead; less hardware-minded, more cautious individuals might find an experience like this upsetting.

The Kaypro box contains a fair amount of empty space, but installing the Co-Power main circuit board takes up a lot of it. Wires have to be pushed around and, when installation is finished, ventilation for the disk drives seems to be obstructed because the Co-Power CPU board is mounted directly behind them. I encountered no operational problems, however, and the disk drives don't seem to be getting any hotter than they used to.

Indeed, once installed, the Co-Power hardware worked flawlessly. When the machine is first turned on or reset, the system is unaware that the Co-Power is present, and Z80 operation is completely normal.

SWP's advertisements specify that the 8088 is run at 5.33 MHz. No technical data or schematics are included.

The RAMDISK program

Two Z80 programs are included in the Co-Power package: RAMDISK and MSDOS. The first sets up and manages a disk emulation system that can be used with the CP/M-80 system but *not* with MS-DOS; the second allows MS-DOS to be booted.

A *RAM disk* is a software-controlled portion of memory that can be treated as if it were a disk drive; programs that use such a pseudo-disk execute disk operations much faster than do programs on a real drive. The Co-Power RAM disk suffers the usual drawbacks of such an arrangement: the psuedo-disk does not retain data when power is switched off, nor, of course, is it removable. On the other hand, it is really fast. I am using WordStar to write this, and when I use the ctrl-Y function to yank a line, I don't have to wait a couple of seconds while the Yank overlay is loaded from disk—it gets into the TPA in a hurry. To take advantage of this, I had to copy WordStar and all the overlays to the pseudo-disk, and I'll have to do that every time I turn the machine on, but it's definitely worth the effort.

The RAMDISK program provides a number of options, one of which assigns the drive letter. Any letter can be assigned to the RAM disk; if you pick A or B, then the letters normally assigned to those physical devices are bumped up, as appropriate, by the ingenious RAMDISK software. However, if you want the RAM disk to be drive A:, the software insists that you use standard CP/M 2.2. I didn't, and sure enough my system would not work using A: as the RAM disk. Other options are related to directory initialization, and the installation address of the RAMDISK filter program. Default values are supplied for everything, and the inexperienced user can operate the program easily by using a command such as

RAMDISK *

which would cause the pseudo-disk to be set up on drive M:.

One peculiarity of the system is that after things crash—as they sometimes do—the Co-Power board may lose its way, requiring a manual reset to get RAMDISK working again. This is fully described in the documentation. You are also warned that RAMDISK will not necessarily work with all programs—however, I would expect it to work with most. Not documented was the requirement that the computer be reset when going from RAMDISK to MS-DOS.

The 8088/MS-DOS system

The whole point of the product is, of course, to allow you to run MS-DOS on the 8088 CPU. To boot the 8088 op-

The RAMDISK program speeds up 8-bit development tasks.

erating system, you first execute the command **MSDOS** under CP/M-80, then insert an MS-DOS system diskette in any drive, and enter the letter of that drive via the console keyboard. After a little disk churning, MS-DOS signs on and asks you for the current date in a format that it doesn't explain (hint: don't enter the day of the week—just the month, day, and full year, separated by hyphens). Or, you can skip the entry of date and time by entering carriage returns. However, once you have entered the date correctly, files will be timestamped, even though the Kaypro/88 does not have a hardware clock, so the time-keeping function of MS-DOS is by no means wasted. When you wish to return from MS-DOS to the normal Kaypro CP/M-80 operating system, simply execute the command **Z80**, switch diskettes, and type any character.

This arrangement places something of a burden on people who intend to do software development on the Co-Power, since after a program or system crash, the booting procedure can be tedious. Using a diskette that automatically executes **MSDOS** speeds things up a bit, and Kaypro's disk copy program can create such a diskette.

How it works

The 8088 and Z80 systems communicate with each other through a few I/O locations. There does not appear to be any memory sharing; the connection between the Z80 system and the main 8088 card has only 16 conductors, terminated with 16-pin DIP headers at both ends—not enough to contain both the address bus and the data bus without major contortions. However, this arrangement avoids complex and expensive shared-bus mechanisms.

According to SWP documentation, the usual MS-DOS system files, IO.SYS and MSDOS.SYS, are replaced by MSDOS.COM in the CP/M load process. This implies that the MSDOS.COM file contains the necessary Z80 I/O handler and an image of the resident portions of MS-DOS itself. The 8088 card apparently contains a ROM that loads the MS-DOS operating system from the port that communicates with the Z80, instead of the usual process of loading it from diskette.

The Z80 file, MSDOS.COM, remains resident in the Kaypro 64K memory, and services all I/O requests as the 8088 card makes them. Simultaneously, the Co-Power main card executes 8088 programs in its 256K memory space. It appears that the 8088 cannot talk directly to any I/O devices; instead, it talks through a port to the Z80, which performs the physical I/O operations and returns information through a port to the 8088.

Indulging in a little more speculation, I doubt that the Z80 is placed in a hold or wait state while the 8088 computes—or vice versa—so it's probable that the system does indeed offer real coprocessing, the Z80 handling I/O while the 8088 is computing. This won't usually produce any noticeable speed increase, since a single-user system such as MS-DOS is usually I/O-bound rather than compute-bound.

What you get

The MS-DOS that I received was version 2.11. For CP/M afficionados unfamiliar with MS-DOS, it has UNIX-like features such as hierarchical directories (which allow highly efficient organization of files), and piping (which allows the output of one program to be automatically sent to the input of another), as well as intuitive command specifications (in MS-DOS, you COPY FROM_FILE TO_FILE rather than PIP TO_FILE=FROM_FILE, as you do in CP/M).

The package did not contain any compiler, interpreter or assembler—though, strangely enough, a linker was included. *(Editor's note: The above condition is the usual MS-DOS environ-*

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ment, created by the marketing practices of the operating system vendor (Microsoft), and is not unique to the SWP product. The linker is included as part of the O/S package because it is common to compiler languages such as C and Pascal, as well as assemblers. The assembler ASM, the macroassembler MASM, and the library manager LIB are marketed as a separate package. Policies on bundling software are different for various retail vendors; however, based on the prices of other products of similar value in the industry, the cost of the SWP product is very reasonable, even without any extra software bundled in.) I don't know what programs are included with the Kaypro-supplied version of the Co-Power system—check before your buy.

Compatibility

The Co-Power system should be able to run all software that uses standard MS-DOS function calls. Unfortunately, the version of MS-DOS that runs on the IBM PC, called PC-DOS (and sometimes just plain DOS), has features and extensions that are not standard MS-DOS function calls. In particular, the IBM has memory-mapped video I/O, and PC-DOS allows application programs to interact directly with the video RAM. Much software has been written, especially screen-oriented applications, that takes advantage of the speed increase gained by writing directly to the video RAM.

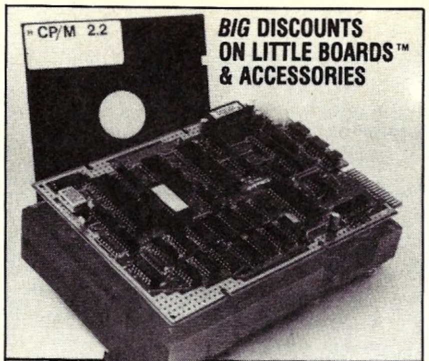
The SWP documentation indicates that some non-MS-DOS "PC ROM" calls are supported in the Kaypro/88 system—specifically, those associated with the activation of function keys (which must be simulated on the Kaypro by escape sequences), and escape sequences that access the line-editing functions. However, any program that writes directly to the IBM screen will not run correctly on the Kaypro/Co-Power system. I've read that Kaypro has a list of programs that will run with the system, and a reasonable amount of MS-DOS (as opposed to PC-DOS) compatible software is available.

The disk formats, at any rate, *are* PC-compatible. This means that you can go to your local computer store, purchase a diskette with an IBM PC program on it, put it into the Kaypro/88 system, and read the directory or copy files from it. It does *not* mean that the program will run on the Kaypro—that depends on the issues discussed above. Both single- and double-sided diskettes are supported, and the system appears to be able to tell which is which. In addition, a formatting option allows the creation of diskettes using the standard format of MS-DOS 1.25, which is different from that of 2.0; the system can, of course, also read DOS 2.0 diskettes. There is a program, called UNIFORM, available for transferring Kaypro CP/M files to MS-DOS, and vice versa.

The MS-DOS system appears to send print output to the CP/M-80 BIOS; thus whatever printer works with the normal Kaypro system should also work with MS-DOS.

MS-DOS documentation

Included in the Co-Power package is about 20 pages of SWP documentation and a sizeable softcover edition of the MS-DOS 2.0 User's Guide. The SWP documentation was adequate, describing the various operations necessary to enter and leave the system, format and back up diskettes. The MS-DOS User's Guide is a complete and detailed book, with a useful index, but, oddly, no table of contents.



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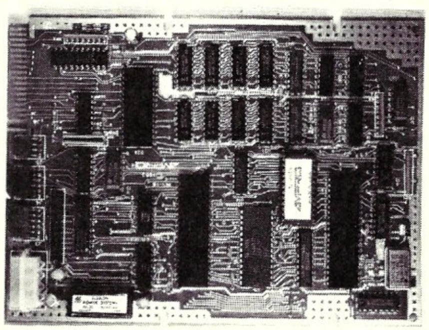

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Co-Power-88

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Support

In the short time I have had the system, I have encountered one possible bug: on a few occasions it seemed to forget to turn off drive B:, and I had to access drive A: to catch its attention. It is certainly possible that there may be more bugs, which brings us to the issue of support.

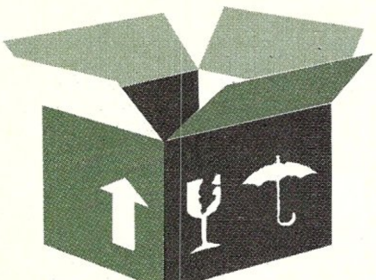
I have called SWP twice. The first time, I was connected quickly to a technical person who seemed reasonably well informed. The second time, the technical person was not immediately available, and my conversation with a sales representative proved to be unfruitful. I didn't make an effort to continue the investigation. I am content in the knowledge that SWP answers their phones, and that they have at least one technical person who is thoroughly acquainted with the product. If you think you'll need a lot of technical information and support from SWP, be aware that there may be some delays in getting through to the right person.

Conclusion

The SWP Co-Power-88 system will not make the Kaypro into a PC-compatible system. However, the Kaypro models 2 or 4 alone—even without *any* PC/MS-DOS capability— still make a pretty good deal for many small business applications, since both models come bundled with a selection of useful software. With MS-DOS added, they become especially attractive.

The SWP product is an attractively priced package, particularly for system and software developers interested in MS-DOS and the Intel family of 8086/88 processors. While other 8086/88 add-on accessories have appeared, Kaypro's decision to include the SWP product into the Kaypro 4 Plus 88 is, for my money, an important plus. I feel the package would be considerably more attractive if SWP had found a way to include an assembler and technical documentation. Even without it, however, I think the enhancement is worth investigation by those who want a relatively inexpensive system that can cope with both CP/M-80 and MS-DOS, and who don't place a high priority on running off-the-shelf IBM PC applications. The RAMDISK program is a valuable extra, and certainly speeds up typical 8-bit development tasks. For information, contact *SWP, 2500 E. Randol Mill Rd., # 125, Arlington, TX 76011; (817) 469-1181.*

James G. Owen, 35 Admiral St., Port Jefferson Station, NY 11776



New Products

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

HARDWARE

Alphacom 42 printer

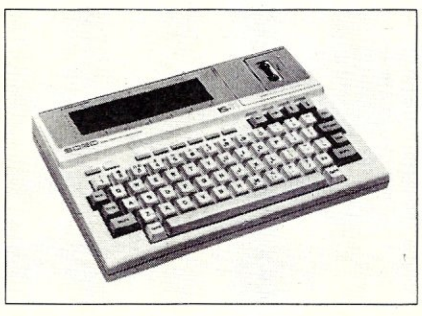
Alphacom, Inc. has announced a price cut on its 40-column Alphacom 42 "universal" printer, lowering its suggested retail price to $99.95, which includes an interface cable. The printer itself may be purchased separately at a suggested retail price of $79.95. Interface cables are available separately for $20 (except the cable for the Texas Instruments 99 4/A, which is $40). Alphacom 42 has upper and lower case letters and a wraparound facility for printing text lines longer than 40 characters. It also recognizes standard ASCII control, or "action" codes for changing the printing mode, which include carriage return, linefeed, right justification, formfeed, graphics control, and multiline feed.

The Alphacom 42 combines a single-chip microprocessor and a proven Olivetti print mechanism using advanced thermal technology. The unit is packaged in a lightweight, impact-resistant plastic housing that covers the paper roll for a low-profile, sleek look. It operates at two lines a second, and features bit-mapped graphics. **Alphacom, Inc.,** *2323 South Bascom Ave., Campbell, CA 95008; (408) 559-8000.*

CIRCLE 284 ON READER SERVICE CARD

Portable computer with windows

The IS-11 briefcase-sized portable computer offers an integrated software package and multiple-windowing capabilities, measures $11^{13}/_{16}'' \times 8^{7}/_{16}'' \times 1^{7}/_{16}''$ and weighs only 4lbs. 16 oz. It has an 8 × 40 bit-mapped LCD display that is angle adjustable, user memory of 32K of nonvolatile RAM expandable to 64K and a high-speed recorder supported by



a tape operating system: each tape can store over 128K. CMOS technology permits the IS-11 to operate on internal, rechargable Ni-Cad batteries, which last nearly eight hours per charge. An AC adapter/battery charger is also included. Expandability of the IS-11's capabilities is assured through these soon-to-be-available options: thermal printer, numeric keypad with 16 additional functions keys, $3^{1}/_{4}''$ floppy disk drive, barcode reader and Basic programming module. The "IS" (Integrated Software) package contains modules activated by each of the six functions keys, including:

- I-PIPS: provides data-handling and data-processing capabilities, such as spreadsheet generation, search, sort, calculation, graphics, windowing, directory and print functions;
- I-CALC: provides calculations required in simulations; includes the basic four mathematical functions and other preprogrammed functions, such as subtotal and recompute;
- I-EDIT/I-WP: provides basic text-editing capabilities to produce and store documents; also includes I-WP, a word processing ROM-pack that permits advanced functions, such as cut and paste, as well as search;
- I-COMM: provides data-transmission capability via an RS-232 interface activated by a single command.

Software options presently under development in 64K ROM-pack form includes: Sales-pack, Financial-pack, Business Security-pack, Time-Sharing Systems-pack and Data-Entry-pack. An IS-11B version with a built-in modem is also available, priced at $1,095. The IS-11 currently on the market is priced at $995, and is available from: **Sord Computer of America, Inc.,** *645 5th Ave., New York, NY 10022; (212) 759-0140*

CIRCLE 296 ON READER SERVICE CARD

Desktop printer stand

The WRITE ANGLE desktop printer stand is designed to solve problems often encountered in using printers with personal computers. The rugged one-piece unit, on which your printer can be placed, is angled to allow a convenient view of the material being printed. It is made of clear acrylic, and anti-skid protective feet prevent it from slipping. Room for paper storage is provided in the area below the printer, while its height allows paper to refold automatically.

RP/M T.M.

By the author of Hayden's "CP/M Revealed."

New resident console processor RCP and new resident disk operating system RDOS replace CCP and BDOS without TPA size change.

User 0 files common to all users; user number visible in system prompt; file first extent size and user assignment displayed by DIR; cross-drive command file search; paged TYPE display with selectable page size. SUBMIT runs on any drive with multiple command files conditionally invoked by CALL. Automatic disk flaw processing isolates unuseable sectors. For high capacity disk systems RDOS can provide instantaneous directory access and delete redundant nondismountable disk logins. RPMPIP utility copies files, optionally prompts for confirmation during copy-all, compares files, archives large files to multiple floppy disks. RPMGEN and GETRPM self-install RP/M on any computer currently running CP/M®2.2. Source program assembly listings of RCP and RDOS appear in the RP/M user's manual.

RP/M manual with RPMGEN.COM and GETRPM.COM plus our RPMPIP.COM and other RP/M utilities on 8" SSSD $75. Shipping $5 ($10 nonUS). MC, VISA.

microMethods

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CIRCLE 42 ON READER SERVICE CARD

Extended Processing S100 Boards

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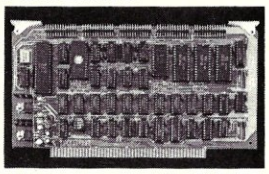

High performance S100/IEEE-696 smart slave computer with 64K RAM, 3 serial ports, 1 centronic port, comprehensive 4K operating system in EPROM and 1 timer. Host access is through a high speed parallel I/O port. Accepts 256K RAMS when available. Optional ADD-ON board doubles I/O and RAM. Standard software and hardware supports 6 serial ports, 2 parallel ports and 512K of RAM. Entire board is software programmable including all I/O buffer sizes.

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64K RAM ADD-ON board:	$175.00
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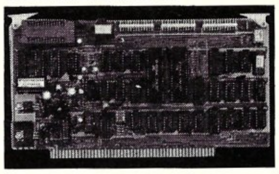
64K and 3S+P ADD-ON board:	$295.00

BURNER I/O II



Multifunction S100/IEEE-696 board. Complete EPROM programmer handles 5 volt EPROMS: 2508, 2758, 2516, 2716, 2532, 2732, 2732A, 2564, 2764, 27128, 27256. Fully I/O mapped. EPROM selected totally with software. No switches or program modules. Menu driven software supplied in 4K EPROM. 2 independent serial ports with baud rate to 19,200. 1 centronic type parallel port. Memory management for address lines A16-A23.

Option A: Full board	$355.00
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Option D: Programmer+I/O	$330.00
Option E: Memory management	$110.00
Memory management for B or C:	$ 25.00

All E.P. boards are built with quality components and are fully assembled and tested. Full documentation including schematics and source code listings.

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CIRCLE 142 ON READER SERVICE CARD

The Image Solution

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

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

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

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CIRCLE 35 ON READER SERVICE CARD

New Products

Continued from page 120

Prices: Two sizes are available. Standard for 9½″ paper: 12″d x 11″w x 8″h, $29.95. Large for 15″ paper: 12″d x 15″w x 8″h, $39.95. Add $2.50 shipping and handling; NJ residents add 6% sales tax. **Northeast Peripherals,** *RD 31, Box 44, Somerset, NJ 08873; (800) 526-0988, ext. 120; in N.J. (800) 272-1321, ext. 120.*

CIRCLE 287 ON READER SERVICE CARD

Smith-Corona's L-1000

The L-1000 Plus daisywheel printer has the following features:

- Both RS-232 serial and Centronics parallel interface ports
- Capability to handle xon/xoff and hardware handshake protocol

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- Bidirectional printing
- Multiple pitch capability
- Easy setting of switches for baud, parity, character length carriage return, linefeed, and for foreign-language wheels
- Automatic underscore
- Programmable margins and tabs
- 570-character buffer
- Low-cost, easy-to-change ribbon cassettes and printwheels
- An optional tractor feed attachment for continuous-form fanfold paper.

Prices: L-1000: $545; optional tractor feed attachment: $149.

Smith-Corona, *65 Locust Ave., New Canaan, CT 06840; (203) 972-1471.*

CIRCLE 285 ON READER SERVICE CARD

SOFTWARE

Program name: MagicPrint
Requirements: text editor, Diablo 630/1650-compatible daisywheel printer or NEC Spinwriter
Minimum memory: 48K
Language: assembly
Description: MagicPrint is a text-output formatter that features true proportional spacing with local and general character spacing, kerning and universal-spacing adjustments to prevent disproportionate gaps between words. The refined line-forming techniques of MagicPrint transform daisywheels and Spinwriters into precision typesetting machines. Other features include text screening with page-break display, automatic footnotes (up to 15 per page) with user-defined designations, automatic handling of widow/orphan lines, multicolumn printing and free-form page heading/footing. MagicPrint also provides all the basic print-formatting functions including boldfacing, underlining, superscript, subscript, accenting, indent (right/left), flush right, soft hyphenation and controls for line length, margins and page length.
Price: $195
Available from:

Computer EdiType
509 Cathedral Parkway, #10A
New York, NY 10025
(212) 222-8148

CIRCLE 300 ON READER SERVICE CARD

Program name: MASS-11pc
Requirements: Digital Rainbow, IBM, or Tandy 2000 PCs
Minimum memory: 256K
Language: Fortran
Description: MASS-11pc offers virtually the same features found in the original MASS-11 running on Digital's VAX computers under the VMS operating system, including generation of table of contents, split-screen editing, list processing, utilities, footnoting, column mathematics, four-function calculator, multiple columns, scientific-equation editing, redlining, user-defined keys, automatic page numbering, stored text, automatic headers and footers, multiple wrap tabs, sub-/superscripts, line drawing and multiple fonts and pitch changes. Also provided are automatic pagination with widow/orphan control. Both MASS-11 and MASS-11pc are compatible with commercial electronic mail services and a conversion utility provide for the transfer of DECmate files into MASS-11. Twenty-five printers are supported, including several laser printers. Documentation is identical for both MASS-11 and MASS-11pc.
Available from:

Microsystems Engineering Corp.
2400 West Hassell Rd., #400
Hoffman Estates, IL 60195
(312) 882-0111

CIRCLE 277 ON READER SERVICE CARD

Program name: Word Wand
Requirements: IBM PC or compatible; MS-DOS
Minimum memory: 256K
Language: Intel 8080 assembly
Description: Word Wand is a multilingual word processing system that can

display onscreen and print all diacritics and graphics needed to correctly process documents in English, French, Spanish, and German. Additional features include hyphen help and micro commands, erase or underline by character, word, line, sentence, paragraph or block, search and replace with option to pause, ignore case and include all occurrences or complete words only, dual-file editing, horizontal split screen and decimal tabbing. Word Wand will drive any printer once it has been installed using the Installation Program, which allows the embedding of commands that alter spacing, pitch, offset the left margin, allow pauses during printing, insert files at print time, nest up to five files, allow the printing of several files in sequence as one document, background printing, mail merge, headers and footers, automatic page numbering with/without headers/footers, printing of specific pages of a document, no numbering of the first page of a document, dual-column paragraph alignment and the printing of accented uppercase characters. Special features include electronic mail receive/send capacity with file encryption, a global reformat procedure and a disk-print routine which allows several users to access a single printer in a shared work environment.
Price: $395 U.S.
Available from:

Tanda Software, Inc.
P.O. Box 244
Orleans, Ontario
Canada KLC 1S7
(613) 235-5127

CIRCLE 302 ON READER SERVICE CARD

Program name: WordMarc
Requirements: Dos 1.1, 2.0, or 2.1; two disk drives or a hard disk
Minimum memory: 256K
Languare: Fortran
Description: WordMarc is a multilingual word processing system that is hardware independent, running on virtually any computer system and driving virtually any printer. Standard features include full-screen cursor-controlled editing, programmable function keys, menu-driven software with menus and prompts in eight languages (English, French, German, Spanish, Italian, Portuguese, Dutch, Swedish) and capacity to process documents of almost any length will full onscreen display and printing of European-language diacritics and graphics. Optional capacity to display and print all scientific graphics and the complete Greek alphabet is also available ($100). Additional features of the multilingual text editor are: document-spelling checker with interactive spelling correction, abbreviation glossary, send/receive document transmission

New Products

Continued from page 123

with encryption/decryption, cursor-controlled document selection/deletion, automatic form-letter formatting with variable insertion and document-name entry with wildcard characters. Special features of the display are horizontal scroll to 168 characters, continuous screen-/page-number display, right-margin justification and sub-/supersripts at six levels. Menus and prompts may be customized: the spelling checker and the hyphenation-exception list may also be updated. Special printing features are automatic hyphenation, all or partial, proportional spacing, select-printing of specified pages, intermixing of single, double or triple spacing, mail-merge option and automatic widow/orphan protection.

Price: $495

Included with price: Complete user documentation, including:

- Installation guide
- User guide
- Tutorial
- Quick-reference guide
- Technical-reference guide
- Alternate-Character template
- Function-key labels

Available from:

Marc Software International, Inc.
260 Sheridan Ave., #200
Palo Alto, Ca 94306
(415) 326-1971

CIRCLE 303 ON READER SERVICE CARD

Program name: Csharp Realtime Toolkit

Requirements: any C Compiler

Minimum memory: 4-6K (compiler dependent)

Language: C

Description: The Csharp Realtime Toolkit consists of five multitasking C-programmer tools, most of which can function independently of one another, as well as of any system processor. Each tool addresses a particular aspect of realtime C programming, allowing the programmer to choose the tool best suited to any task. Each of these tools can be directly accessed by the programmer:

- **Cisr** supports the other Csharp tools and ties directly into critical processor features. Cisr is available in versions that support the PDP-11 processor family, as well as a generic version for other 8- and 16-bit microprocessors.
- **Cevent** provides a high-level interface to external events, such as switch closures and button presses and can count and time these events.
- **Cgraph** lets programmers write portable graphics programs and configure graphics-system parameters by us-

New Products

Continued from page 124

ing C-procedure cells. Cgraph routines support most graphics devices with programmer-specific device handlers.

• **Cshed** controls the realtime execution of C-user procedures, allowing programmers to schedule, cancel and synchronize their tasks. Cshed creates a multitasking environment where each scheduled procedure can turn to completion unless interrupted by a procedure with a higher authority.

• **Cstate** structures process control using state-system notation. State systems are connected graphs of states that describe actions to be performed when a state is entered and the conditions for changing from one state to another. The Csharp Realtime Toolkit, which is distributed in source code, is available under a single source license.

Price: $600

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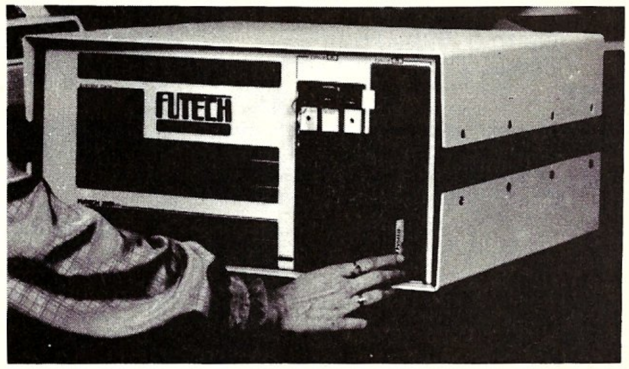

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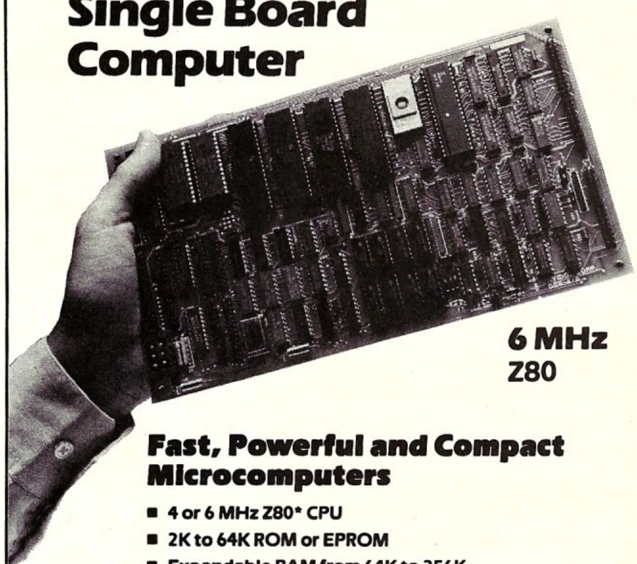

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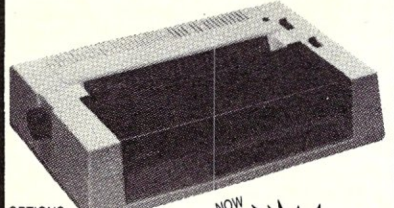

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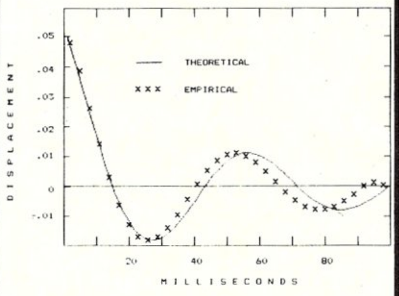

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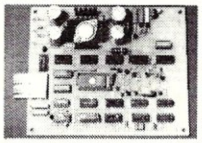

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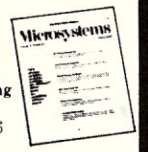

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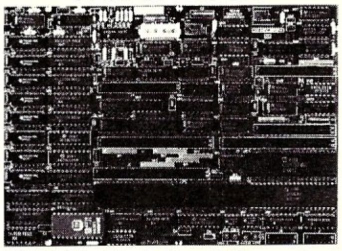

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