BYTE

SEPTEMBER 1988 A McGRAW-HILL PUBLICATION

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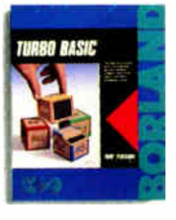

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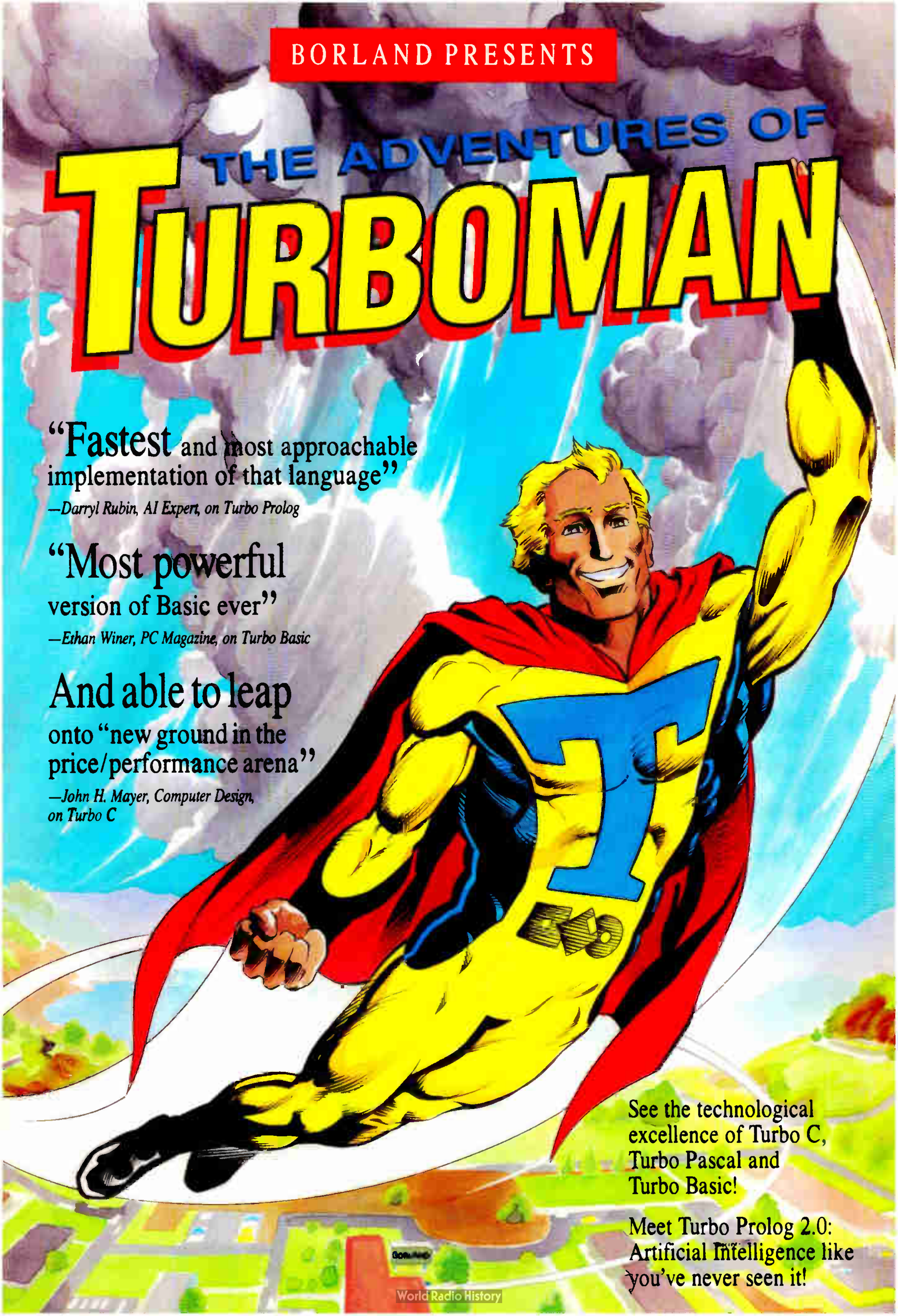
	Turbo Basic 1.1	QuickBASIC 4.0 Compiler	QuickBASIC 4.0 Interpreter
Compile & Link to stand-alone EXE	*3 sec.*	7 sec.	— —
Size of .EXE	*28387*	25980	— —
Execution time w/80287	*0.16 sec.*	16.5 sec.	21.5 sec.
Execution time w/o 80287	*0.16 sec.*	286.3 sec.	292.3 sec.

The Elkins Optimization Benchmark program from March 1988 issue of Computer Language was used. The Program was run on an IBM PS/2 Model 60 with 80287. The benchmark tests compiler's ability to optimize loop-invariant code, unused code, expression and conditional evaluation.


BORLAND PRESENTS
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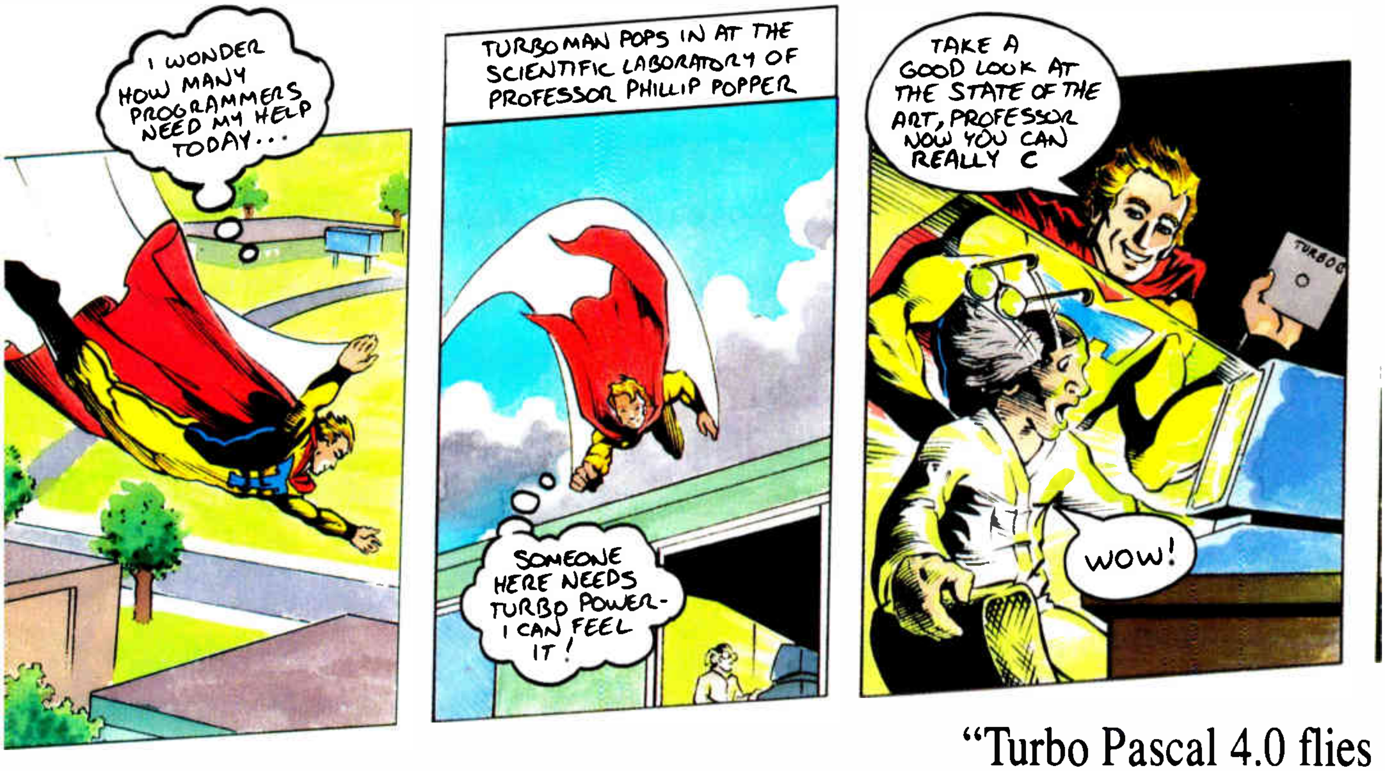
The Critics Agree: Borland's



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Heap Sort

	Turbo C 1.5	Microsoft C 5.0
Compile time	4.7 sec.	16.3 sec.
Compile & link time	7.4 sec.	19.5 sec.
Execute time	10.5 sec.	15.5 sec.
Object code size	1119	1313
Execution size	6392	7891

Sort benchmark run on an 8 MHz IBM AT using Turbo C version 1.5 and the Turbo Linker version 1.1; Microsoft C version 5.0 and the MS overlay linker version 3.61.

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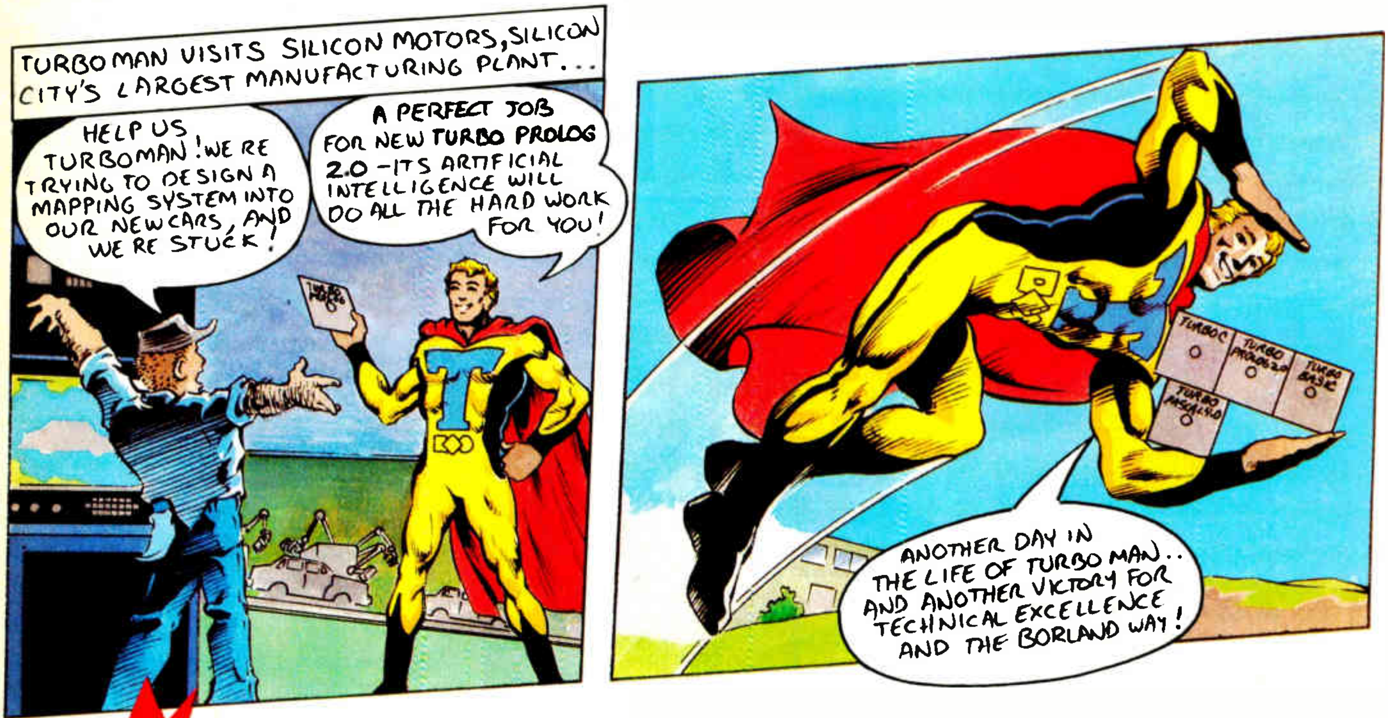

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—Darryl Rubin, AI Expert ”

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BYTE

SEPTEMBER 1988 VOL. 13/NO. 9

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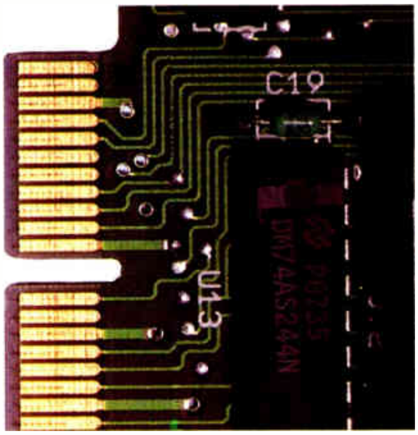

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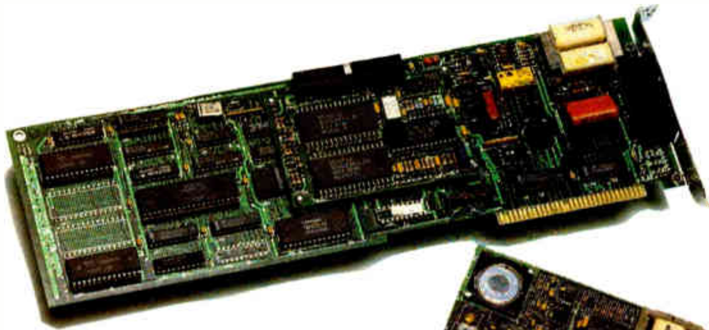

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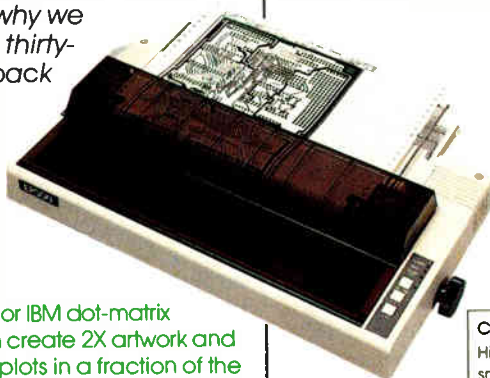

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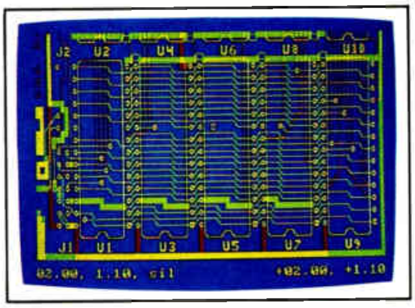

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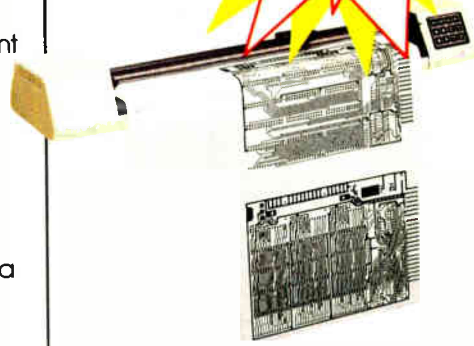

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Mac Clones and OS/2 Trends

The "Happy Joiner" Mac is up and running; and some early OS/2 users voice surprising opinions

At this year's Hannover Faire in Europe (the world's largest computer show), we got a sneak peek at a Taiwanese Macintosh clone. This summer, at Taiwan's Computex show, the clone was openly displayed, and it attracted crowds.

The clone is not for sale—yet. In fact, the prototype Mac knockoff was built primarily as a demonstration device for Mac-compatible gate-array chip sets—chips built in the U.S. by an unnamed manufacturer.

The story gets murky here. According to the generally reliable *AsiaTrends* newsletter, the company displaying the clone—its name translates as Happy Joiner Co., Ltd.—did as its name implies by acting as an intermediary between an offshore chip-design house and the U.S. manufacturer.

"Our gate array doesn't violate any existing copyrights," said a company spokesperson. "In fact, there is no copyright on gate arrays."

By themselves, the chips are at most only the foundation of a complete Mac clone; for example, you'd still need a legal ROM (a major stumbling block, considering Apple's recent litigiousness). *AsiaTrends* quotes the spokesperson as saying, "We met many people at the show who were very interested, including major Australian and Taiwanese software houses. The people we talked to said they were very interested in writing a functionally compatible legal [ROM] BIOS."

Although the gate arrays are made in the U.S., Happy Joiner has no plans to sell them here. Instead, it plans to work with clone makers in Hong Kong, South Korea, and Singapore to produce finished machines that *would* be sold in North America and elsewhere.

While I am sympathetic to Apple's desire to maintain control of its market, I'd also welcome a legitimate, inexpensive Macintosh—one that would do for the Apple side of the market what the low-cost IBM PC clones did for Intel-family machines: expand the user base, and spur vigorous growth in third-party hardware and software development.

The best kind of low-cost Mac would be one with an authentic Apple logo on it. Apple surely could produce such a machine: I've seen estimates that place Apple's manufacturing costs for a hard disk drive-equipped Mac SE as low as about $500. (The list price for such a machine is about $3600.) Yes, Apple has a healthy R&D budget, and both Apple and its dealers deserve fair profits, but surely these prices could come down some.

If it chose to, Apple could employ the strategy once used successfully by General Motors in offering a family of products ranging from Chevys to Cadillacs—from some kind of a true entry-level, lowball Mac up to Mac IIs, and beyond.

If Mac prices stay high, we may see a strange new kind of machine: a Mac-like box with American chips, an Australian ROM, a Hong Kong motherboard, and a brand name that's something like Happy Joiner.

OS/2 Trends

Datapro, one of BYTE's computer-oriented siblings within McGraw-Hill, recently completed a survey of early purchasers of the OS/2 Software Developer's Kit (SDK). The survey results make for fascinating reading.

The survey culled out software developers and hardware companies in order to target the heavy-hitting end users—nondevelopers who were interested enough in OS/2 to shell out the $3000 for the SDK.

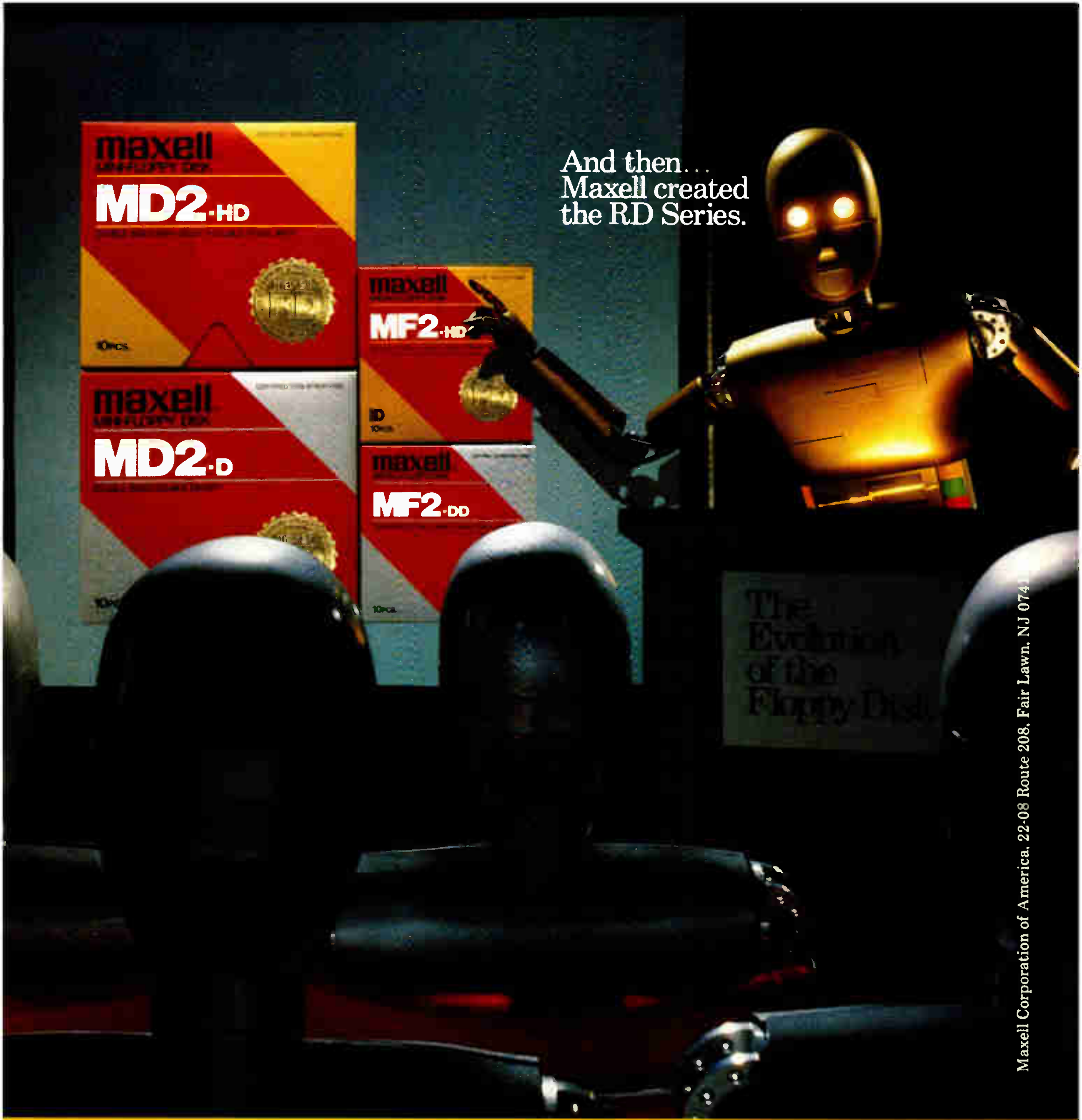
One surprise was the glacial pace these earliest adopters predicted OS/2 would take in becoming the operating system of choice for Intel-based machines. Many believe it will be well into 1989 or even 1990 before significant OS/2 applications are available: Unlike some industry gurus, these end users don't believe there will be an end-of-the-year blitz of OS/2 software this year.

A full third of the respondents see Unix as a serious alternative to OS/2. But Unix has its own perception problems. One participant said, "If Unix gets onto a commodity hardware platform so the end user can go down to the corner store or mail-order house and get [Unix] software, then Unix may make it in the end-user environment. . . .But if that doesn't happen, then OS/2 is going to wipe it out. . . ."

OS/2's major strengths were seen to be its screen-handling ability (assuming Presentation Manager lives up to its claims) and—strangely—its DOS compatibility. Vaunted features like Dynamic Data Exchange and the LAN Manager were cited far less frequently. The respondents saw OS/2's major weaknesses as stemming not so much from OS/2 itself, but from its timing: Lack of applications and delays in release were the two most-cited negatives.

All in all, the report is an eye-opening glimpse into the real world of OS/2 users. (Individual copies of "An Inside View of OS/2" at $695 can be ordered through Datapro, 1805 Underwood Blvd., Delran, NJ 08075.)

—Fred Langa
Editor in Chief
(BIX name "flanga")



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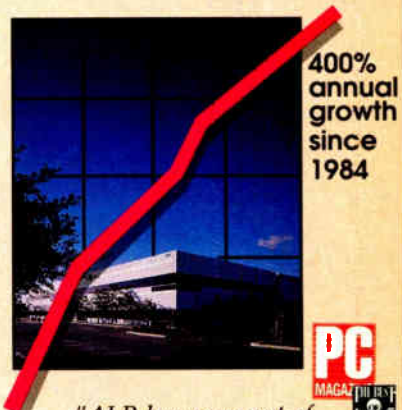
PC WEEK
March 29, 1988



PC MAGAZINE

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PC MAGAZINE *excerpts from Editors Choice June 28, 1988*

The ALR FlexCache 20386 Model 150 achieved a rating of 19.7 in Byte Lab. "*Tops in price and performance*"

BYTE LAB *Byte June, 1988*

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First Looks March 15, 1988 PC MAGAZINE

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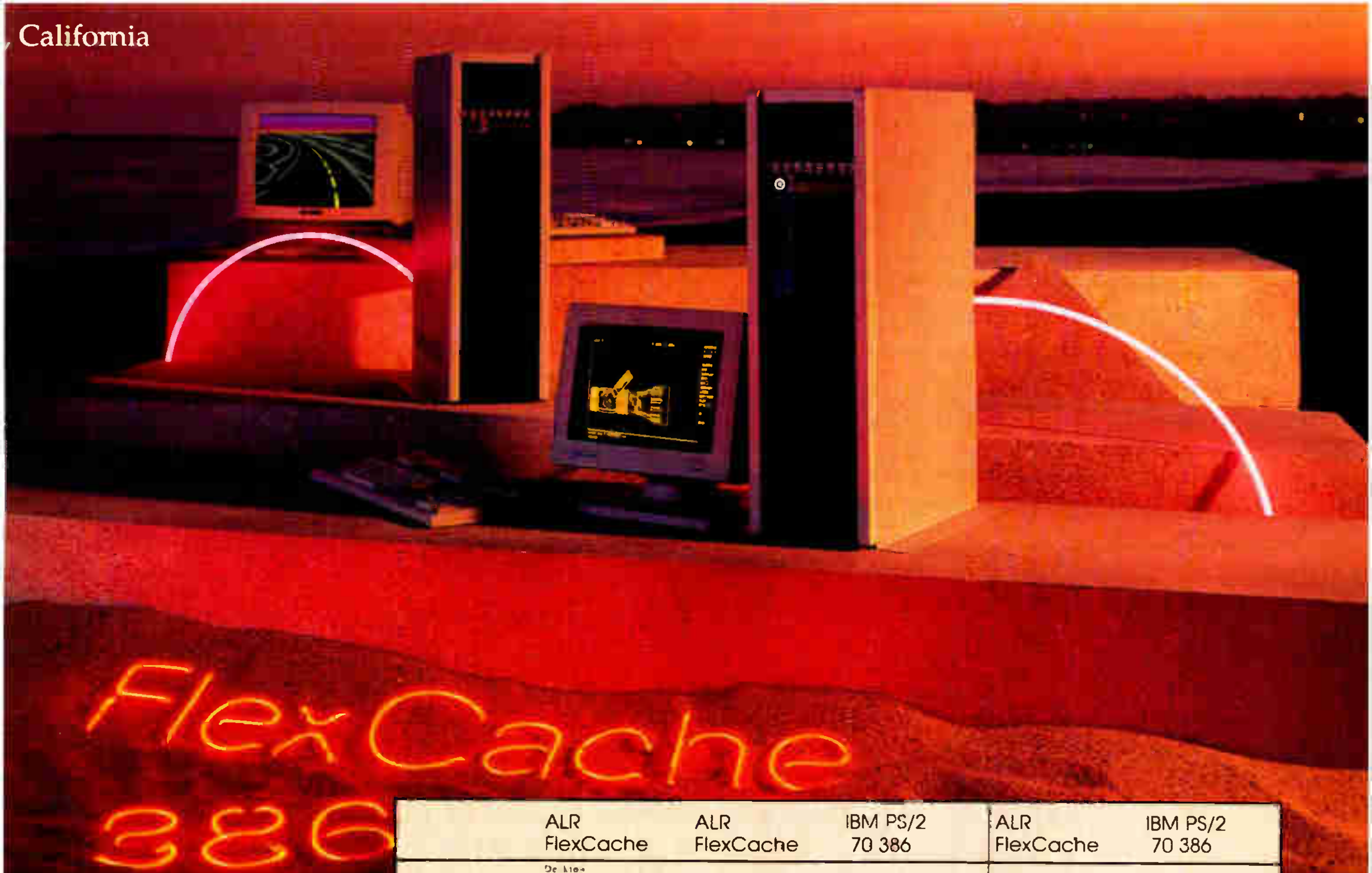
TECH PC JOURNAL *June, 1988*



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Staff-written highlights of developments in technology and the microcomputer industry

Study of Coordination Leads to New Groupware

Coordination is one of those things that you don't notice until it's not there. But Anatol Holt has noticed it; in fact, he's developed a new technology around it. Holt, who has worked at places such as Remington Rand and Boston University, developed a science called coordination mechanics. And next year, Holt's company, Coordination Technology, Inc. (Trumbull, CT), will release a computer implementation of coordination mechanics. The company claims that the new product will help groups of people on networked personal computers work together more effectively. And many routine tasks that have steadfastly resisted being computerized will soon be more efficiently done on a PC, CTI officials say.

The CTI product works by assigning each person to a number of groups. Each person then interacts with the other people in the group according to pairs of coordination patterns. For example, one person might be a requester, the other a responder. Other possible pairs are submitter/approver and provider/consumer. Any personal relationship can be represented by combining coordination-pattern pairs.

Once the relationships have been established, the program can guide and monitor the electronic mail communication between the members of the group. If you request a piece of information from someone else, the product will continue to remind that person to provide the information and will remind you that it has not been provided. Or if you submit an E-mail proposal to your boss, and your boss in turn submits it to his or her boss, the CTI product will keep you up to date on the status of the proposal.

The product, which does not yet have a name or a price, will not be available until August of next year, a CTI spokesperson said. It will run under IBM's OS/2 Extended Edition or Microsoft's OS/2 and LAN Manager. According to CTI, the product will function as an environment and will be compatible with application software such as Lotus 1-2-3. A prototype version of CTI's program currently runs under DOS, but the company says it wants to wait until OS/2's Presentation Manager is available. CTI also says that OS/2's memory management techniques will considerably speed up the product, which currently is somewhat slow.

Ansa Develops Cooperative Processing Model with Paradox

One of the promising features of local-area networks (LANs) is the possibility of cooperative processing, with CPUs on the network sharing the processing tasks and "balancing the load" on the system. This is particularly useful in networked database applications that require compute-intensive tasks such as sorts, queries, and preparation of reports. Ideally, if a single workstation on the network is overloaded with tasks, it should be able to send some of its tasks to nodes that are less utilized.

Borland's Ansa Software division (Belmont, CA) has written an application in the Paradox PAL programming language, running under OS/2, that allows cooperative processing in Paradox. In a demonstration for BYTE, Paradox OS/2 was running on a beta version of 3Com's 3+ network. The PAL application controlling the cooperative processing uses a standard Paradox table that tracks the sessions running on each workstation of the network. As more sessions are activated (another report or sort operation, for example), the PAL application uses an algorithm to decide which workstation should execute the session, depending on current workloads. The PAL application is made possible by the new `SESSION` command in the OS/2 version of Paradox, which performs the function of the OS/2 task selector in PAL scripts.

The cooperative processing application represents an "architectural concept" that software developers can use in their Paradox applications, said Borland's Richard Schwartz. Borland will make the application available to Paradox developers, he said. The application is a good example of the potential of multitasking capabilities combined with LANs for increasing the efficiency of CPUs on the system.

continued

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• We'd like to see more of this modesty in our industry. At a **Sony Microsystems** (Palo Alto, CA) press conference announcing a twin-68030 Unix-running workstation, company president Mas Morimoto said it would be inappropriate for Sony to take sides in the current AT&T/Open Software Foundation fight over control of **Unix standardization**. "In this market, Sony cannot create a standard—we follow the standard. Sony is not that big an influence," he said.

• At the same press conference, Murray Goldman of **Motorola** confirmed that Motorola will be producing a 68040 processor, but he refused to comment on a time frame or specific features of the chip.

• Matsushita (Secaucus, NJ) says it has developed a **digital optical disk recording system** that can put 2.6 gigabytes of information on each side of a 12-inch write-once optical platter. The system has a read and write speed of 18 megabits per second, a spokesperson said. In an audiovisual application, for example, all that storage space could hold 500 still pictures and an hour of stereo sound, according to Matsushita specs.

• **MicroPro International** (San Rafael, CA) plans to ship its WordStar for the Macintosh this month. The $495 Mac WordStar is a completely new product

continued

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rather than a port from the MS-DOS version. President Leon Williams said the program will provide virtually every feature of WordStar Professional, WordStar 2000, and Microsoft Word, and much of what's in Aldus's PageMaker. Among the advanced features are ability to wrap text around graphics, text rotation, text routing, and grammar-checking. All the new WordStars are pushing hard into the low end of the desktop publishing market and will help push high-end desktop publishing "back into the art department," said product manager Dave Cannon. Versions for Unix and OS/2 are in the works, he said.

• **Toshiba** (Irvine, CA) is offering a new display and a new storage device for its T1200 laptop computer. For $475, you can get a backlit supertwist display swapped in. For $1200, you can have one of the T1200's two 3½-inch floppy disk drives replaced with a 20-megabyte hard disk drive.

• **NCR Microelectronics** (Dayton, OH) has a new SCSI host adapter chip that can interface the IBM PC series, PS/2 Model 30, and compatibles to any small-computer-system-interface (SCSI) peripheral. NCR claims that the chip has a higher level of integration and greater versatility than its competitors. Product marketing engineer Prasan Pai declined comment regarding which companies would be the first to use the new chip. The CMOS 53C400 uses two rotating 128-byte buffers and a Move Block instruction to pro-

continued

Chip Set Will Yield 80-MFLOPS PC Cards, Company Says

How about an 80-million-floating-point-operations-per-second (MFLOPS) coprocessor card for about $3000? Sound too good to be true? Interstate Electronics (Anaheim, CA) says it will introduce a wavefront array processor chip set by the end of next year that will pack performance of 80 MFLOPS onto a PC-size card. Cost of the cards will probably be around $3000 each, and the company claims that you'll be able to hook four of them together to produce 320 MFLOPS of computing power for less than $20,000.

Those will be rather specialized MFLOPS. A wavefront array processor is designed to work on problems best solved by highly parallel methods. This means applications such as CAD, imaging, engineering and scientific simulation, computational fluid dynamics, and signal processing—the classes of problems often worked on by supercomputers.

The Interstate chip set will be based on the QUEN architecture, developed at Johns Hopkins University. QUEN uses an array of processors, with each pair of adjacent processors sharing a dual-port memory. Information is passed via the memories, and the memory units also handle memory-address generation and control data flow. The design produces a fast parallel processing system with minimum computational overhead.

The first QUEN-based processors are being built using Analog Devices' 32-bit digital signal processing (DSP) chip sets. Like many DSP chips, the Analog Devices sets are limited to fixed-point arithmetic, but like DSP chips in general, they are extremely fast.

Falling Prices, Changing Techniques Could Put GaAs in Your Next Personal Computer

Gallium arsenide (GaAs) chips have been considered an exotic but expensive technology. Microprocessor experts have agreed that until costs come down and yields go up, the chips will not find their way into personal computers. Costs have been coming down slightly, and several chip makers now say they're able to raise reliable output.

"Most of the groups working on it wanted to build the fastest devices they could," said David MacMillan, one of the founders of Gazelle Microcircuits (Santa Clara, CA). "They tended to have low yields, and since the fabrication plants were not heavily utilized, costs were high. GaAs chips were also historically difficult to use; they required multiple power supplies, had nonstandard logic switching levels, and required unique ceramic circuit boards to handle the microwave switching levels," he said. "We wanted to take GaAs's high speed and make it available."

Gazelle is one of the chip designers trying to solve some of the problems and lower the costs of putting GaAs in personal computers. The company recently announced its GA22V10, a GaAs version of the 22V10 programmable logic device. The 22V10 isn't a household name with most computer users, but according to MacMillan it's commonly used in memory caching systems for high-performance systems based on the 80386, 68020, and newer reduced-instruction-set-computer (RISC) chips. The PLD is used for custom logic that interfaces the fast processor to slower dynamic RAM and a fast RAM cache.

The GA22V10 uses standard TTL logic levels for all inputs and outputs and runs from a 5-volt power supply. But inside, the gates are all GaAs. As a result, the propagation delay is 10 nanoseconds or less; that means the GA22V10 can run at speeds of 90 MHz or faster. The fastest silicon 22V10 runs at a top speed of around 50 MHz.

MacMillan explained that because Gazelle engineers chose a high-volume standard part for its first chip, they were able to design it conservatively. "We traded off a little speed for reliability," he said. The result is that Gazelle is already getting good chip yields, MacMillan claimed. The company uses outside foundries to manufacture the chips.

The GA22V10 is more than three times as expensive ($55 each in 100 quantities) as silicon chips with about half the performance (around $16 in 100 quantities), which makes it too expensive for most PC-type applications. The advantages of GaAs—high speed and steady performance across a wide range of temperatures and voltages—make such chips worth the price for some designers. But MacMillan said that with improving yields and volume, within 3 or 4 years GaAs chips should fall to around $10. The company will be introducing several products by the end of this year—more PLDs, as well as "other standard parts," MacMillan said.

continued

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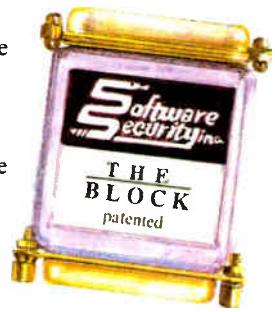

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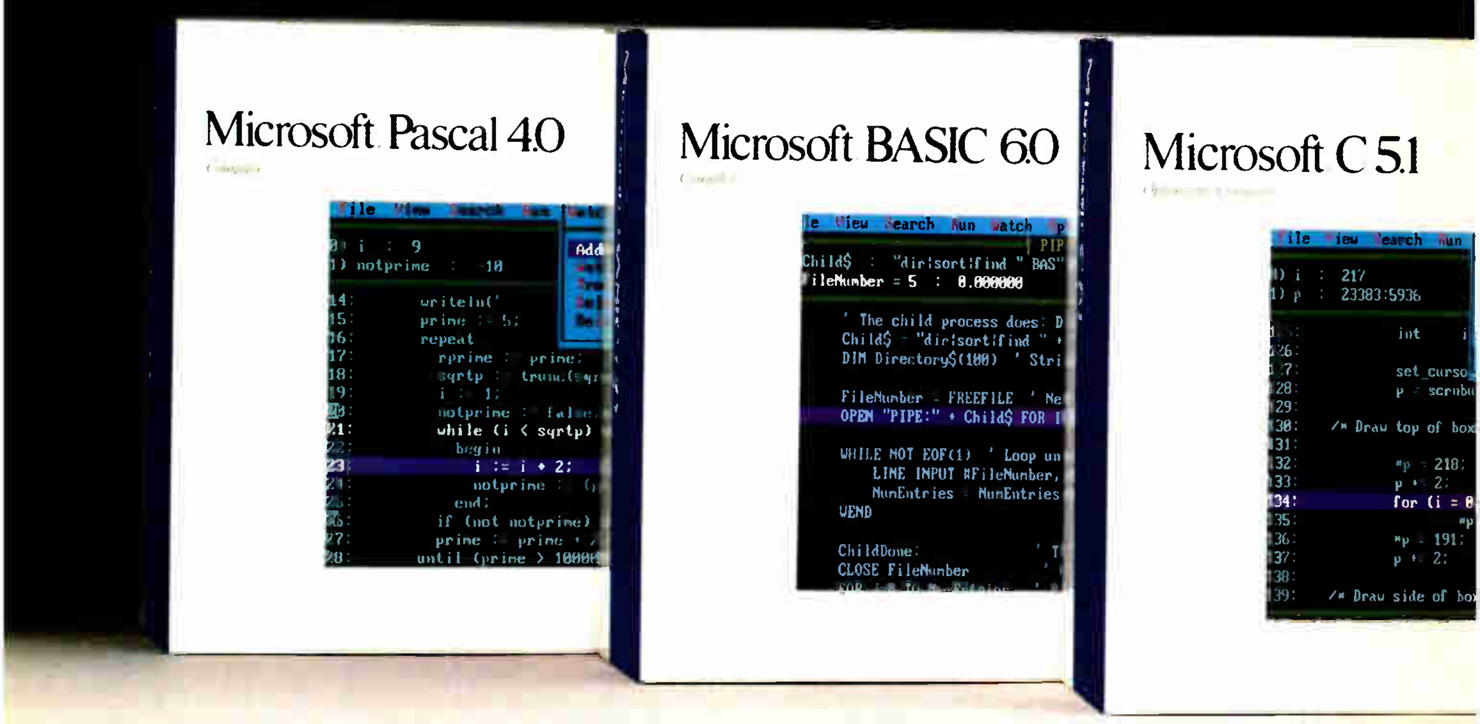

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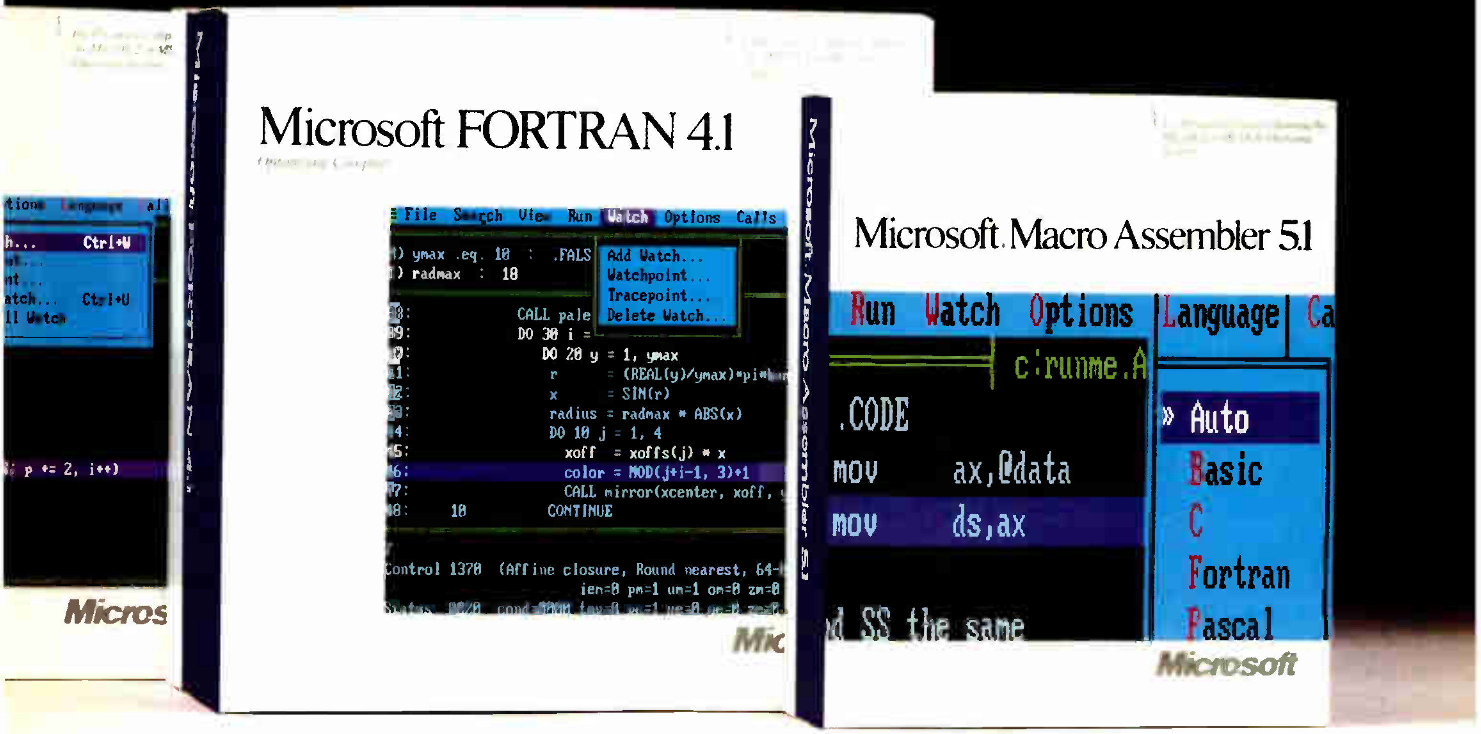

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vide data burst rates of up to 1 megabyte per second, NCR says. Control over data burst rates permits matching speeds between a host bus and a SCSI peripheral.

• Researchers at Stanford University (with support from the U.S. Air Force) have developed a device called a "nanoindenter" for testing the strength and frictional resistance of **thin films** with thicknesses of less than 1 micron. The results from submicron materials testing can help engineers determine the wear resistance and corrosion characteristics of ICs and other applications using thin films.

• **National Instruments** (Austin, TX), which makes a variety of IEEE-488 test and analysis devices, is now running seminars on data acquisition and analysis using personal computers, like IBM PCs and Mac IIs. Besides how to choose and use a data acquisition system, the lessons will include training sessions on hooking up sensors; capturing and graphing points; and formatting, filtering, compressing, and displaying waveforms. The seminars run until November in locations throughout the U.S. For more information, phone (800) 531-4742; in Texas, dial (800) 433-3488.

• For everyone who's waiting for a new desktop presentation program for the Macintosh, **Software Publishing Corp.** (Mountain View, CA) plans to release one next year sometime. The company is developing the program in conjunction with Three D Graphics (Pacific Palisades, CA),

continued

Currently, the company can put about 10,000 gates on a chip, and the number of gates per chip is roughly doubling every year, he said. MacMillan would not comment on the prospect of GaAs CPUs except to say that in 2 to 3 years, the number of gates on a chip will be high enough to support such a processor.

Engineers at chip giant Texas Instruments have fashioned ICs containing GaAs and silicon transistors, combining the former's high speed with the latter's high density and low power use. With an innovator like TI behind such a project, desktop PCs powered by GaAs are likely within the next couple years.

DRI Hopes to Out-DOS MS-DOS with DR DOS

Digital Research, Inc. (Monterey, CA), is hoping a new operating system will help it regain some of the ground it lost to Microsoft. DRI says its MS-DOS workalike, called DR DOS, is a better operating system than Microsoft's. The new operating system is ROMable, offers 512-megabyte disk partitions and password protection, and costs up to 50 percent less than its competition. But though DRI says DR DOS can run all MS-DOS software, the system's commands aren't exactly the same—and, at least initially, it will be sold only to OEMs.

The new operating system wasn't his company's idea, according to DRI's Michael Malloy. OEM customers asked for an "entry-point" operating system that would ease the migration to DRI's Concurrent DOS. "It wasn't designed as a clone [of MS-DOS]. What we've done is used our own commands and command structure to create a wholly proprietary, unique product."

DR DOS can be put into ROM and executed from ROM. "These days, RAM chips are a precious commodity," Malloy said. "A ROMable operating system is valuable for laptops, because it gives you 'instant on' capability, and another use is in diskless PCs that function as nodes to a network." At 64K bytes, DR DOS is also slightly smaller than current versions of MS-DOS. DRI will also offer version 3 of its GEM mouse-and-menu graphical interface as an option for DR DOS; like the operating system, GEM can run entirely from ROM.

Malloy said some of the commands in DR DOS will be familiar to MS-DOS users. "Some commands are generic; for example, `FORMAT` and `COPY`. And others date back to CP/M or earlier, such as `DIR`," he said.

Though DRI claims DR DOS can run all MS-DOS-compatible software, DR DOS isn't being presented as an inexpensive MS-DOS copy. Malloy emphasized DR DOS's extensions beyond MS-DOS: large hard disk partitions (up to 512 megabytes, compared to MS-DOS's 32 megabytes); password protection for all files and subdirectories; and a built-in help system behind each utility. "You can bring up help at any time with a single key combination," said Malloy.

Although DRI will initially sell DR DOS only to OEMs, the company is looking at the end-user market.

Company Claims to Cut Cost and Time of Prototyping Custom Chips

One of the fastest-growing areas in the computer business is the application-specific integrated circuit (ASIC). ASICs are custom-designed chips for specific applications. However, ASICs typically are expensive to produce; chip makers need high volumes to justify the investment.

United Silicon Structures (US2), a San Jose, CA-based subsidiary of a European-based ASIC manufacturer, hopes to change all that with an ASIC manufacturing method that allows "short-term prototyping" and low-volume production of ASIC designs. The company uses "E-beam" technology to write circuits directly onto the silicon wafer rather than using traditional photomasking techniques. With E-beam technology (variable-width electron beams), multiple ASIC designs can be produced on a single wafer. US2 claims that as many as 21 designs have been prototyped on a single wafer. In contrast, traditional photomasking allows only a single design per wafer. With the E-beam method, a customer can get 10 guaranteed prototypes in about 8 weeks for a cost of around $20,000, US2 says.

As the cost of prototyping ASIC designs comes down, ASICs will be used more frequently in production computers. According to US2's Jacques Castaillac, "until now the main use of ASICs has been for logic replacement. The new trend

continued

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which brought us Boeing Graph, aka Perspective.

- **3Com** (Santa Clara, CA) has trimmed the prices of its adapters for connecting PCs to Ethernet and token-ring networks. EtherLink II will now sell for $445 instead of $495, and Token-Link will sell for $595 instead of $650.
- **CMS Enhancements** (Tustin, CA) will soon start selling an external 30-megabyte SCSI hard disk drive for the Apple IIe and IIGS and a similar-size unit for the Mac Plus, SE, and II. The half-height 3½-inch units have an access time of 30 milliseconds, a spokesperson said. The IIe/IIGS model will have

continued

is to put entire systems on silicon."

Castaillac predicts that by 1990, the volume of ASIC production will match that of printed circuit boards. By the end of 1989, US2 will be offering 1-micron CMOS ASICs (current designs are 1.5 microns).

US2 also offers ASIC design software that runs on Sun Microsystems workstations, Apollo workstations, and IBM PC AT computers.

Weitek Says New Math Chip Cures "Anemic" 386ers

Calling 80386 machines "anemic number crunchers," Weitek has designed a single-chip floating-point coprocessor for machines based on the Intel 80386. The new Weitek Abacus 3167 coprocessor is object code–compatible with the Weitek 1167 coprocessor chip set and is available in 20- and 25-MHz versions.

In sustained performance at 25 MHz, the Abacus measures 0.7 MFLOPS double-precision LINPACK and 1.0 MFLOPS single-precision LINPACK, the company claims. These figures represent floating-point performance comparable to that of a VAX 8560 and about triple that of the 80387 math coprocessor, according to Weitek official John Rizzo. In a demonstration, a three-dimensional image screen refresh appeared significantly faster with the Abacus than with an Intel 80387—1.4 seconds versus 4 seconds, according to Weitek.

Weitek president Art Collmeyer said that present 80386 systems, even with 80387 coprocessors, "fall well short of the performance standards for engineering platforms. PCs make up less than 20 percent of the CAD/CAM market." Weitek hopes to raise that percentage with Abacus.

The chip plugs into the 121-pin Extended Math Coprocessor (EMC) socket supported on many 80386 system boards, including those from Compaq, AT&T, Dell, NCR, Sun, and Hewlett-Packard. An optional daughterboard allows installation of both the Abacus and the 80387 coprocessor, for maximum flexibility.

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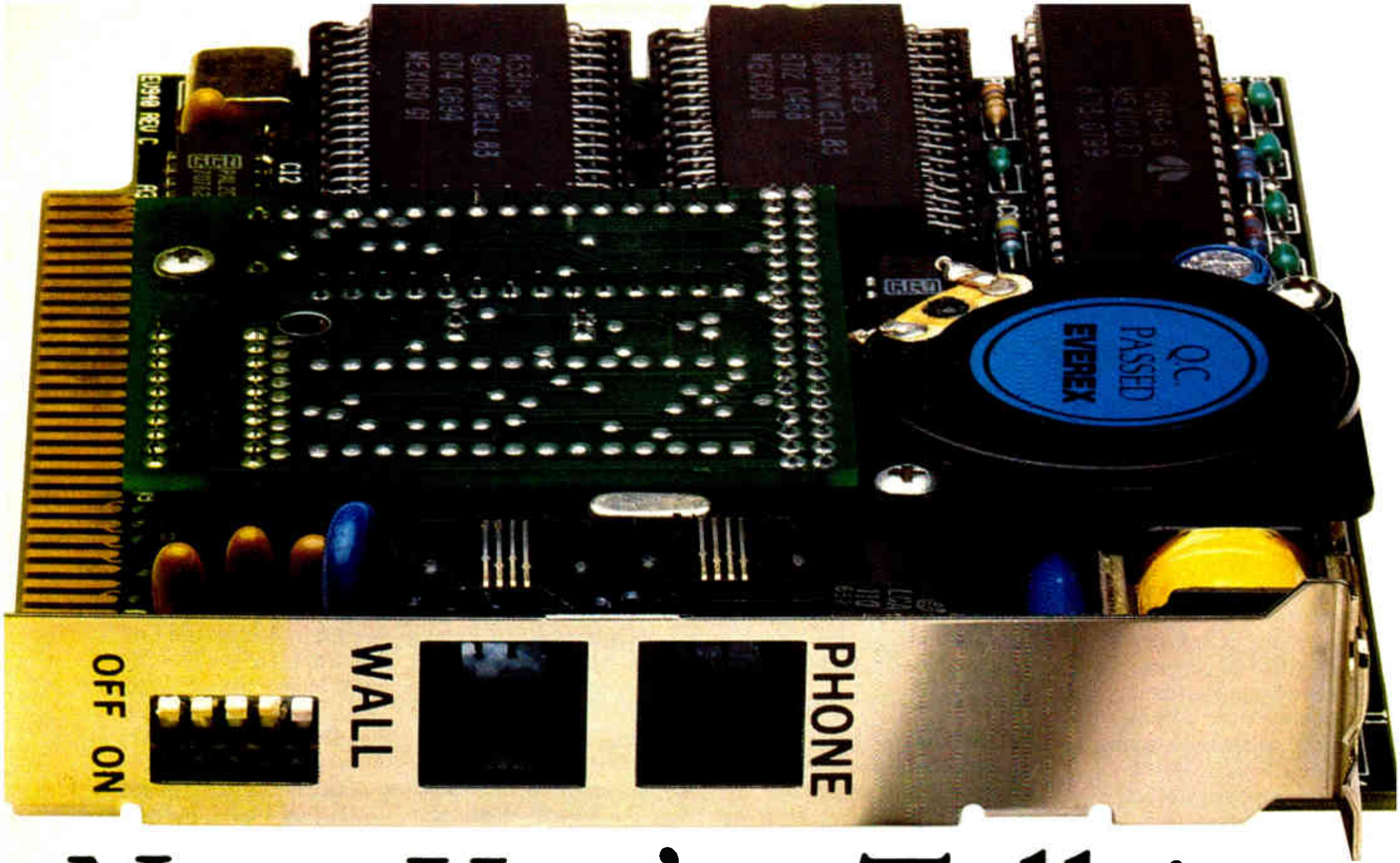

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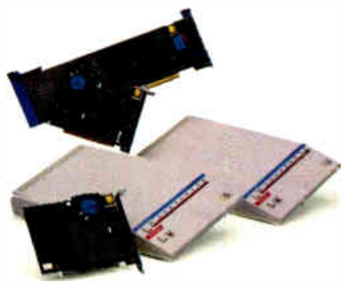

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• **The Thing That Would Not Die, Part II:** "Home business" was again the magic phrase of computer makers and other equipment manufacturers at the Summer Consumer Electronics Show in Chicago. Nearly every manufacturer who sells a combination of desktop PCs, typewriters, personal copiers, one- or two-line telephones, or low-cost facsimile machines is trying to peddle them for the home business market. There are about 13 million home businesses in the country, says the American Home Business Association.

The Abacus or 1167 chips do not support the 80387 instruction set, however. Applications written for the 80387 must be recompiled to run on Weitek's chips.

IBM does not currently support the EMC socket in its 80386 systems, but Far Point Engineering (Atlanta, GA) has announced a Micro Channel expansion board that uses the Abacus chip. Rizzo said Weitek hopes IBM will support the EMC socket but declined to comment further.

Several major engineering software and compiler vendors said they'll support the Abacus coprocessor. These companies include CadKey, MCS, MacNeal-Schwendler, Swanson Analysis, Lahey Computer Systems, MetaWare, and other developers of engineering, statistical, and CAD/CAM software. However, the Abacus chip poses difficult problems for companies that have traditionally relied on mainframe and minicomputer customers for the bulk of their revenues. For example, MacNeal-Schwendler is porting its lower-priced PAL2 finite-element software but is reluctant to port its high-priced NASTRAN software, since that would undercut the company's minicomputer business, where prices and profit margins are higher than in the microcomputer industry.

The Abacus chip can be sampled now but won't be widely available until the end of the year. The chip is being manufactured for Weitek by Matsushita Electric Co. of Japan. The OEM price in quantities of 5000 is $445 for the 20-MHz chip and $882 for the 25-MHz chip; the daughterboard with a 20-MHz chip is $595. At the retail level, these prices translate into $1200 to $2500 added to the cost of an 80386 system, or at least three times the cost added by an 80387.

TECHNOLOGY NEWS WANTED. *The news staff at BYTE is interested in hearing about new technological and scientific developments that might have an impact on microcomputers and the people who use them. If you know of advances or projects relevant to microcomputing, please contact the Microbytes staff at (603) 924-9281, send mail on BIX to Microbytes, or write to us at One Phoenix Mill Lane, Peterborough, NH 03458. An electronic version of Microbytes, which offers a wider variety of computer-related news on a daily basis, is available on BIX.*

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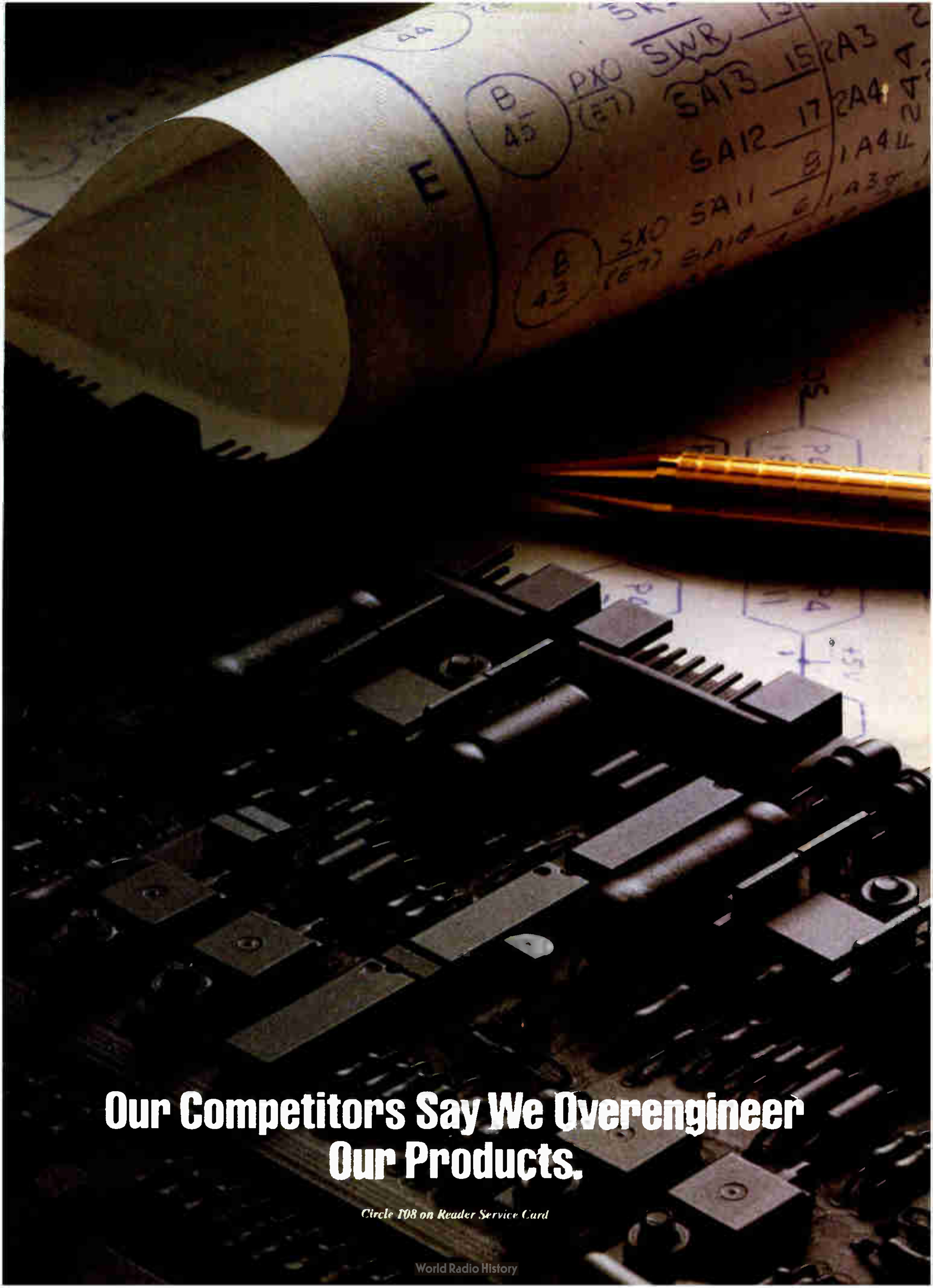
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LETTERS

Recursion vs. Iteration

In "Problems and Pitfalls" (June), Alfred A. Aburto Jr. compares the usual Fibonacci benchmark to a "nonrecursive form" and says that "the performance differs by a factor of over 4500. Apparently, recursive function calls are highly inefficient" (page 224). This is incorrect. In the Fibonacci benchmark, when fib(24) is called once, it turns out that fib(23) is called once, fib(22) twice, fib(21) three times, fib(20) five times, fib(19) eight times, and so on, down to 28,657 procedure calls to fib(2). This redundancy causes the efficiency loss.

This and similarly inefficient recursive procedures often lead to the conclusion that recursion is necessarily bad compared to iteration. (That is the real comparison here, not recursion versus "nonrecursive" procedure calls.) However, any recursive routine can be written iteratively, and vice versa; it's easy to write a recursive fib( ) with no redundancy. The only reason recursion is usually singled out as worse is that it's easier to overlook redundancy in procedure calls than in a FOR. . .NEXT loop.

The benchmark tests procedure calls and addition. (It would be nice to remove the addition, but then there would be no answer to test.) It's difficult to compare recursive procedure calls to nonrecursive procedure calls, because it's difficult to write a program with one that does exactly the same as a program with the other, but the Fibonacci benchmark does a good job of comparing procedure calls under one compiler on one machine to those under another.

Daniel J. Bernstein
Bellport, NY

Rounding Calculations

In "Error-Free Fractions" (June), Peter Wayner discusses a weakness in digital computing. His proposed solution, factorial-base fractions, is more open-ended than some alternative schemes of fractional representation. However, regardless of the storage method, the results of most calculations need to be rounded.

Seldom do we consider that between any two of the exactly representable digital values, there are infinitely many rational numbers.

In general, after multiplying two fractions, as many bits are required to exactly represent the result as are required to represent the two fractions. I call this "doubling the denominator." Adding terms with denominators that are mutual primes also doubles the denominator. Recursive operations, such as those used in modeling or in producing fractal approximations, soon overflow any scheme of representation.

For example, using factorial arithmetic, the Mandelbrot Set recursion $z = z^2 + c$, with $c = 0.25$ (.012f), requires 5, then 9, then 17, then 33 factorial terms, for the first four iterations. If you were to use a 256-byte array for the factorial fractions, the result of the seventh iteration of this series would not be representable. In spite of the fact that 256 factorial terms can exactly represent an enormous quantity of values (about 10^{507}), seven or eight multiplications are sufficient to find a number outside the scope of the method.

I think we'll be living with rounding errors for some time to come.

Larry Van Stone
Stillwater, OK

Rave Review

I am not a subscriber to any personal computer magazine, although I pick one up occasionally. I want you to know that from the few BYTEs I've picked up, I have been impressed with your articles

continued

WE WANT TO HEAR FROM YOU. *Please double-space your letter on one side of the paper and include your name and address. We can print listings and tables along with a letter if they are short and legible. Address correspondence to Letters Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.*

Because of space limitations, we reserve the right to edit letters. Generally, it takes four months from the time we receive a letter until we publish it.

on numeric methods and calculations methods.

I just read "Error-Free Fractions" by Peter Wayner (June). This was something completely new to me, even though I have taken a course on numeric analysis and my occupation as an engineer requires me to deal with numerically intensive applications.

BYTE seems to be unique among personal computing magazines in carrying such articles, and the articles that I have read intensively seem to reflect the state of the art. I hope you continue to carry such articles and continue the same high quality. It makes your magazine a standout among personal computer magazines.

James Larson
Minneapolis, MN

Don't Reorder the Alphabet

As a programmer and student of computer science, I must comment on Billy R. Pogue's letter ("Reordering the Alphabet," June). Pogue claims that "a few moments' thought shows that if our alphabet were arranged in descending order of frequency of occurrence of the letters, any search based on alphabetic order should go much faster, whether done by humans or computers."

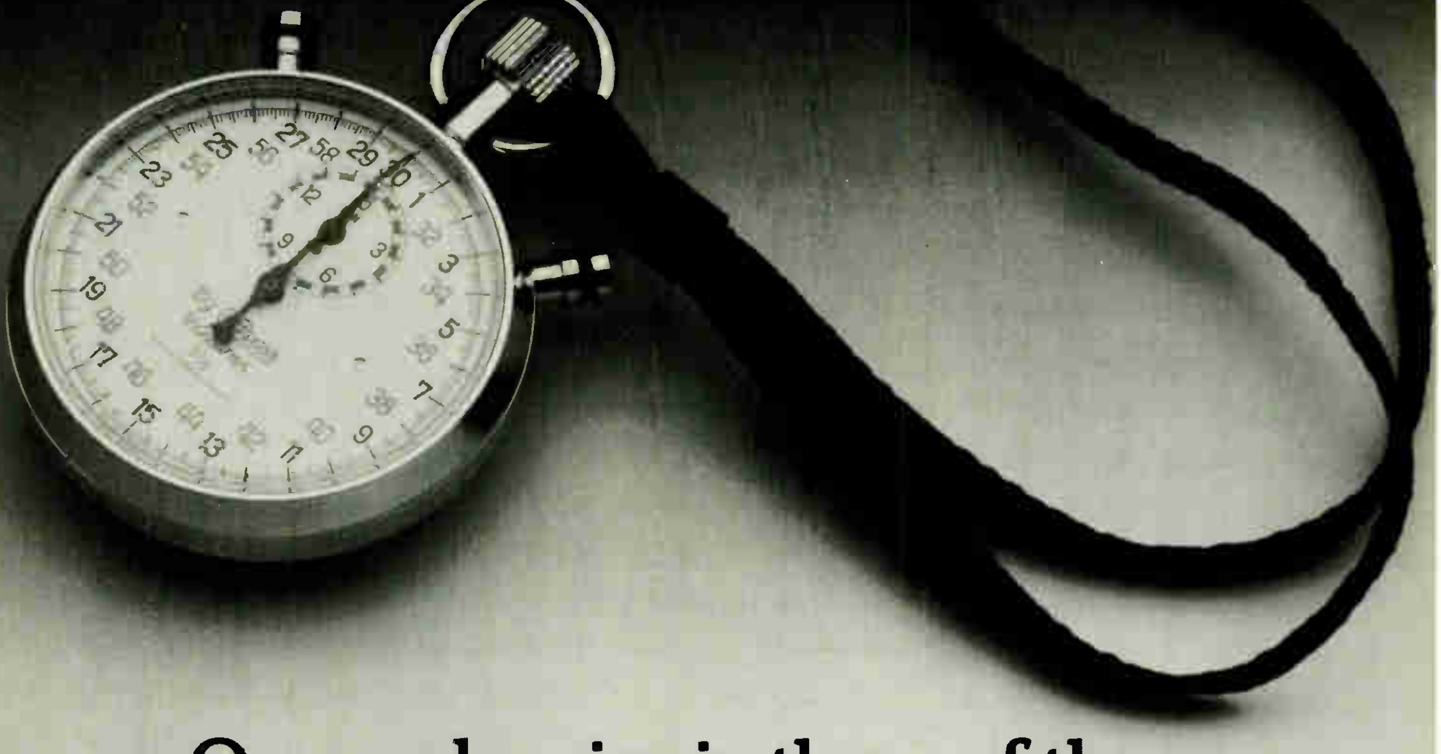
In fact, computer search and sort algorithms are completely insensitive to the coding of the information that they operate on. That is, if you changed the order of the alphabet and therefore its representation as numbers inside the computer, the search or sort would produce the same results in the same time. The only change you would be able to see would be the order of sorted information, which always follows the order in which characters occur in the alphabet.

The reason for this behavior is simple. With very few exceptions, character data in a computer is represented as 8 bits per character. Therefore, the search or sort algorithms operate on the same amount of data, regardless of the coding of the characters. It is the number of bits of data rather than the coding of characters that dictates the amount of time an algorithm takes to run.

For a more rigorous proof of this principle, refer to "Sorting and Searching" by Donald Knuth (*The Art of Computer Programming*, Volume 3, Addison-Wesley, 1973), in which run times of various algorithms are derived. In each case, the run times are dependent on the length of the information being searched or sorted and are independent of the encoding of the information.

continued

THERE ARE FOUR WAYS TO MEASURE THE SPEED OF A LAN.



Ours only wins in three of them.

1. How fast does it install.

We have no competition in this category. LANLink 5X installs in about fifteen minutes, and it doesn't take a technician to do it. Since LANLink 5X uses standard parallel or RS-232 serial ports, installing a network means little more than connecting the cable and loading the software.

With hardware LANs, installation can easily take two days–one to set it up and one to tweak it. And it also takes someone who really knows what he's doing. That is, someone expensive.

2. How fast does it transmit.

Okay, this is the category we don't win; the hardware LANs are generally a little quicker. At least, they are under optimal conditions, which is how they rate themselves.

But LANLink 5X is pretty quick, too. At half a megabit per second, it's way out ahead of any other software LAN, and right at the heels of the hardware types. Which, of course, are far more expensive.

3. How fast does it maintain.

The real cost of a network is not so much the initial price as it is the continuing outlay for maintenance -adapting it to changing needs.

That's something LANLink 5X does practically on its own. Running under PC-MOS/386™ or PC-DOS, it turns your server PC into a multi-tasking controller, driving a truly expandable LAN that is easily and quickly upgradable.

A hardware LAN, on the other hand, becomes obsolete as new technology is introduced. And, to keep the network up and running as applications change, you need the attentions of a technician, on a continuing basis. A very well-paid technician.

4. How fast can you pay for it.

Now we've arrived at the bottom line, where LANLink 5X is toughest to beat. You can install a five-user LANLink network for about the same cost as the LAN board in a board-driven network. On top of that, factor in what you save on installation and maintenance time, and the difference is pretty dramatic.

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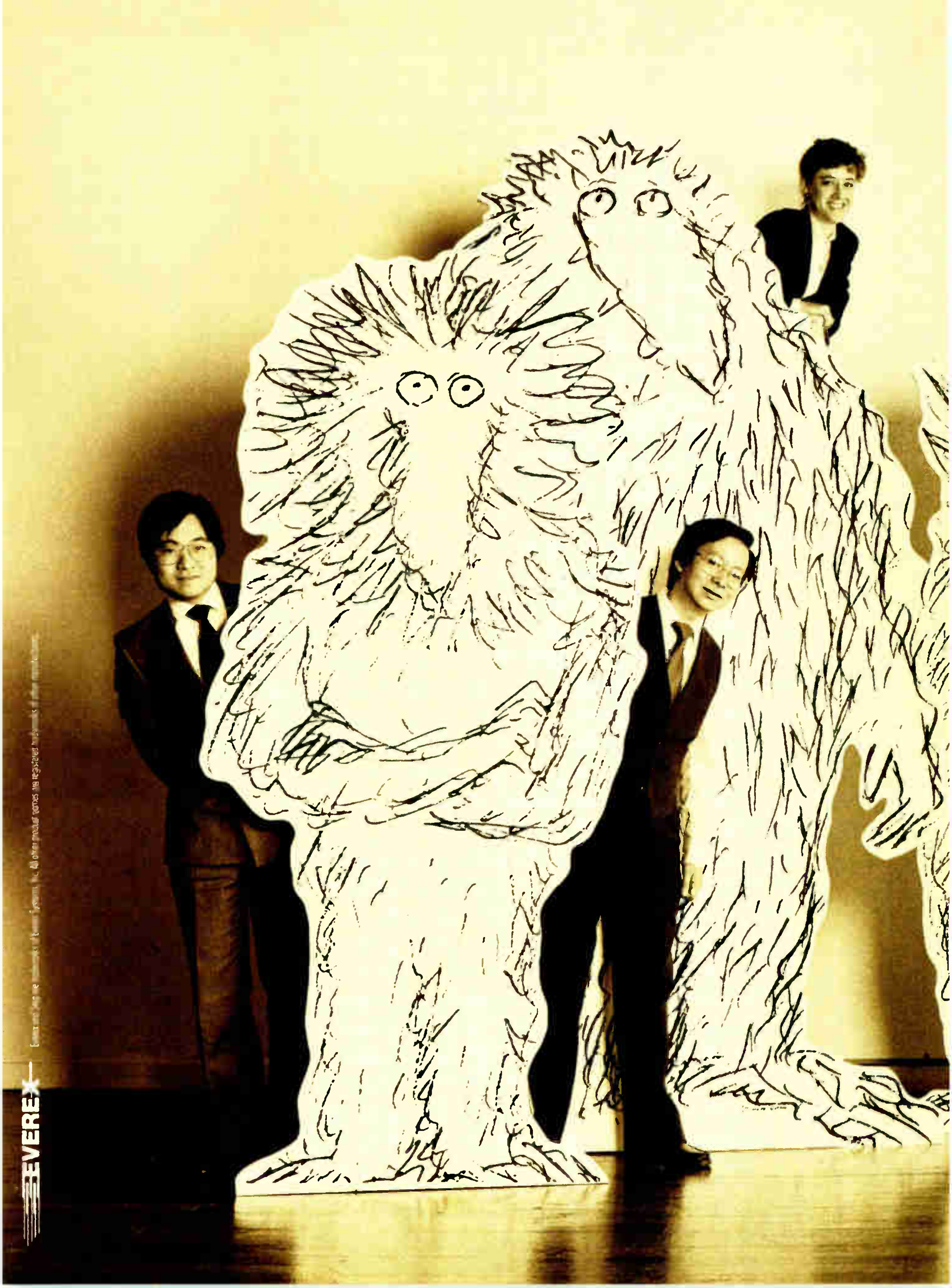
EVEREX

AST Premium 386/20	3.04 MIPS
IBM PS/2 Model 80 (20 MHz)	3.52 MIPS
Compaq DeskPro 386/20	4.59 MIPS
Everex Step 386/20	4.91 MIPS

Power Meter MIPS Version 1.2. The Database Group.

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Raymond Li, Kam Chow,
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Everex Project Engineers

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EVEREX STEP

A simple experiment proves the point: Write a program that codes a file, giving each character its order in the "new" alphabet. Then use the DOS SORT command to sort some large text file, once for the uncoded version and once for the coded one. I tried it and found no difference in the run time.

Search and sort algorithms are complex and easily misleading. A few moments' thought about how computers work, however, should convince readers that there is no benefit to reordering our arbitrarily ordered alphabet.

Brad Brown
Toronto, Ontario, Canada

Minds vs. Programs

I read with interest the comments made by Shawn Corey (May, page 24) in response to my original letter (January, page 30). I would like the chance to address the issues Mr. Corey raised.

To begin with, he seems to be under the impression that I am against all research in the field of artificial intelligence (AI). I regret that I may not have made myself clear on this matter, since nothing could be further from the truth. AI research has made significant progress in many areas and added considerably to the body of human knowledge. We have also realized a number of tangible benefits from this research, which in some cases has been in the form of commercial products.

The point I was originally attempting to make was that there are some inherent limits to what AI is capable of realizing, and that these limitations are not technical but philosophical. Researchers in AI need to take a step back from the technical aspects and examine the enormous body of philosophical work pertaining to the nature of conceptual thought and how it relates to physical substance.

That this is necessary is demonstrated by Mr. Corey himself in that he appeals to a philosophical argument drawn from the school of thought known as materialism. Materialism contends that we are essentially "meat machines," and if this were true, his assumption that one day we will invent a "nonmeat machine" capable of conceptual thought would be entirely reasonable.

However, there is an opposing school of thought called, appropriately enough, immaterialism, which is further divided into dualism (the idea that we are "meat puppets") and hylomorphism (the idea that we have a nonmaterial component necessary for conceptual thought but that cannot be separated from the material component; there is no convenient and clever analogy for this one).

The immaterialist school has been held by such philosophical giants as Aristotle, the Stoics, Aquinas, Descartes, Pascal, Locke, Rousseau, Kant, and Hegel. If these thinkers are correct—and one would be obstinate to totally disregard the work of such an august body—then there cannot be a purely mechanical explanation for conceptual thought.

Even without appealing to ancients who are frequently believed to have nothing important to say to our age, I suggest that a number of modern scholars have demonstrated the value of philosophy to AI research. A persuasive argument was put forth by John Searle. This argument is briefly stated as follows:

1. Programs are purely formal (i.e., syntactical).
2. Syntax is neither equivalent to nor sufficient by itself for semantics.

continued

3. Minds have mental contents (i.e., semantic contents).
Conclusion: Having a program—any program by itself—is neither sufficient for nor equivalent to having a mind.

Mr. Searle is, I believe, a materialist, and therefore he's likely to contend that some kind of machine can—in principle—be built that is capable of conceptual thought. However, his argument with respect to computers is difficult to refute. I would again suggest that those involved in AI research make every effort to examine the body of philosophical work pertaining to their subject in order to discover what the most fruitful avenues of their research will be.

Marin David Condic
Parsippany, NJ

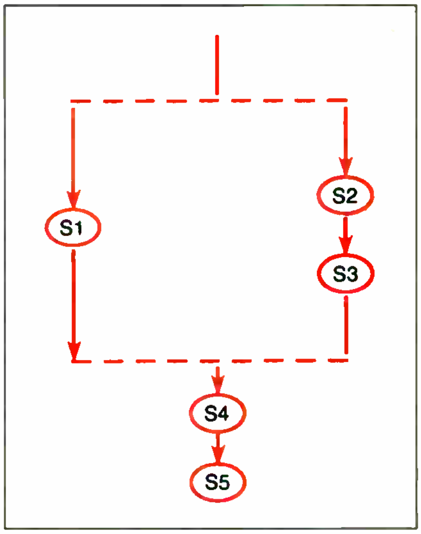
Nonrecurrent Steps

I am writing to correct an error in Gary Bricault's article ("Juggling Multiple Processes," May). The article introduces five operations in a code fragment:

```
(S1) x := y + z;
(S2) a := (b + 3) * c;
(S3) d := e * a;
(S4) w := d - x;
(S5) writeln (d, w);
```

Clearly, S4 cannot execute until S3 has completed, since S4 requires a value for d, which is calculated by S3. Bernstein's second requirement—O(Si) ∩ I(Sj) = {}—leads to the same conclusion. The output of S3 = {d}; the input of S4 = {d,x}, and the intersection of these sets is not null.

Thus, S3 and S4 cannot be concurrent. However, Mr. Bricault's precedence diagram (figure 3, page 317) for this code fragment incorrectly shows S4 as concurrent with S3. The correct diagram is as follows:



Charles E. M. Dunlop
Yellow Springs, OH

FIXES

• Megahertz Corp. alerted us to some incorrect information that we published in our July 1988 Short Take of the EasyTalk board.

The list price of the board is $999.95. It runs on the Toshiba T3100 in addition to the T1100 Plus and the T1200.

After our July issue went to press, the company moved to 4505 South Wasatch Blvd., Salt Lake City, UT 84124, (801) 272-6000.

• The price of Spot from Flagstaff Engineering (Computing at Chaos Manor, August, page 108) should be $995.

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We even built features like advanced VGA graphics and standard interfaces for a mouse, printers and other peripherals into the system. This saves your slots for modems, network boards and much more.

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CHAOS MANOR MAIL

Jerry Pournelle answers questions about his column and related computer topics

BASIC Pilgrimage

Dear Jerry,

I was amused by your comments concerning Turbo Basic from Borland International. When some things didn't work as you expected, you patiently read the manual and went on to declare the product a "success." In contrast, however, you couldn't be bothered with reading the manual when doing a previous review of True BASIC and went on to declare the product a failure, referring to it as "True Madness."

Now that Microsoft has just released QuickBASIC 4.0, I expect you'll soon be raving about its separately compiled program modules, calling them an "exciting development in BASIC programming." Of course, the program modules available in version 2.0 of True BASIC for the past 12 months "just don't seem like BASIC and will never be accepted by users of GWBASIC."

Have you noticed that each new version of QuickBASIC looks more and more like True BASIC and less and less like GWBASIC? The very features you condemn in True BASIC are being copied into QuickBASIC and Turbo Basic—the ANSI BASIC standards. (Thomas Kurtz of True BASIC and Dartmouth College served as chairman of the standards committee.) Whether you like it or not, Kemeny and Kurtz are dramatically changing the language. You detest their influence while unwittingly praising Turbo Basic and QuickBASIC for copying most of the ANSI standards.

In 1985, Apple Computer came very close to releasing MacBASIC, which included many features similar to True BASIC. The language was developed by Apple's own software engineers. However, according to the *Wall Street Journal* (September 25, 1987), Apple president John Sculley killed MacBASIC and signed over the rights to the MacBASIC name when Microsoft's Bill Gates demanded the product be withdrawn and threatened to cut off Apple's license to use Microsoft's program for the company's best-selling Apple II machine. Several of Apple's key software engineers resigned in disgust. The *Journal* quoted an Apple employee as saying, "He insisted that Apple withdraw what was an exceptional product. He held the gun to our head."

Sybex Publishing actually released a book on the MacBASIC language—a book that suddenly had no market. Tell me, is Mr. Gates a man we should all admire and hero-worship?

Alan F. Tomala
St. Clair Shores, MI

Well, to begin with, True BASIC had all the defects of a compiled language without the speed and convenience; it "compiled" into p-code and interpreted that. Why would anyone want to do that? Turbo and QuickBASIC compile into stand-alone code that you can give your friends or sell for jujubes.

I will also admit that the name True BASIC and the arrogant letters denouncing "street BASIC" that accompanied it had a good bit to do with the attitude with which I approached True BASIC.

And whether you like it or not, the marketplace seems to have accepted Turbo Basic and QuickBASIC.

I hadn't heard the story about Apple and Bill Gates. I must have missed that issue of the Journal. —Jerry

Proof Positive

Dear Jerry,

Once again, I take keyboard in hand to perpetrate correspondence. You often wonder if you have any effect on the computer industry. You do. I offer the following as proof.

Some months ago, you reviewed the NEC MultiSync monitor. Your main complaint was that the adjustments were completely automated. (I'll pass over

continued

Jerry Pournelle holds a doctorate in psychology and is a science fiction writer who also earns a comfortable living writing about computers present and future. He can be reached c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458, or on BIX as "jerryp."

your gripe about the size of the screen. Maybe you should consider hooking your current word processor to a projection TV set.) The new MultiSync II has a full set of manual controls. Except for the mode selectors, everything is handily located under a door in front.

Also, I would like to enter a comment on your taste in text editors. You prefer WordPerfect because it is "transparent." I would call it "invisible." Admittedly, I cut my teeth on WordStar 3.31. Further, I actually like WordStar. Maybe that implies something about my sanity, but at least my old faithful has a useful help facility. WordPerfect does not. If you ever lose that blasted keyboard template, you may as well buy a supply of goose quills.

WordPerfect's on-screen "help" comes in two flavors; you either specify the key with which you want help or give the initial letter of the function you want. This assumes you know what the various keys do and at what level of shift they do it. The "organization" of the function keys might best be described as anti-mnemonic. (WordStar, at least, groups similar operations under the same Control-key menu.) Finding the letter that will call up help for a specific operation is mostly luck. It took me two tries before I could find the command to exit a file. Even DisplayWrite, a program widely regarded as the joke of the industry, has an index of help screens. If WordPerfect has such a feature, it is well hidden.

Finally, how can anyone with your notoriously poor vision even use that blasted template? My optometrist whistles in awe whenever I bring him my new lens prescription, but I don't need an oversize monitor. What I do need is a blowup of the template.

If you insist on a transparent editor with automatic paragraph reformat, try PC-Write 2.71. It is faster, much more helpful, and does windows. Its worst feature is its documentation, which tends toward the dense side of understandable. If I could find a book on PC-Write that's half as good as Arthur Naiman's book on WordStar, I would switch in a minute.

Bryan Edenfield
Allendale, SC

One thing that isn't generally known: when Art Naiman wrote his excellent book on WordStar, he used WRITE, the text editor I used for so many years.
—Jerry

BRIEFly Speaking

Dear Jerry,

Last year, you casually mentioned that you have problems running BRIEF with SideKick and SuperKey ("In the Chips," September 1987).

We recently started using BRIEF here in the office, and we had similar problems. We tried to run BRIEF with SuperKey and our own memory-resident software and found that the machine locked up just as you described. We were using an IBM PC AT with 3 megabytes of memory.

Our solution was to set two switches when starting BRIEF. We set -k (lowercase, no numbers) and the -p (lowercase). The first is a keyboard-compatibility switch. It's odd to have to set this when using a true IBM machine, but it seems that these memory-resident programs hang off the keyboard interrupt and can affect timings.

The second switch is a video-page-compatibility toggle. Apparently, BRIEF uses the second video page to display text, and if some software doesn't support multiple video pages (such as SideKick or SuperKey), this can cause problems.

After setting these switches, we have experienced no problems in running BRIEF.

Terence J. Griffin
Washington, DC

I find I don't need the power of BRIEF, and I've gone over to the Logitech Point editor for most of my programming. If I worked at programming full-time, I'd reconsider, but BRIEF had just enough commands that I'd keep forgetting them, while Point is totally intuitive.—Jerry

Avoiding Custom Programming

Dear Jerry,

At my law office, we had a very large relational database written in dBASE III. But we had to change it all the time because the attorneys and the judges would always be asking for new reports that had not been set up previously. We ran into custom programming costs because dBASE III is too difficult for ad hoc queries and custom reports to be designed by the secretaries and the data entry-level people.

So, we rewrote the entire system in Paradox. Now data entry and secretarial personnel can create ad hoc queries and custom reports with minimal time from our high-priced computing consultant. This saved us money. I thought you'd like to know.

Daniel J. Ashley
Chicago, IL

I did want to know, and thank you for telling me.—Jerry ■

Competition

WE THINK YOU CAN!

THERE ARE 17,000,000 speech-deaf persons, i.e. do not understand speech, in the U.S. The objective is to provide a communication device that will allow one-on-one communication. The final EARS design, incorporating all possible operational advantages and economies of production, may be the composite of the prize winners' designs and may also incorporate features of the designs submitted by non-prize winners. Winners will be accorded cash and royalties. **All royalties negotiated by EARS will be passed through to the contestants.** The royalties will be apportioned by the Judges on the basis of their evaluation of the importance of each element submitted by any contestant which is included in the Final Production Design.

Those desiring to participate should apply (by mail or phone) for a registered entry blank to the Executive Audial Rehabilitation Society shown. Each entry shall include design, programming instruction and an operating "bread board" model which need not conform to the size goals. EARS will compensate those contestants (whose entries are adjudged to be operationally feasible) for the current cost of the components used to build the bread board operational model. The entries will be evaluated by the Judges on the basis of merit, i.e. operationally effective that can be produced at a reasonable cost.

Detailed conditions of the competition will be set out on the entry form. DEADLINES: Entry forms must be procured and returned to EARS not later than October 31, 1988. Designs and bread board models must be received by 5 P.M. on May 1, 1989.

All designs submitted and accepted by the Judges shall be the property of EARS. No essential conceptual element of a design shall constitute a conflict with an existing patent. Conceptual protection of the device has been established as of date of origin. Formal application for patents on pertinent features will be applied for by EARS. A firm of patent attorneys specializing in electronics is retained. All decisions by the Judges as to the award or non-award of prizes or royalty shall be final and shall not be subject to change, review or amendment by EARS., its Officers, Executive Committee or the design contestants.

DESIGN GOALS

1 The goal is a design for a hand-held, lightweight real time communication device capable of being produced at economical cost. The design should allow a speaking person to communicate on a one-on-one real time basis with the hearing-impaired person in any situation where normal conversation occurs and will provide for filtration of extraneous noise. The goal is a device contained in approximately 6" x 8" x 1½". A 5" x 7" screen will be on one side. The speech-deaf person can place it on a desk or hold it in hand. The speaker will first read a text identifying his phonetic alphabet in the memory. A multi-position switch would allow storage of the phonetic alphabets of different persons. For telephone calls, the speech of a person (whose phonetic alphabet is in one of the memory channels or who reads the text into a new channel) will enter the communication device through a standard telephone plug. The device will be battery-powered with rechargeable batteries but provide for alternative operation with a voltage converter. Intensive electronic speech analysis combined with the personal phonetic alphabet of the speaker will result in the "real-time" production of the spoken words on the screen. The speech of the hearing-impaired person not fitting the phonetic alphabet of the memory should be filtered out automatically if possible, otherwise manually.

2 Equally important is a design for this device that can be manufactured economically so that the cost is within the means of this group of people, many of whom may be economically disadvantaged.

ASK BYTE

Circuit Cellar's Steve Ciarcia answers your questions on microcomputing

Clipped by Clipper

Dear Steve,

I have a problem with my Clipper application, but perhaps it's a general problem. I can't find any way to access more than 15 files in my application because of the restrictions of MS-DOS. I think the only way I can solve this problem is to open another process, but maybe you could suggest something else.

Michael Stöckel
Berlin, Germany

Your problem is not so much a restriction of MS-DOS as it is a configuration problem.

Examine the contents of your `CONFIG.SYS` *file if you have one. It should be in the root directory of whatever disk you boot the computer from (if not, add this file with the following). See if there is a* `FILES=??` *statement, where* `??` *is a number that indicates the maximum number of files any application can have open at one time. You can increase this number to whatever you like, but each open file takes some memory, so the sky is not the limit. You should also add a* `BUFFERS=??` *statement to speed processing if you have lots of open files. However, remember that all this takes memory, and if Clipper takes too much to allow more open files, then you're stuck because of Clipper, not MS-DOS.*

Set the number of files and buffers to the smallest value that accommodates your requirements. Typically, 20 is a good number. All this is listed in the MS-DOS manual in greater detail.—Steve

Seeing Digital

Dear Steve,

Since June of 1987 I have been considering purchasing a digitizer/transmitter and receiver system for several small systems that I deal with on a regular basis. The unfortunate part of the whole thing is that all I know of how the system works is what I could catch up to in the June 1987 Circuit Cellar.

What I'm looking for is a total rundown on the system, including both its good points and bad points. I plan on setting up a series of these in external cases and using my own telecommunications network. Would you be willing to give me some information on this system and your own thoughts on how it can be applied?

Jason S. Beam
Saco, ME

The definitive works on the ImageWise video digitizing system are in "Build a Gray-Scale Video Digitizer," Parts 1 and 2 (May and June 1987). The two subsequent articles ("Using the ImageWise Video Digitizer," Parts 1 and 2, July and August 1987) went into some depth on applications for the hardware, featuring some image processing and colorization programs that demonstrated how to write a software interface to the boards.

For your telecommunications applications, you'll need to think about transmission time and hardware control problems. The transmitter uses run-length encoding to reduce the volume of data, but you'll still have about 30K to 40K bytes for each image. Transmitting an uncompressed 62K-byte image at 1200 bits per second can take up to 9 minutes.

The transmitter and receiver will work when connected together, either directly or through modems, but you'll probably need to use a computer at each end to handle dialing, selecting options, and so forth. We've used BCC-52s and BCC-180s, as well as ordinary PCs and ATs, with success. Teaming a BCC-180 with a 9600-bps modem gives you quite a bit of power. This is exactly what I have done in a subsequent ImageWise project in the fifth issue of Circuit Cellar Ink *magazine. There are some sample programs and images on the Circuit Cellar bulletin board system (BBS) that may be of some use. Give it a call at (203) 871-1988 and see what we've got for you.*—Steve

IN ASK BYTE, Steve Ciarcia, a computer consultant and electronics engineer, answers questions on any area of microcomputing and his Circuit Cellar projects. The most representative questions will be answered and published. Send your inquiry to

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Teaching an Old Board New Tricks

Dear Steve,

Upgrading to a new system (from an IBM PC to an AT, or from an AT to an 80386 system) costs not only the purchase price of the new system, but also the replacement cost for the boards. Could you design an adapter so that old PC boards would fit into an AT bus or so that PC or AT boards fit into a Micro Channel bus? Are such adapters already being marketed?

James P. Eshleman Jr.
Philadelphia, PA

Using your old PC 8-bit expansion boards in the AT bus is just a matter of plugging them into any available expansion slot. Actually, ATs and all the clones I know of provide 8-bit slots for video cards, serial ports, parallel ports, and so on, but 8-bit cards will work in any AT expansion slot. Of course, 8-bit memory-expansion cards won't be of much use, and while it would be possible to design an adapter, the result would be slot performance at a high price. You could also use the PC XT 8-bit hard disk drive controllers in an AT, but the 16-bit controllers are considerably faster and worth the extra money for most people.

Adapting PC or AT cards to the Micro Channel is another story, however. There are system requirements built into the Micro Channel architecture that

continued

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would make adapting these cards difficult and expensive. In addition to all the electrical problems, AT and XT cards are too big to fit into the PS/2 boxes. All in all, adapters to fit PC and AT cards into the PS/2 probably won't happen.—Steve

Translation, Please

Dear Steve,

I ran across some long FORTRAN source code recently that has what the author refers to as Warnier-Orr diagrams in place of the more generic English comment lines. As near as I can fathom, these diagrams appear to be a sort of condensed truth table outlining the program logic flow.

I'd like to know more about these diagrams so I can make some sense out of the cryptic symbols they contain. Could you or your knowledgeable readership offer any references?

James T. Himer
Calgary, Alberta, Canada

Your question seemed easy until I started looking for an answer. Apparently, programmers must have stopped using Warnier-Orr diagrams. Searching through back issues, I found two articles in BYTE: "Structured Programming with Warnier-Orr Diagrams" by David A. Higgins (December 1977) and "Warnier-Orr Diagrams: Some Further Thoughts" by G. T. Wedemyer (May 1978).

The only recent reference I found was the book Diagramming Techniques for Analysts and Programmers *by James Martin and Carma McClure (Prentice-Hall, 1985).*—Steve

Hebrew Word Processing

Dear Steve,

What can you recommend as a current data book for information about software? I once had a copy of *The Whole Earth Software Catalog*, and *The Data-Pro Report* was highly recommended to me, but apparently neither is up to date.

I'm hoping to get specific information about word-processing programs in Hebrew and a shopping guide to word-processing systems with scientific notation and plotting capability.

Ellen Dean
Cambridge, U.K.

I can readily understand your desire to have a truly current software directory. I'd like to know where to find one myself.

Unfortunately, in a business that grows and changes as rapidly as the microcomputer trade, any compendiums are dated before they're published.

The most current information sources are magazines such as BYTE, PC Tech Journal, *and* PC Magazine. *These magazines contain the most current software/hardware reviews, as well as manufacturers' advertisements, product notices, and other useful information. The manufacturers themselves are frequently the most useful information sources, although one must be wary of hype. Of the directory-type publications, the one published annually by* PC Tech Journal *is frequently the most useful.*

Although I can't provide all the information you need, I can offer some sources for information on Hebrew word-processing software for IBM-type PCs. Two companies advertising PC software with multilingual text capabilities, including Hebrew, are Gamma Productions, Inc. (710 Wilshire Blvd., Suite 609, Santa Monica, CA 90401) and MegaChomp Co. (3524 Cottman Ave., Philadelphia, PA 19149).—Steve

Pictures, Hexes, and the Weather

Dear Steve,

I have three unrelated questions.

For a long time, I've been seeing ASCII characters used to make some very good printer pictures. These pictures are found on BBSes all over the country. I was wondering how these pictures are made—some cannot even be listed to the screen and viewed. It takes an 80-column printer set to condensed mode and a small line spacing to make any sense out of the image data. Is there a software or hardware package available that can produce these picture files?

I have access to an EPROM programmer. It has its own card that goes into one of the slots in an IBM PC (it's not a serial-type programmer; it's like the $179 ones that many of the clone suppliers sell), and it programs up to four EPROMs at once. I've seen ads for EPROM data on a disk that is in the Intel Hex format. I am not sure if my programmer will accept this Intel Hex format. Can you describe the Intel Hex format so I can determine whether or not it is compatible with my programmer?

Now for the hard question. A long time ago, you wrote an article entitled "Build a Computerized Weather Station" (February 1982). You used a Heathkit anemometer and a temperature sensor connected to a computer to tell you of the changes in weather conditions. I'm also interested in predicting the weather. In fact, I purchased a program that, when supplied with a few readings (data such as date, location, average temperature, and current atmospheric pressure), will

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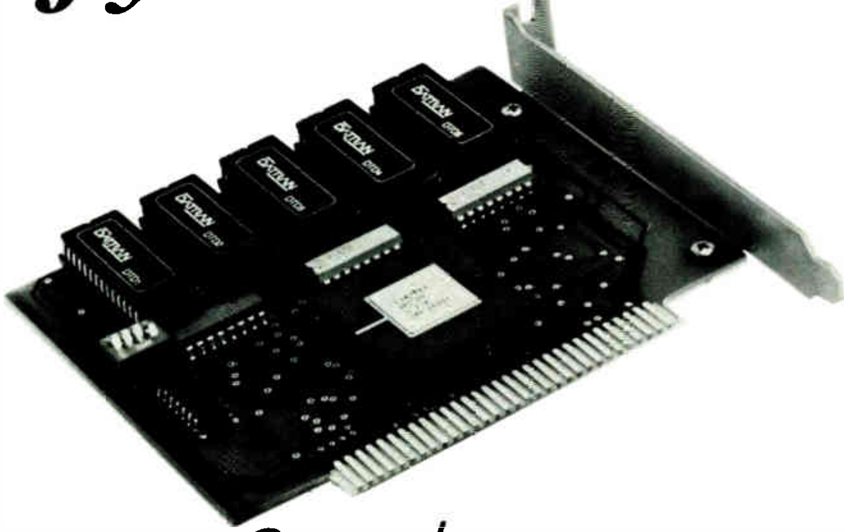

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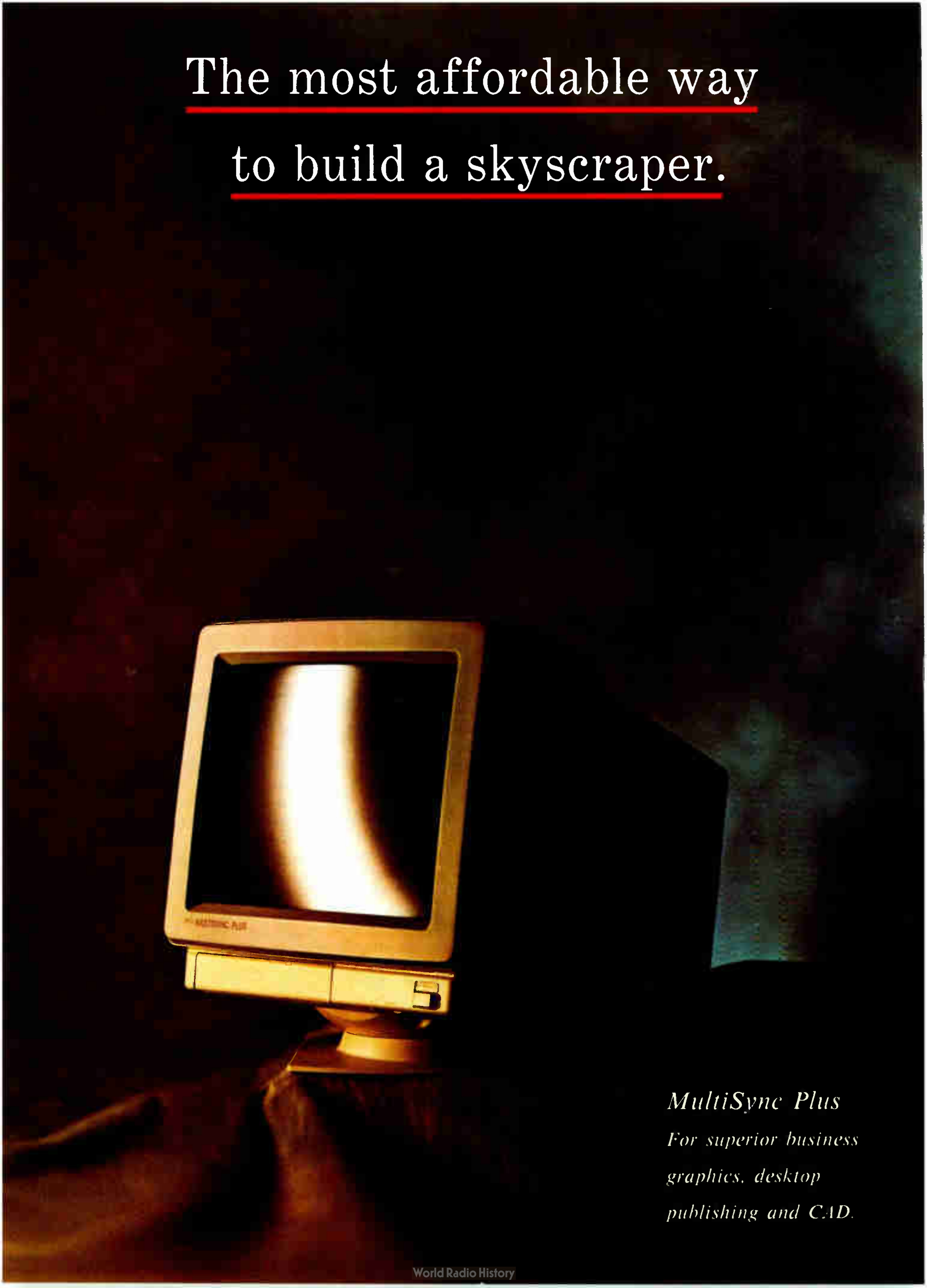
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forecast the next three days' weather and even draw a local weather map. I was going to rely on the local weather radio and the cable TV weather channel for the data, but when they said for three straight days that the high was 9°F (in summer), I knew I needed my own source for this data. I remembered your old article and decided that it should provide some guidance for putting together a computer-controlled system to take readings every hour or so.

I'm not a programmer, but I figure that with trial and error I can make a program that will do what I want. The actual instruments and the interface to the computer is a bigger problem. Can you give me any clues on this? Also, is there a better or cheaper way for measuring wind speed and direction?

Donald P. Bolton
Richland, WA

The "printer pictures" you mention are reminiscent of pictures I used to create when I was in school (before personal computers). The technique used involved creating the drawing (on graph paper), determining the shading or gray scale, and assigning characters to represent the shading or gray-scale levels.

The character assignments followed the concept of using the density of a character that is essentially centered in the character space. You can easily see that a + symbol has a lesser density than a # or a @. It would then be a simple matter to code in the lines of character (even using backspacing to increase density). I haven't experimented in this area in quite some time, but since you can create the rules necessary to code the character lines, you should be able to create a program to automate the process. This should be fairly easy, given that paint and video capture programs are available to get the image into the computer. I don't know of a commercial program, however, that creates these pictures.

As to your question about the Intel Hex format for files, this format differs from the normal Hex file in that the data is transmitted in record blocks, with necessary control and checksum codes. There are two types of records. The data record is formatted as

```
:BCAAAA00HH<data>....
CC<cr><lf>
```

where : is the start character, BC *is the byte count of the record data (inclusive of control info),* AAAA *is the starting address of this record,* 00 *indicates that this is a data record, and* CC *is the two's complement checksum of the binary summation of all the previous bytes.*

The end-of-file record is formatted as

```
:BCAAAA01CC
```

where : is the start character, BC *is the byte count of the record's data,* AAAA *is the starting address of this record,* 01 *indicates that this is an end-of-file record, and* CC *is the two's complement checksum of the binary summation of all the previous bytes.*

As you can see, it would be a simple process either to append or delete the control information. A short BASIC program would do the trick.

Regarding your third question, the methods for data collection of weather information have improved dramatically in recent years. Several devices are available to aid construction of these tools. Among them are the following:

- *Temperature measurement: National Semiconductor's LM135-series precision temperature transducers*
- *Barometric pressure: National Semiconductor's LX05xxA series Monolithic Pressure transducers*
- *Wind directions: Hall-effect sensors and magnets*

You'll need to use the transducers in an analog environment, then convert the signals to digital information with an A/D circuit (National's ADC0802 is a fairly easy device to use). You can use the Hall-effect sensors digitally for count or direction. National Semiconductor can provide information on these and other devices in its linear and digital families (including sample application data). Contact National Semiconductor Corp., 2900 Semiconductor Dr., Santa Clara, CA 95051.

You might consider buying a new instrument system that Heath is marketing. The Digital Weather Master is portable and has the ability to monitor temperature, barometric pressure, wind speed and direction, and rainfall. It also has some "history" functions built in. Perhaps you could investigate adapting this type of unit to your needs (it might be easier to start with a functional and calibrated unit, then create the interface).

Concerning weather forecasting programs: I have investigated some programs (in fact, one of my associates went to great lengths to determine the reliability of one package). Unfortunately, most of them use NOAA-derived formulas that are so generic in nature that their reliability is highest in the midwest area of the country. Extreme northern, southern, and coastal users will find that they need to fine-tune the algorithms to their native area. Consequently, it's always best for a new user to determine if the program can be modified (source code is provided) or allows for some form of area-dependent offsets.—Steve

Have ROM Will Travel

Dear Steve,

I have received conflicting information as to the possibility of removing the ROM BIOS chip from a Western Digital hard disk controller card and inserting it into an empty ROM socket on a PC XT–clone motherboard. Removing the W3 jumper on the controller card would then tell the board that it should look to the motherboard for its BIOS. The purpose of these modifications is to remap the memory address of the hard disk BIOS from its normal C800 address in memory segment C into a location in memory segment F, along with the regular system BIOS. If the hard disk BIOS were in segment F, I could set up 128K bytes of my HiCard board (similar to the Max-It board advertised in BYTE) memory in segments C and D and put my 64K-byte Lotus/Intel/Microsoft Expanded Memory Specification (LIM/EMS) window in segment E.

This chip-transfer scheme was suggested to me by someone in technical support at RYBS Electronics (which supplies the HiCard board); he claimed to have done this himself. However, someone at Western Digital technical support said that he had never heard of this and did not believe it could be done.

My computer is an XT clone assembled from parts primarily from JDR Microdevices. The turbo motherboard has seven sockets for 64K-byte ROMs. Only one of these sockets is currently used by the ROM BIOS chip. Can the suggested modification be done? I especially have a problem figuring out how two 64K-byte ROMs on the motherboard map into the 64K-byte space of segment F. If this modification is possible, would I have any problems with application or utility programs such as Norton Utilities, Fastback, or Coretest?

Franklin Chase
Boston, MA

Maybe I don't quite understand what you're trying to do, but it seems to me that if you're using EMS 3.2 or EMS 4.0 with the small frame option, you only need 64K bytes of space somewhere in the first megabyte of memory in which to put the

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page frame. The expanded memory does not go into this space.

Moving the hard disk BIOS might work, but I think you might then have to boot with a floppy disk. The BIOS is programmed to scan for ROM programs in the memory range from C800:0000 to F400:0000, so if you address it at F800:, the hard disk routines won't be found during system start-up. If it turns out that the 800 part of the segment address isn't sacred, you might be able to locate it at F000: and boot without trouble. If the ROM is relocated to F800:, you may be able to boot from a floppy disk and reset the interrupt vector to point to F800 and operate the hard disk, but I don't know for sure.

The empty ROM sockets on the motherboard are for ROM BASIC (cassette BASIC), and inserting the hard disk BIOS into that area shouldn't interfere with the normal BIOS, which is only 8K bytes (the chip is 8K bytes by 8 bits).

Would this cause any problems with utility programs that do special things with the hard disk? Probably. I haven't done this, and it is impossible to predict how various programs will react to a change of this type. If you really want to do this, I think you should call RYBS Electronics again and see if you can get the full scoop. Maybe someone there can tell you exactly how to set it up.—Steve

Fishing for IIGS Info

Dear Steve,

I'm looking for information on the Apple IIGS. It's pretty hard finding anything. Can you help?

Todd Daugherty
Chicago, IL

Your shortage of information on the IIGS isn't unusual or unexpected, although the people at Apple Computer aren't as open with information as they used to be 10 years ago.

The best source I'm aware of for information is the A.P.D.A. (Apple Programmers' and Developers' Association), which has membership dues of $20 per year and can supply development software, as well as hard-to-find manuals and such, all at reasonable cost. You can contact A.P.D.A. at 290 Southwest 43rd St., Renton, WA 98055.

Another good source of Apple information is Don Lancaster. See his columns in Computer Shopper *magazine and* Radio Electronics *magazine for specifics on his hotline and mailing address. His hotline number is (602) 428-4703 (business hours, weekdays, Mountain Standard time).*—Steve ■

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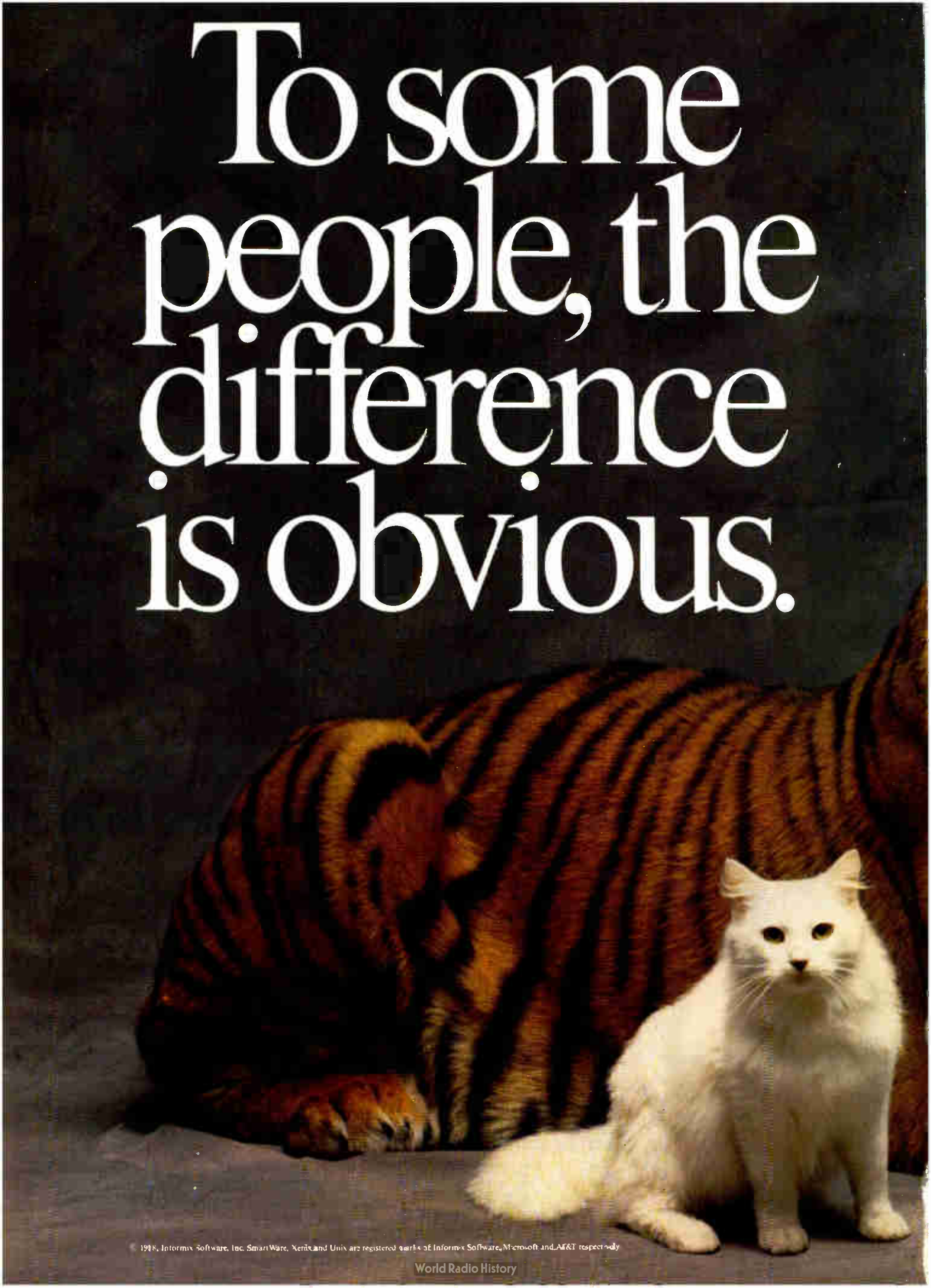
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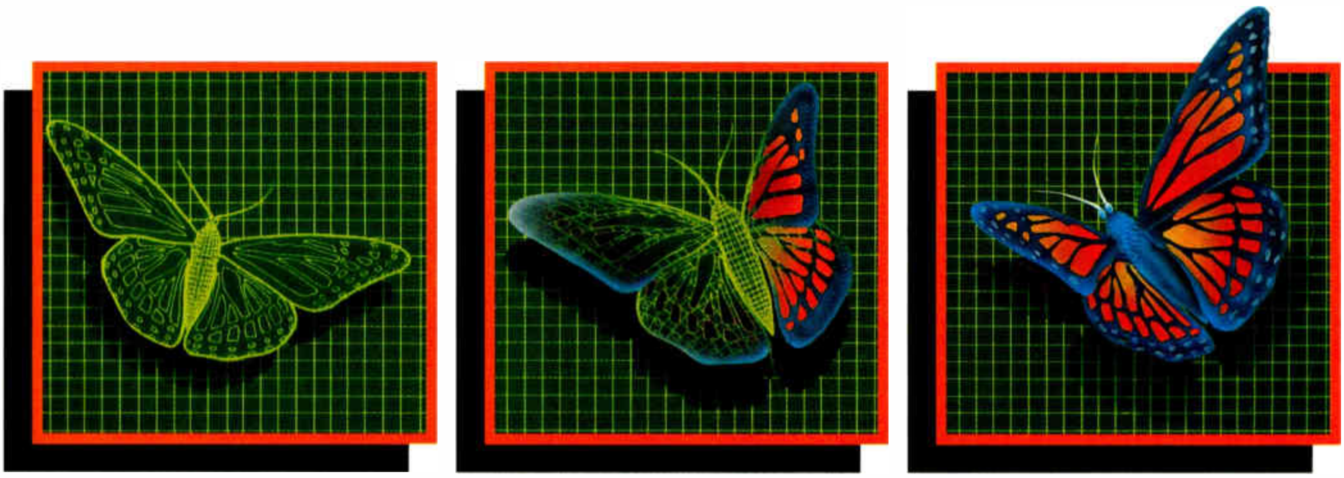

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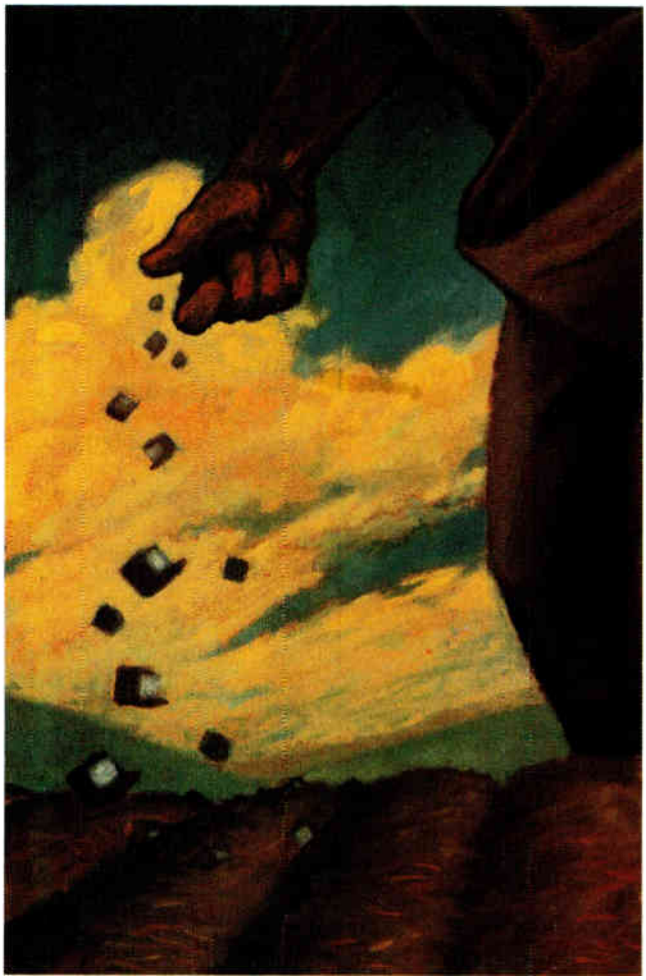

The First Electronic Computer: The Atanasoff Story

by Alice R. Burks and Arthur W. Burks

University of Michigan Press, Ann Arbor, MI: 1988, 387 pages, $30

Reviewed by G. Michael Vose

History books tell us that the ENIAC machine was the first true electronic computer. Its principal inventors, John W. Mauchly and J. Presper Eckert, rightfully occupy a niche as pioneers in the annals of computing. But a successful 1973 court challenge to the ENIAC's patents showed that Mauchly developed much of the ENIAC's theory from information obtained from another man: John V. Atanasoff.

The trial in 1973 set the record straight about Atanasoff's contributions to digital computing theory. But the passage of time has obscured Atanasoff's seminal ideas. Mauchly and Eckert's work stays memorialized in dozens of history texts, while the pioneering efforts of Atanasoff are mostly forgotten.

Like the early work of the brilliant English mathematician Alan Turing, John Atanasoff's innovations were swallowed up by the turmoil of a world war. Unlike Turing, though, Atanasoff never returned to research in computing after his wartime stint as a researcher for the United States Naval Ordnance Laboratory in Washington, DC. Both Turing's and Atanasoff's contributions to the science of computing needed a chronicler to secure them their rightful place in history.

Turing's story became a major biography in 1984 (*Alan Turing: The Enigma* by Andrew Hodges). Atanasoff's story unfolds in *The First Electronic Computer: The Atanasoff Story*, written by a member of the ENIAC design team, Arthur Burks, and his wife Alice, a longtime technical writer. Their book sets the record straight about Atanasoff's contribution to computing theory.

The ABC Computer

Atanasoff did not set out to invent a general-purpose computer. His original purpose was to automate the calculation of problems in physics, a subject he taught and researched at Iowa State College. Specifically, he sought to mechanize the solving of large sets of simultaneous linear equations. To build such a device, he first had to develop a method for solving these algebraic equations that would lend itself to mechanization. He decided that he needed to solve sets of up to 29 equations with 29 unknowns at an accuracy of 15 decimal places.

Then, the task became one of putting together the pieces that would allow the execution of the algorithm. Atanasoff modified the standard Gaussian algorithm for solving simultaneous linear equations. His modified Elimination Algorithm required only addition and subtraction operations, avoiding the more complex multiplications and subtractions used in standard Gaussian calculation.

This simplified algorithm lent itself nicely to a digital calculation mode like that found in desk calculators used widely in the late 1930s. The Burkses' description of Atanasoff's algorithm makes it easy to understand how it led naturally to many of the decisions that resulted in Atanasoff's computer.

Atanasoff's assistant during the creation of the machine was Clifford Berry, a graduate student. When the patent issued in 1964 to Mauchly and Eckert came under challenge in the 1970s, Atanasoff began referring to his early computer as the ABC, for Atanasoff-Berry Computer.

Once Atanasoff created his elimination algorithm, he and Berry proceeded to build a specialized computing device to execute his algorithm. One

continued

ALSO REVIEWED

UNIX System Readings and Applications, Volumes I and II

Programming Windows: The Microsoft Guide to Programming for the MS-DOS Presentation Manager

Software Engineering: A Beginner's Guide

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of the research team's primary constraints was money. They had only a little more than $5000 to work with at a time when electronic components were scarce and expensive. Since capacitors, resistors, and wire were cheaper than vacuum tubes, Atanasoff invented a memory system using capacitors mounted on a drum; that mechanism further led to the invention of an electronic switching add-subtract circuit.

Along the way, Atanasoff developed several other important ideas: a way to regenerate or refresh the charge to the memory capacitors; calculating in binary rather than decimal; and performing arithmetic with logic functions instead of counting.

The Burkses describe the development of these ideas in the context of Atanasoff's attempt to build a machine to execute his algorithm. This motivation is contrasted with the early work of Mauchly, who was building machines to perform meteorological calculations. Mauchly's machine, called a harmonic analyzer, was an analog device. The kind of problem to be automated dictated the kind of machine needed.

Today, we live in an era of 1-megabit dynamic RAM memory chips in computers with circuitry to refresh memory on a regular basis. But in 1939, refreshing an electrical charge to a capacitor was a breakthrough idea. John Atanasoff intended to apply for a patent on this and the other ideas that went into the ABC machine. But wartime duty called, and that administrative task fell through the cracks.

Bones of Contention

The Burkses' book not only recounts the early work of Atanasoff, Mauchly, and Eckert and describes the machines they built but examines these efforts in the context of the 1973 trial of *Honeywell* v. *Sperry Rand*. In this trial, Honeywell challenged the patent granted in 1964 to Mauchly and Eckert and Sperry Rand for the ENIAC in hopes of avoiding the high royalties being charged by Sperry Rand.

The court case provides a dramatic backdrop for the Burkses' narrative. The authors pored over the trial transcripts and examined every document submitted as evidence. They quote the trial transcript on many occasions to reveal how the Honeywell attorneys extracted from Mauchly testimony revealing that much of his ENIAC knowledge had come from letters exchanged with Atanasoff and from a 1941 visit to Iowa to see the ABC machine.

Mauchly did not intentionally steal Atanasoff's ideas. In the manner of many scientists, he attempted to make himself aware of all the research on a given subject and to synthesize his own inventions given the current state of the art. Borrowing and using ideas developed elsewhere is not uncommon. Later, the absence of patent applications from Atanasoff no doubt made Mauchly and his employers think that the ideas they wanted to patent were available for claim. The social turmoil of an ongoing war only served to add to the confusion.

But the trial finally established who invented what. The authors' use of the trial as a device to frame the historical narrative makes an otherwise dry read much more exciting.

An Ax to Grind

It seems a truism to say that the people best qualified to record events are those who were involved—unless, of course, they lack objectivity. Coauthor Arthur Burks helped to build the ENIAC and well knew the other people involved with it. Only someone so intimately involved could care enough to want to make sure that the historical record was accurate.

But Burks's intimate involvement in the events raises some questions. While he

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worked with Mauchly and Eckert to build the ENIAC, he had no qualms about encouraging his later employer, Honeywell, to challenge his old comrade's patent claims. Setting the historical record straight is an admirable ideal, so long as that is the only motivation. The fact that there was a strong economic motivation taints ever so slightly Burks's role in telling the story.

Maybe Burks's 1988 book is intended to leave the world with the impression that his motives in 1973 were pure. Whatever the motivation, the resulting volume is another fascinating glimpse of the genesis of one of this century's major scientific accomplishments.

BRIEFLY NOTED

UNIX System Readings and Applications, Volumes I and II *by AT&T Bell Laboratories, Prentice-Hall, Englewood Cliffs, NJ: 1987, 416 pages (Volume I), 336 pages (Volume II), $19 each.* From Aho to Weinberger, these volumes are the who's who of Unix research.

Unix originated at Bell Laboratories, and these books, originally published as Bell System Technical Journals in 1978 and 1984, contain about 20 insightful research papers each. Nearly everyone associated with the initial design and development of the Unix operating system contributes.

Volume I covers the early to mid-1970s, a time when Unix was already firmly entrenched in government and university installations. The papers discuss topics that are now commercial realities: "Unix on a Microprocessor," "The C Programming Language," and "Document Preparation."

Volume II introduces research from the late 1970s and early 1980s that relies heavily on ideas presented in Volume I. The original paper on C++, an extension to the C programming language that is rapidly gaining favor, is here, as are papers describing the historical development of Unix: "The Evolution of the Unix Time-Sharing System"; "The Evolution of C—Past and Future"; and "The Evolution of Unix System Performance."

There's little here for the programmer that isn't covered well in recent books, but for someone interested in the design philosophies and original applications of Unix, there's no better resource.

Most of the papers require a general knowledge of computer operating systems and hardware to be fully appreciated; however, the writing style is so uniformly accessible that anyone with even a cursory interest in Unix and its origins and design will find addictive reading in each volume.—*Jason Levitt*

Programming Windows: The Microsoft Guide to Programming for the MS-DOS Presentation Manager *by Charles Petzold, Microsoft Press, Redmond, WA: 1988, 852 pages, $24.95.* Three years after Microsoft introduced Windows, Charles Petzold has produced the official guide to Windows programming. Written for Windows developers, prospective Windows developers, or the just plain curious, this book offers a solid foundation in Windows program development. Covering a wide topic with very few omissions, *Programming Windows* teaches the whys as well as the hows of programming for Windows.

The book's major strength is its examples. The author assumes that you are fluent in the lingua franca of Windows—the C language—so be prepared for all examples to be written in C. Petzold starts with simple examples and adds detail until functional programs have been created.

Unless you have a good foundation in the basics of window procedures, painting, event loops, and other con-

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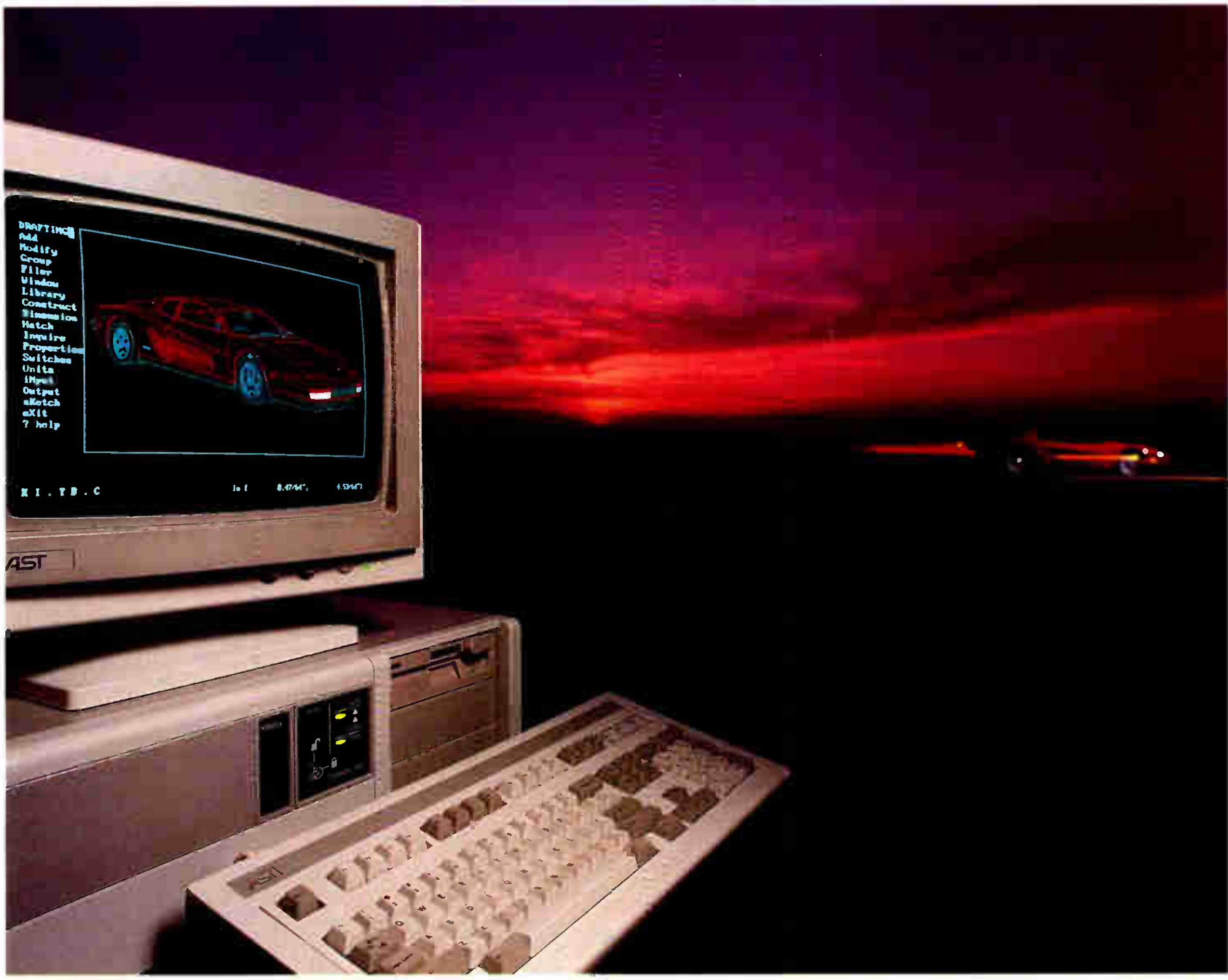

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cepts, understanding Windows is impossible. Fortunately, the book's development of these topics is excellent. Once the basics are presented, the pace and level of treatment accelerates into high gear.

Windows provides a rich graphical environment, and *Programming Windows* contains many fine examples for graphics programming. Mastering the many service routines provided by Windows is just as important, and these topics are presented carefully and thoroughly.

As witness to the richness of Windows, 852 pages still doesn't provide space to cover several important advanced topics, like dynamic data exchange and rich text format.

Programming Windows is filled with details and inside information that make it worthwhile reading. The layout integrates charts, tables, and source code in a way that does not interrupt the flow of the text. Broad in scope and omitting little, this book is a must for anyone who is serious about Windows.

—Philip Taylor

Software Engineering: A Beginner's Guide *by Roger S. Pressman, McGraw-Hill, New York: 1988, 294 pages, $49.95.* This book is a sweeping but measured overview of modern software design principles for students and entry-level professionals. Roger S. Pressman uses the requisite buzzwords: "prototyping," "data design/flow," "transform/transaction mapping," "abstraction," "program description language," and "white-box testing," and he provides supporting technical details and brief examples.

The author never loses sight of the real applications his theory will be put to, ending each chapter with a section entitled "What This Means to You." The text flows relentlessly but easily from analyzing the problem to designing the solution, coding the program, and testing and making changes. The book's noteworthy conclusion is an exhaustive software engineering checklist and comprehensive example.

—Darrow Kirkpatrick

Expert Systems for Experts *by Kamran Parsaye and Mark Chignell, John Wiley & Sons, New York: 1988, 462 pages, $29.95.* The role played by domain experts in the development of expert systems has expanded as the tools for building such systems have become higher-level and easier to use. Parsaye and Chignell's book is aimed at domain experts who might be thinking of implementing an expert system (with or without the help of a knowledge engineer), yet who are unfamiliar with artificial intelligence (AI) terms and concepts.

The authors provide a good, solid discussion of a broad range of technologies and methodologies currently in use in the development of expert systems. Chapters are devoted to logic and logic programming, knowledge and knowledge representation, uncertainty, the inference process, building expert systems, and knowledge acquisition and validation. The discussions are uniformly good and sufficiently detailed. The chapter on uncertainty, for example, covers traditional probability theory, fuzzy logic, certainty theory, exact and semiexact inference, and quantification of uncertain knowledge. I found the chapter on knowledge acquisition and validation to be valuable.

Detailed as the discussion may be, it is nevertheless fairly high level: There is no consideration of hardware, nor of specific expert-system building tools (despite an offer to refund the book's price upon purchase of one of several products from Intelligence-Ware, of which Parsaye is chairman). Although this book would be a valuable resource for anyone developing an expert system on his or her

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  F remove:             0

Step:     6        Dependent Variable: Total        Degrees of Freedom:    9

Ind  Var  Coefficient    Std Error     Beta Coeff   F Statistic  Probability

    Index  15.06187227  84.91492577   .046282023        .03146   .863140833
      GNP  -.035819179   .033491008 -1.013746349       1.14387   .312681061
 Unemploy -2.020229804   .488399682  -.537542578      17.11003   .002535092
 Military -1.033226867   .214274163  -.204740692      23.25154   .000944367
 Popltion  -.051104106   .226073200  -.101221114        .05110   .826211796
     Year  1829.151465  455.4784991  2.479664383      16.12737   .003036803

                                                     r^2:   .995479005
        Intercept: -3482258.635                        r:   .997736942
      F-Statistic:  330.2853392                r  (d.f.):   .996603485
   Standard Error:  304.8540736     Proportion Reduced:    .000015805
Std  Error  (d.f.):  373.3684631     Cumulative Reduced:    .995479005

---------------------------  Analysis of Variance  ---------------------------

            Sum of Squares     D.F.    Mean Squares      F Ratio     Probability
Regression     184172401.9       6     30695400.32    330.2853392    4.9840e-10
 Residual      836424.0555       9     92936.00617
  Total        185008826.0      15

------------------  Residuals   Durbin-Watson:  2.559487689  -----------------

 Case    Observed      Expected      Residual     -2s  -1s   0   +1s  +2s

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Expert Systems for Experts has a broader audience than its title implies. I recommend it for students of AI and novice knowledge engineers, and as a valuable reference for more advanced AI practitioners.
—*Alex Lane*

Artificial Intelligence Programming with Turbo Prolog *by Keith Weiskamp and Terry Hengl, John Wiley & Sons, New York: 1988, 262 pages, $22.95.* Turbo Prolog books with the term "artificial intelligence" on the cover have gotten a bad reputation. A number of them merely rehash the user's manual or provide lengthy tutorials on fundamental Turbo Prolog concepts, paying only lip service to AI applications. Happily, this book bucks that trend, providing useful code and ideas for the beginning-to-intermediate AI or Turbo Prolog programmer.

Authors Weiskamp and Hengl try to teach fundamental AI programming concepts and to show how to write useful programs in Turbo Prolog. After providing the reader with the obligatory opening chapters on the fundamentals of the language and its Turbo implementation, they progress from general-purpose toolbox code to specific AI applications.

The chapter on building an AI toolbox is deceptively easy to overlook in a first reading if you're at all familiar with Prolog and looking only at the code, or if you're a beginner looking only for Prolog programs to run. The chapter, however, contains many interesting ideas on how to write portable Prolog predicates.

The discussion of inference engines is ambitious, beginning with a discussion of formal reasoning and predicate logic, continuing with a description of forward- and backward-chaining control strategies, and ending with the development of a simple inference engine.

Despite a whirlwind introduction, I found the discussion of natural-language processing quite meaty. Code is developed to implement recursive transition network (RTN) and augmented transition network (ATN) natural-language parsers. The final sections of the book attempt to deal with knowledge representation and expert systems; however, there just isn't enough room to give either subject sufficient coverage.

Although the scope of the book is too broad for its medium size, the authors go about their business in a clear fashion with examples that stick in your mind, such as a robot riding a bicycle downstairs to illustrate commonsense reasoning. The code, which is easy to read, is available on disk for $24.95. The book includes a glossary and an index.

While advanced AI or Prolog practitioners will find this book a bit light, others will find it a good way to learn more about AI and Turbo Prolog.—*Alex Lane* ■

CONTRIBUTORS

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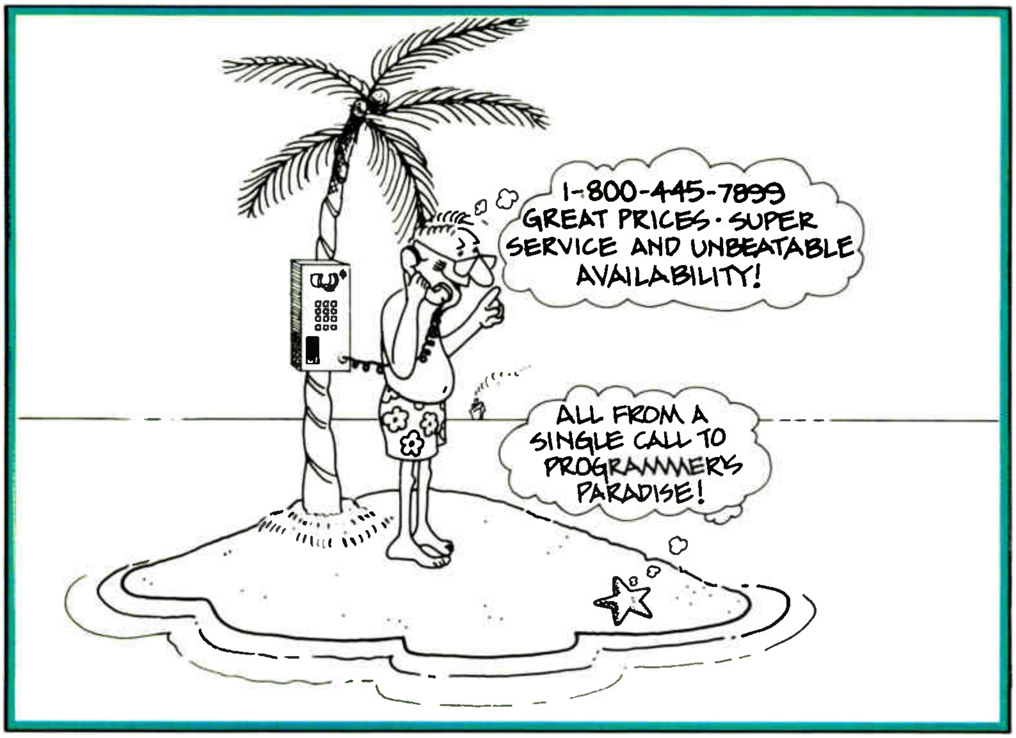

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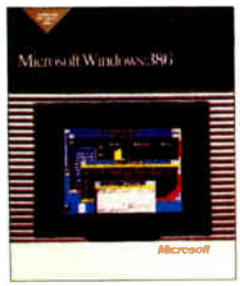

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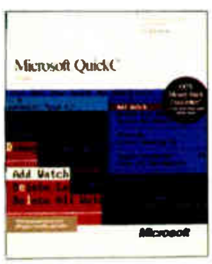

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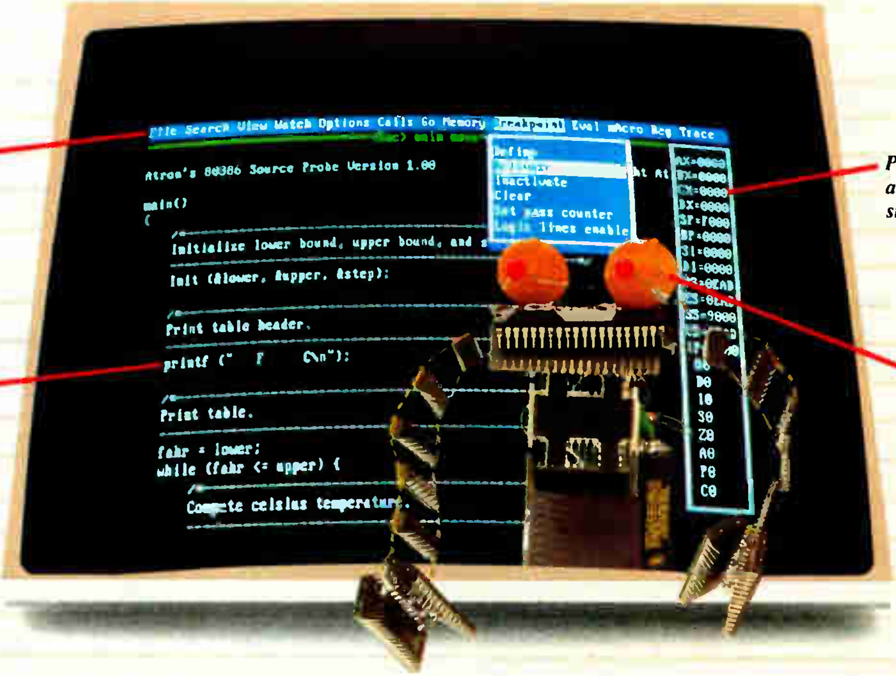
Products in Perspective

IT'S TIME TO DO SOME SERIOUS 386 BUGBUSTING!



Welcome to your nightmare. Your company has bet the farm on your product. Your demonstration wowed the operating committee, and beta shipments were out on time. Then wham!

All your beta customers seemed to call on the same day. "Your software is doing some really bizarre things," they say. Your credibility is at stake. Your profits are at stake. Your sanity is at stake.

THIS BUG'S FOR YOU

You rack your brain, trying to figure something out. Is it a random memory overwrite? Or worse, an overwrite to a stack-based local variable? Is it sequence dependent? Or worse, randomly caused by interrupts? Overwritten code? Undocumented "features" in the software you're linking to? And to top it off, your program is too big. The software debugger, your program and it's symbol table can't fit into memory at the same time. Opening a bicycle shop suddenly isn't such a bad idea.

THIS DEBUGGER'S FOR YOU

Announcing the 386 PROBE™ Bugbuster,*from Atron. Nine of the top-ten software developers sleep better at night because of Atron hardware-assisted debuggers. Because they can set real-time breakpoints which instantly detect memory reads and writes.

Now, with the 386 PROBE, you have the capability to set a *qualified breakpoint*, so the breakpoint triggers only if the events are coming from the wrong procedures. So you don't have to be halted by breakpoints from legitimate areas. You can even detect obscure, sequence-dependent problems by stopping a breakpoint only after a specific chain of events has occurred in a specific order.

Then, so you can look at the cause of the problem, the 386 PROBE automatically stores the last 2K cycles of program execution. Although other debuggers may *try* to do the same thing, Atron is the only company in the world to dequeue the pipelined trace data so you can easily understand it.

Finally, 386 PROBE's megabyte of hidden, write-protected memory stores your symbol table and debugger. So your bug can't roach the debugger. And so you have room enough to debug a really big program.

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From MS-DOS to Apple and Back

Two microprocessors inside the IBM XT-compatible WPC Bridge allow it to run (without rebooting) MS-DOS as well as "proprietary Apple-booting software," according to the company. The boards connect to the IBM floppy disk drive controller and then to the monitor and serial and parallel ports. You can also load FP BASIC from Apple DOS 3.3 for better compatibility.

Inside the machine, there's a 16-bit 8088 microprocessor that runs at 4.77 MHz for normal operation or at 8 MHz for faster operations, and a 65C02 microprocessor for 1-MHz Apple DOS operation. All you do is hit Alt-Esc to go back and forth between MS-DOS and Apple software programs. The system BIOS is from Up To Date Technology.

Memory in DOS mode is 512K bytes, expandable to 768K bytes, while memory in the Apple mode is 128K bytes for the main and auxiliary banks and 16K bytes for the Apple language card. Resolution in the DOS mode is 640 by 400 pixels; Apple-mode resolution is 720 by 360 pixels.

Two internal 360K-byte 5¼-inch half-height floppy disk drives come standard and operate off the two motherboards for Apple and IBM PC compatibility. On the IBM side, there are three full-length expansion slots and a clock/calendar. Both sides support an RS-232C serial port, a parallel printer port, and CGA capabilities.

An option on the IBM PC side is a 20-megabyte 3½-inch hard disk drive that requires one of the full-length expansion slots. There's a slot on the Apple side for an optional Apple drive; there's also an optional 8087 math coprocessor. An AT-compatible keyboard and a built-in 12-inch monochrome monitor come standard.

Price: $1695.
Contact: Cordata Technologies, Inc., 1055 West Victoria St., Compton, CA 90220, (213) 603-2901.
Inquiry 751.

WPC Bridges offer a choice of MS-DOS and Apple DOS.

25-MHz Machines with Zip!

With company ratings of 27 percent better performance than Compaq's Deskpro 386/20, Advanced Logic Research introduced the FlexCache 25386, a 25-MHz, zero-wait-state machine. It's based on a proprietary extended-emulation 82385 cache system, which the company claims is an enhancement of the Intel 82385 form of caching.

This proprietary caching system is enhanced by a 64K-byte, 25-nanosecond RAM-caching memory between the central processor and the main memory; direct memory access (DMA) caching of RAM I/O; byte, word, or doubleword caching; posted write-through on all accesses, including bytes; and background refresh cycles. Such a caching system makes the main memory 80 percent faster than the Compaq Deskpro, the company claims.

The Model 150 comes standard with 80387 support, 1 megabyte of main memory, one 1.2-megabyte 5¼-inch floppy disk drive, one 150-megabyte enhanced-small-device-interface (ESDI) hard disk drive, one serial port, and one parallel port. The Model 300 has a 300-megabyte ESDI hard disk drive with a controller.

Price: $9499 for Model 150; $12,499 for Model 300.
Contact: Advanced Logic Research, Inc., 10 Chrysler, Irvine, CA 92718, (714) 581-6770.
Inquiry 752.

Little features that promote using Hertz Computer's new 25-MHz machine as a file server include two cooling fans and possible hookup without floppy disk drives, keyboards, or monitors, according to the company.

Three standard versions include the big features as well. System 25/70 has a zero-wait-state 64K-byte cache with 2 megabytes of 32-bit RAM that's expandable to 24 megabytes. There's a 1.2-megabyte floppy disk drive, a 72-megabyte hard disk drive, and support for all types of 5¼- and 3½-inch drives. A VGA controller is standard.

Eight expansion slots include two 32-bit, five 16-bit, and one 8-bit. There are two serial ports and one parallel port, and the system can run anything from MS-DOS to OS/2 to Unix/Xenix.

Enhanced systems have 150- (System 25/150) and 320- (System 25/320) megabyte hard disk drives.

Price: $11,995 for System 25/70; $13,995 for System 25/150; $15,995 for System 25/320.
Contact: Hertz Computer Corp., 325 Fifth Ave., New York, NY 10016, (212) 684-4141.
Inquiry 753.

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Tallgrass Drives into the PS/2

Changing one module in the 40-megabyte tape backup system from Tallgrass Technologies upgrades the AT- and XT-compatible TG-1140 floppy disk drive to work at the faster AT and PS/2 floppy controller speed of 2.4 megabytes per minute.

You can also buy that tiny replacement module that's compatible with the 1.2-megabyte-per-minute XT-controller speed and put it into the PS/2 floppy disk drive and have a PC-compatible drive. Replacing either module takes about a minute, and you won't need any special tools.

There's also an economical 2-megabyte-per-minute tape backup subsystem in this QIC series of products that comes in Macintosh and higher storage models.

A special feature allows you to locate individual files on the tape in 20 seconds or less. Other features include automatic backup, Novell/3Com and Unix/Xenix compatibilities, and data sharing with other QIC-40 systems. Finally, tapes with 60-megabyte capacities, which will be available soon, will be compatible with the TG-1140.

Price: $495 for an internal PC, PS/2, or compatible; external cabinetry, $179; replacement module, $79 each.

Contact: Tallgrass Technologies Corp., 11100 West 82nd St., Lenexa, KS 66214, (913) 492-6002.

Inquiry 756.

Tallgrass PS/2, AT, or XT tape backup drives.

Clearer Than Night and Day

Beyond all-black and all-white picture elements is the gray-scale level of graphic-quality that Cornerstone Technology achieves with its DualPage display.

The company's newest monitor system, which includes a custom controller, features 4 or 16 levels of gray scale. You can also view two pages simultaneously; with a 19-inch screen, the two split pages come out about 30 percent smaller than actual paper size.

The board fits into a single expansion slot on an IBM XT, AT, PS/2 Model 30, or compatible. When you couple it with Cornerstone Technology's proprietary fonts, the package is compatible with PostScript. Times Roman, Helvetica, Courier, and Symbol fonts are available.

With a standard Hercules graphics adapter in the monochrome graphics mode, you get a resolution of 720 by 348 pixels. With the enhanced, 16-gray-level adapter (which piggybacks the standard card), resolution is enhanced to 1600 by 1280 pixels.

Refresh rate is 67-Hz noninterlaced, video bandwidth is 200 MHz, and a script-driven diagnostic program is included. Microsystems' NeWS and Microsoft's Xenix are supported. Optional drivers for desktop publishing include Ventura Publisher, AutoCAD, AutoShade, Publisher's Paintbrush, and PageMaker.

Also available is a single-page display system, which features 768- by 1008-pixel resolution with a 15-inch portrait screen.

Price: $2395 for 4-gray-level system; $2795 for 16-level system; $999 for single-page system.

Contact: Cornerstone Technology, 1883 Ringwood Ave., San Jose, CA 95131, (408) 279-1600.

Inquiry 757.

Moniterm Conquers with the Viking

An on-board coprocessor allows the 24-inch Viking 2400 monitor to speed up certain functions and simply skip others, like slope adjustments, according to the manufacturer, Moniterm.

It's the Hitachi HD63484 ACRTC that does the work for this giant AT- and PS/2-compatible monitor with a resolution of 1280 by 960 pixels, refreshed at 66 Hz. The 24-inch display and the coprocessor are specifically designed to accelerate AutoCAD and VersaCAD. Several operating platforms are supported, including MicroSoft Windows, DRI's GEM, GSS, Media Cybernetics' Dr. HALO, and Lotus 1-2-3.

Price: $2995.

Contact: Moniterm Corp., 5740 Green Circle Dr., Minnetonka, MN 55343, (612) 935-4151.

Inquiry 761.

Printer Races at 600 cps

A dot-matrix color printer that prints in draft mode at 600 characters per second was introduced by Honeywell Bull Italia. That's faster than most laser printers.

The new 4/68 color printer can also print up to 150 cps in letter-quality mode. The reason for such speed, the company says, is a special 18-pin print head with two 9-pin vertical arrays. During draft printing, the two arrays are lined up and allow each character to be printed in half the time. In letter-quality mode, one of the arrays is staggered with respect to the other to produce a higher-quality character.

The paper-feed mechanism allows you to print both single-sheet and fanfold paper interchangeably. If you press a front-panel button, the 4/68 automatically retracts the fanfold paper and allows you to insert a single sheet of paper through a slot in the front of the printer. Pressing another button resets the fanfold paper.

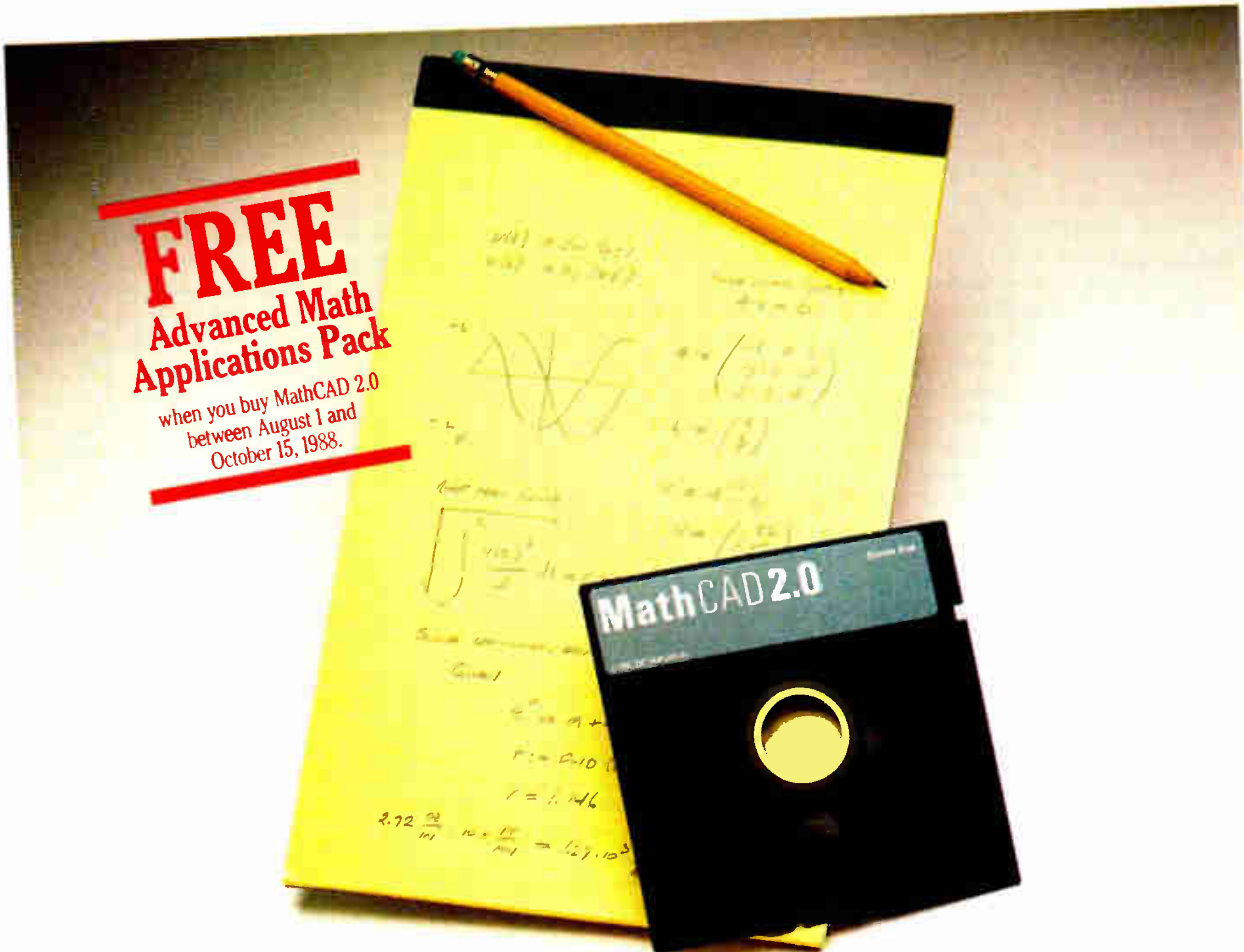
Paper-handling features allow the 4/68 to handle formats from 4¾ to 17 inches wide, from 4 to 24 inches long, and up to C-size portraits. It can accommodate up to five carbon copies and has a parking feature and bottom feed.

Price: $2450.

Contact: Honeywell Bull Italia, 120 Howard St., Suite 800, San Francisco, CA 94105, (415) 974-4340.

Inquiry 762.

continued



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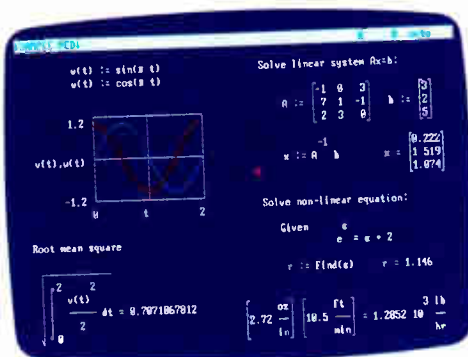

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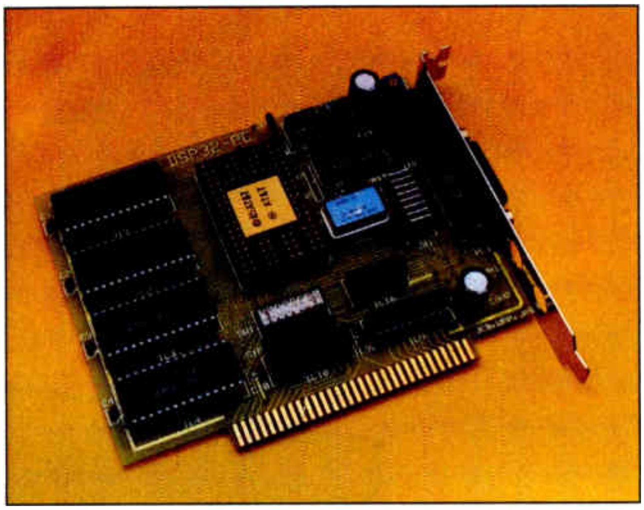
Circle 161 on Reader Service Card

MFLOPS for Less

A floating-point array processor card for IBM PC XT-compatible computers promises to deliver from 8 to 25 million floating-point operations per second (MFLOPS) for under $100 per MFLOP. That means it speeds up some (but not all) computationally intensive applications, like scientific computing, from hours to minutes, according to the company.

The half-length card is based on AT&T's DSP32 for the XT, a single processing chip with a floating-point digital signal processor. The DSP32-PC has 32K bytes of zero-wait-state static RAM. There's an upgrade available to 128K bytes of static RAM. Also available is a development system, including the board, an assembler, a window-based emulator, a math library, and demonstration programs.

In company benchmarks, a 1024-point complex fast Fourier transform was executed in 3.25 microseconds (μs). A finite impulse response was executed in 80 nanoseconds per TAP, and a 3 by 3 matrix multiplication was completed in 2.2μs.



The DSP32-PC reduces scientific computing to minutes.

A C compiler will include a math library. The DSP32C, an AT board with upgrade and development system, may be available as soon as October, when AT&T ships the AT version of the chip.
Price: $745 for XT board; $50 for upgrade; $995 for development system (including the board); the DSP32C version of the board will be under $1500.
Contact: Communications Automation & Control, 1642 Union Blvd., Suite O, Allentown, PA 18103, (215) 776-6669.
Inquiry 763.

31 Users on Your AT

Up to 31 ASCII terminals can now be connected with RS-232C cabling to AT and compatible boards from UltraTek for distributed computing, based on Alloy Computer's NTNX operating system.

RS-232C cabling means 19.2K-bps transmission, and Alloy Computer's operating system means one Multi-Master board per terminal. Each board has an 8088 microprocessor and 512K bytes of RAM (upgradable to 1.2 megabytes). You'll need an expansion chassis if you want to use more terminals than you have slots in your AT.
Price: $695.
Contact: UltraTek, 400 Walnut, Suite 335, Redwood City, CA 94063, (415) 364-1060.
Inquiry 765.

Transform Your AT into a Multiuser Master

One full-length AT-compatible card, an interface box, a monitor, and a keyboard are now all you need to compute as far as 200 feet away from your host AT. The AT needs only full-length slots and a hard disk drive.

Add eight more cards, interface boxes, monitors, and keyboards, and you'll have the maximum number of processing stations—each with a serial and parallel port for modems and printers that can be shared by all the other stations on the network.

Each card has its own 80286, and 512K bytes of RAM running on ODOS, a DOS-compatible multiuser operating system.

Two cards are offered: The O-286H gives the stations Hercules graphics capabilities and monitor resolution up to 720 by 348 pixels; the O-286E has CGA, MGA, and EGA graphics capabilities for monitor resolutions of 640 by 200, 720 by 348, or 640 by 400 pixels, respectively.
Price: $1295 for O-286H; $1495 for O-286E.
Contact: Our Business Machines, Inc., 12901 Ramona Blvd., Suite J, Irwindale, CA 91706, (800) 433-1435; in California, (818) 337-9614.
Inquiry 764.

Putting on the Bits

An on-board BIOS supporting more than 60 hard disk drive types is standard with high-end floppy and hard disk controllers from Perstor Systems. Designed for use in 16-bit expansion slots of 80286 or 80386 AT-compatible computers, the controllers operate at 9 and 10 megabits per second.

Unlike standard Macintosh File System (MFM) and run-length-limited (RLL) controllers that support 17 and 26 sectors per track, the Perstor controllers use a proprietary disk interface to increase the number of sectors per track to 31. So models PS180-16F and PS180-16FHP, which are MFM- and RLL-compatible, are rated to increase hard disk capacity by 90 percent. Model PS200-16F (only RLL-compatible) is rated to increase hard disk capacity by 100 percent. Each controller can manage two hard disks and two floppy disks, in any combination from 360K-byte to 1.44-megabyte capacities in either 3½- or 5¼-inch formats.

The PS180-16FHP's advantage over the PS180-16F is its resident BIOS cache, which runs in any combination of normal internal memory, Lotus/ Intel/Microsoft Expanded Memory Specification (LIM/EMS) memory, or AT extended memory.
Price: $345 for the PS180-16F; $375 for the PS180-16FHP; $365 for the PS200-16F.
Contact: Perstor Systems, Inc., 7631 East Greenway Rd., Scottsdale, AZ 85260, (602) 991-5451.
Inquiry 766.

continued

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Features ● = Yes ○ = No	Sprint 1.0	WordPerfect 4.2	MS Word 4.0	WordStar 4.0	MultiMate Adv. 1.0
Maximum file size	Disk	Disk	Disk	4MB	128K
Thesaurus (integrated)	●	●	●	●	●
Windows Open (maximum)	6	2	8	1	1
Files Open (maximum)	24	2	8	1	1
Cross-Reference (dynamic)	●	○	○	○	○
Indexing Options	7	1	3	3	○
Columns: Parallel	●	●	●	●	●
Snaking (chg. * same page)	●	●	Not same pg.	○	●
H-P LaserJet Support	Full	Partial	Full	Partial	Full
PostScript Support	Full	Text	Full	○	Text
Mouse Support (integrated)	●	○	●	○	○
Dynamic Shortcuts	●	○	○	○	○
Alternative User Interfaces	●	○	○	○	○
Verify Spelling as you type	●	○	○	○	○
Programmable Macro lang.	●	○	○	○	○
Save File[1]	5.9	41.1	9.7	4.4	1.0
Top to Bottom[2]	7.5	7.5	49.4	8.1	21.0
Search and Replace[3]	1.6	6.6	4.6	17.1	13.4
Find Unique Word	3.3	6.2	7.0	13.8	20.6
Suggested List Price	**$199.95**	**$495.00**	**$450.00**	**$495.00**	**$565.00**

Time tests were performed on an Acer 286 (8 MHz). 640K RAM. [1]File size 103K. [2]1636 lines. [3]14 occurrences. Times shown are in seconds. (Benchmark details available upon request.)

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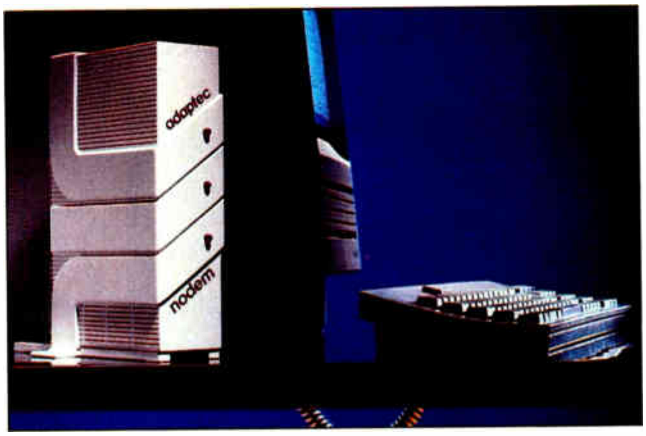
Circle 34 on Reader Service Card (DEALERS: 35)

Ethernet Meets Mac with SCSI

Besides becoming the floppy and hard disk controller interface of choice for both Apple and PS/2 systems, the SCSI has now become a possible local-area-networking port for industry-standard 10-megabit-per-second Ethernet connectivity.

Adaptec has introduced the Nodem, which uses the SCSI port of Apple computers this way. That means the Nodem, in the form of a 5- by 8- by 2-inch peripheral, can automatically enhance the transmission rate between Apple machines 40-fold over what was previously possible with the 230K-bit-per-second LocalTalk cabling system, while retaining Apple's connectivity operating software, AppleTalk.



SCSI Nodem enhances AppleTalk.

Another advantage is that the Nodem doesn't use any internal slots, so you can share information more easily among the Mac Plus (which has no slots), the Mac SE (which has one slot), and the Mac II (which has five slots).

Up to eight different devices can daisy chain on the SCSI bus for connectivity with the three most popular Ethernet transmission media—coaxial, thin coaxial (Cheapernet), and twisted-pair copper. The Nodem architecture is based on Adaptec's I/O controller ICs, rather than traditional Ethernet chip sets. And while Macintosh system disks are available now, the company says IBM-compatible system disks should be available next year.

Price: $545 for coaxial; $595 for Cheapernet or twisted pair.
Contact: Adaptec, Inc., 691 South Milpitas Blvd., Milpitas, CA 95035, (408) 945-2520.
Inquiry 768.

Hook up Your Network Through the AC Lines

PowerLink is a networking system that links any two IBM PCs or Apple Macintoshes and their printers through your building's existing power lines. And, according to its maker, you'll soon be able to expand it to interconnect up to eight systems.

The system transfers data through your computer's serial port at 19.2K bits per second. You simply plug the network device into the nearest wall outlet and you're connected to the Link network. The only limitation is that devices must be on the same side of a power transformer, but this is usually no problem if they're in the same building.

The Link hardware is provided either as an add-in card for the IBM PC and compatibles or as an external 10-inch box for serial port connections.

Price: $495 for the external unit; $395 for the add-in card; ManyLink software for two PCs, $165; ManyLink for up to eight PCs, $395.
Contact: Netline, Inc., 85 West Center St., P.O. Box 3000, Provo, UT 84603, (801) 373-6000.
Inquiry 769.

Voice and Data Travel Together on the Twisted Pair

Two machines compatible with AT&T and Siemens Integrated Services Digital Network (ISDN) interfaces are now available from International Computers Ltd. (ICL), a subsidiary of Standard Telephones and Cables PLC Group.

Both of the AT-compatible machines allow transmission on two 64K-bit-per-second ISDN B channels and one 16K-bit-per-second ISDN D channel (but only if you're one of the small but growing number of telephone company customers served by an ISDN central office switch).

The machines could be looked at as two luxury telephone/computer hybrids. The telephone includes more bells and whistles than the average business executive's telephone, and the manufacturer claims the 80386 version is faster than Compaq's 386/20.

The Model PWS 20 is an 8-MHz, zero-wait-state machine based on Intel's 80286 microprocessor. It comes with a 40-megabyte hard disk drive, a 720K-byte 5¼-inch floppy disk drive, and six 16-bit and two 8-bit expansion slots. Peripherals include an ISDN telephone, an EGA color monitor, and an AT-style keyboard. The Model PWS 386 has the same features, plus an Intel 80386 that runs at 20 MHz with no wait states.

Both models include MS-DOS 4.1, a multitasking Microsoft-designed DOS with a 640K-byte RAM limit per task. MS-DOS 4.1, which was designed earlier this year for ICL and to date has been sold only in the U.K., includes multitasking that ICL has used to provide telephone status on the computer screen's bottom four lines.

A single-slot add-in board with a proprietary S/T interface is used to connect the computer and telephone to your local central office over standard telephone wiring. That connection, with standard RJ-45 connectors, will handle the three channels totaling the 144K-bit-per-second transmission rate.

Several ISDN features include auto-answering; directory-, speed-, and recent-call dialing; and a status display of incoming and outgoing call information. The system includes several non-ISDN connectivity features as well, including V.120 rate adaption software and X.25 packet assembler/disassembler support over one clear 64K-bit-per-second B channel.

Price: $8000 for PWS 20; $10,000 for PWS 386.
Contact: International Computers Ltd., Inc., Network Systems—ISDN Group, 777 Long Ridge Rd., Stamford, CT 06902, (203) 968-7222.
Inquiry 767.

continued

The *easy* way to move files between the 5¼″ world of PCs, and the 3½″ world of PS/2s, Laptops, and 386s: Sysgen's Bridge family.

Because your PCs, PS/2s, 386s and laptops all talk to different floppy disk sizes and formats, they can become frustrating *islands* of information.

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Controls up to four drives, so you can mix and match 5¼″, 3½″, and floppy tape drives as you need. This hot card gives you big storage, plus twice the floppy disk and floppy tape transfer performance rates! At only $95, this is a winner.

Get your computers talking. Call the Sysgen Hotline for the name of your nearest dealer. 1-800-821-2151.

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Circle 266 on Reader Service Card

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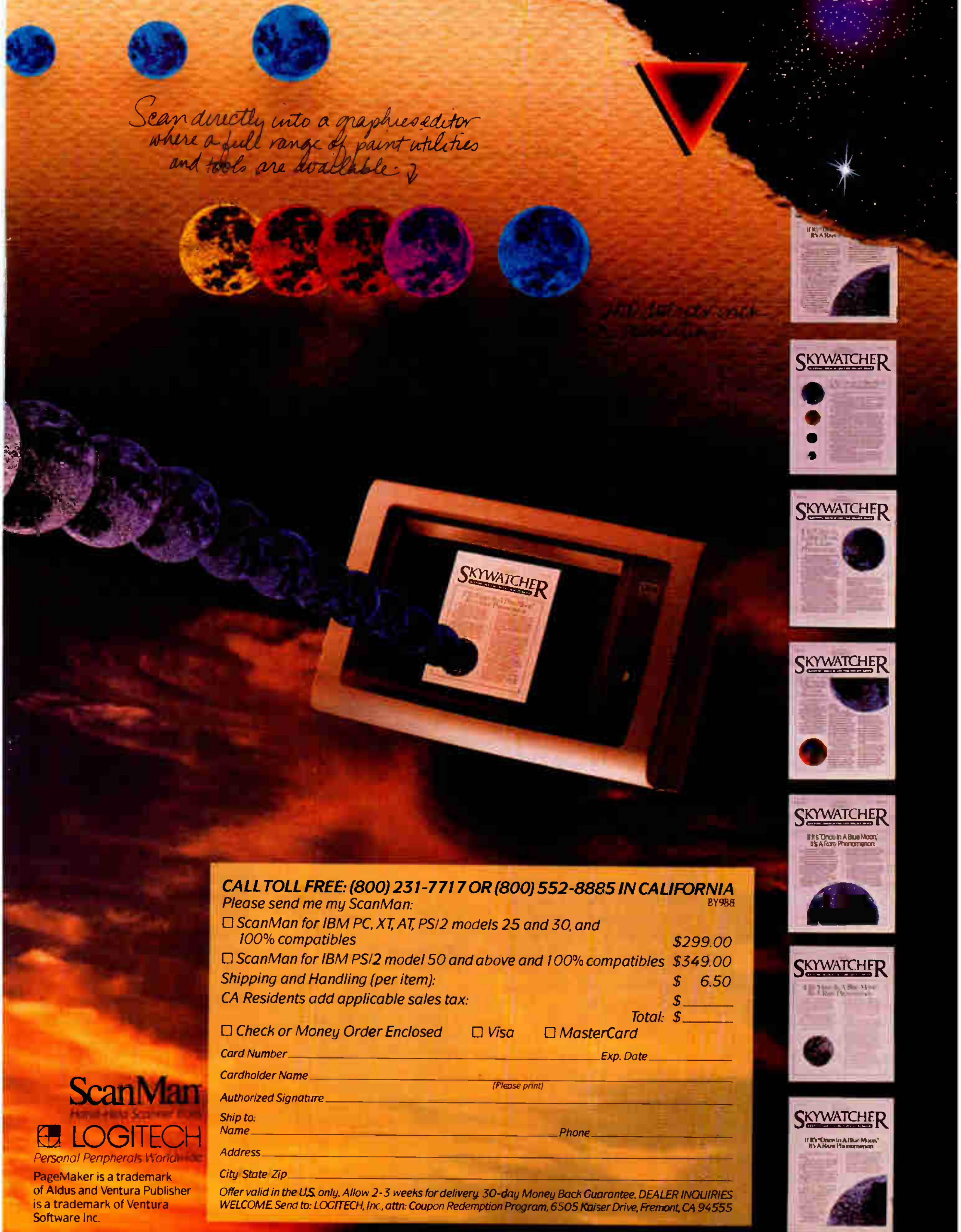

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Circle 149 on Reader Service Card (DEALERS: 150)

Micro Channel on a Chip

If you're designing add-in cards for the Micro Channel, One Chip Plus can make your job easier. It's a full-fledged design system that's built around a chip.

One Chip Plus contains the decoding and logic functions to simplify the design of memory, I/O, and multifunction adapter cards for PS/2 machines. It includes programmable decoding for extended memory, expanded memory, multiple I/O ports, and ROM. It also supports Micro Channel DMA arbitration and burst-mode DMA. Programmable memory and I/O timing match slow and fast devices and can connect directly to single- and dual-in-line memory modules.

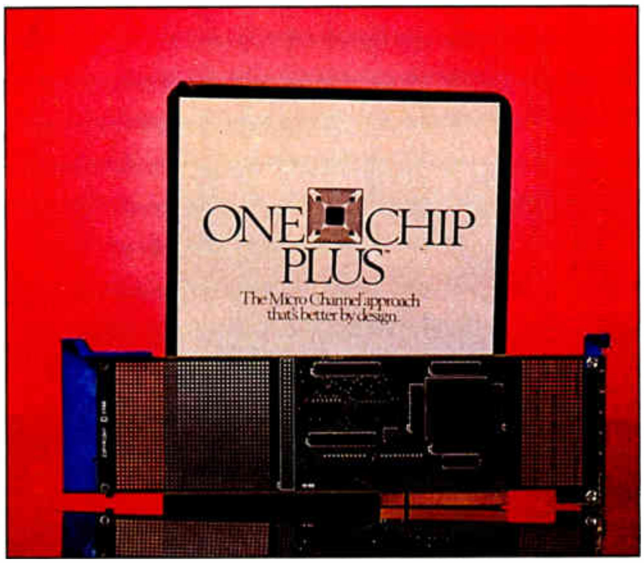
A software kit includes a LIM/EMS 4.0 memory driver. A proprietary design lets you program the Micro Channel ID number rather than designing it into the hardware after being designated the number by IBM—a process that has been known to hold up the design phase.

The company's Acquisition Engine, which provides high-level programming commands for background and foreground data acquisition and I/O control in the form of a 5¼-inch floppy disk, eliminates the need for additional programming and hardware, the company says. The acquisition engine subsequently accepts software modules that interface to any I/O function.

Price: $34 for One Chip Plus; $995 for a combined I/O and memory package; $349 for the Acquisition Engine; $95 for the Application Guide.

Contact: Capital Equipment Corp., 99 South Bedford St., Burlington, MA 01803, (800) 234-4232; in Massachusetts, (617) 273-1818.

Inquiry 770.



Capital Equipment's MCA design system.

Disk Duplicators Multiply

While the floppy and hard disk duplicating companies have thus far concentrated on hardware for software developers, one duplicator company is offering less-expensive products for companies with volatile, voluminous databases.

The new Datapath Technologies' Copy Manager can copy up to four 3½-inch or 5¼-inch disks—or any combination—all at once.

The Copy Manager requires one full-length PC slot per four disks and acts as a peripheral. There's also a duplicator expansion unit that allows another four disks to be copied at one time, bringing the total to eight disks that you can copy at once, in any configuration. The Copy Manager copies 480 copies per hour in its fastest configuration.

The Model 1042 Copy Manager comes in a low-end configuration to copy four 360K-byte 5¼-inch disks. On the high end, the Model 1040 copies up to four of any combination of 3½- or 5¼-inch disks. The Model 1052 expands any of the six Datapath four-copy versions by four 360K-byte 5¼-inch drives. The Model 1050 expands any of the four-copy versions by four drives of any configuration—both expansions increase total copying ability to eight disks simultaneously.

Price: $1995 for Model 1042; $2250 for Model 1040; $1395 for Model 1052; $1650 for Model 1050.

Contact: Datapath Technologies, Inc., 46710 Fremont Blvd., Fremont, CA 94538, (415) 651-5580.

Inquiry 771.

Throw Your Typing Skills into the Trash

A peripheral on which to write and store handwritten information allows those who haven't mastered the art of typing to have the same computer literacy as others, according to the manufacturer.

PenWriter can translate printed handwriting and hand drawings into ASCII and works with all IBM compatibles.

The peripheral is a 640- by 400-pixel backlit liquid crystal or plasma display. Accuracy with the stylus is rated at better than 0.015 inches. Four operating modes are available: stream, switched stream, point, and incremental.

Price: $1895 with LCD; $2895 with plasma display.

Contact: Scriptel Corp., 4145 Arlingate Plaza, Columbus, OH 43228, (614) 276-8402.

Inquiry 772.

Storage Betters Board Testing

Digital EGA storage of sine waves gleaned from IC boards allows technicians and engineers to more quickly test board components and circuitry, thanks to the analog signature analysis tool from Huntron Instruments.

The 5100DS allows you to send a current-limited sine-wave voltage signal across two points of an add-in board, store the sine-wave traces, and then go through other boards to verify components and circuitry with an EGA graphics display of the produced sine waves. A trained eye can notice leakage and backflow problems, the company says, allowing troubleshooting of all but gate-control devices.

You need an 80286 or 80386 machine, DOS version 3.0 or higher, 640K bytes of RAM, a 3½- or 5¼-inch floppy disk drive, a 10-megabyte hard disk drive, an EGA card, an EGA monitor, and a parallel printer port.

Price: $9500 without controller or computer; $14,000 for an entire system.

Contact: Huntron Instruments Inc., 15720 Mill Creek Blvd., Mill Creek, WA 98012, (800) 426-9265; in Washington, (206) 743-3171.

Inquiry 773.

continued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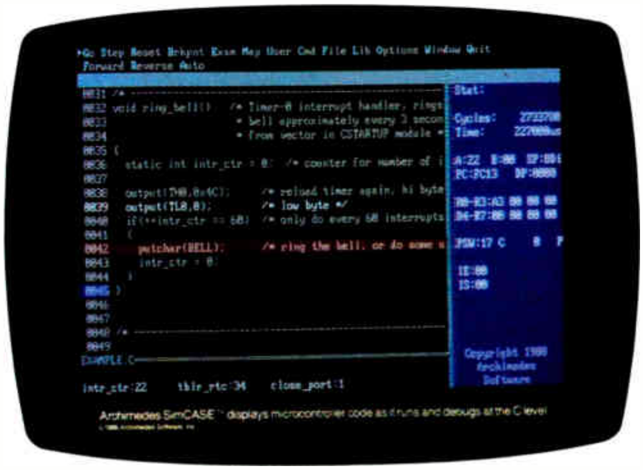


SimCASE displays and debugs microcontroller code.

Archimedes calls it the first microcontroller simulator with a C source-level debugger. SimCASE is a window-based program that allows you to create software prototypes without any target hardware. It debugs C programs at the source level and locates bottlenecks in your code. The simulator consists of the Simulator Engine, the C & A Assembler Source Debugger, the Performance Analysis Tool, and the Input Stimulus Generator.

The Simulator Engine simulates the microcontroller on the computer, including the instruction set, the interrupt handling system, and all I/O ports. The Source Debugger gives you the option of symbolic and source debugging on the C or assembly level. It includes tools like trace, code and data examinations, step, and breakpoints.

The Performance Analysis Tool tests your design ideas by giving you the execution times of every block and line of code and helps you identify bottlenecks in the design.

You can graphically display the execution profile of a program with the Performance Analysis Tool. The Input Stimulus Generator takes a disk file you've created that contains a stream of input signals and tests the program for response to external stimuli. Once your code is tested with SimCASE, you can download it to EPROM or to an emulator for final testing.

The kit is available for the 8-bit Intel 8051 family. It runs on the IBM PC, XT, AT, and compatibles with at least 640K bytes of RAM and DOS 2.1 or higher. It also requires an Archimedes C cross-compiler kit.
Price: $895.
Contact: Archimedes Software, Inc., 2159 Union St., San Francisco, CA 94123, (415) 567-4010.
Inquiry 779.

C Is for Database Management

Code Base is a C library that uses the same naming conventions as dBASE and is compatible with dBASE III Plus. You can operate Code Base as a multiuser program on a network file server, with record and file locking.

According to Sequiter Software, there are 93 external Code Base routines organized into 9 modules. The program indexes three times faster than dBASE III Plus, `Skip 100` is 100 times faster, and it executes `Do While` loops 1000 times faster, Sequiter reports.

To run Code Base you need Turbo C, Quick C, or Microsoft C 5.0 or 5.1.
Price: $149 (includes source code).
Contact: Sequiter Software, Inc., P.O. Box 5659, Station L, Edmonton, Alberta, Canada T6C 4G1, (403) 439-8171.
Inquiry 774.

Develop AI Applications Under OS/2

Production Systems Technologies reports that OPS83 was the first language to integrate procedural and rule-based programming. Now the company has introduced OPS83 for OS/2, enabling you to develop larger artificial-intelligence applications in protected mode. Applications under OS/2 can have at least 32 times as many rules or data items as applications under MS-DOS, according to Production Systems Technologies.

OPS83 has a Pascal-like syntax. It supports separate compilation for program development efficiency and standard subroutine linkages that allow you to interface with other languages. The development environment is coded in C and assembly language. It requires the Microsoft C Compiler and an IBM PC or compatible running OS/2.
Price: $2950.
Contact: Production Systems Technologies, 5001 Baum Blvd., Pittsburgh, PA 15213, (412) 683-4000.
Inquiry 776.

Programming from a Menu

With the introduction of EngLan, computer programming is simplified to the point of choosing functions from a menu. Gentry Software reports that debugging is limited to removing logic errors, because the code you choose is already written. Each time you choose a new command, it is displayed at the bottom of the screen, and you can make changes using the view/change submenu.

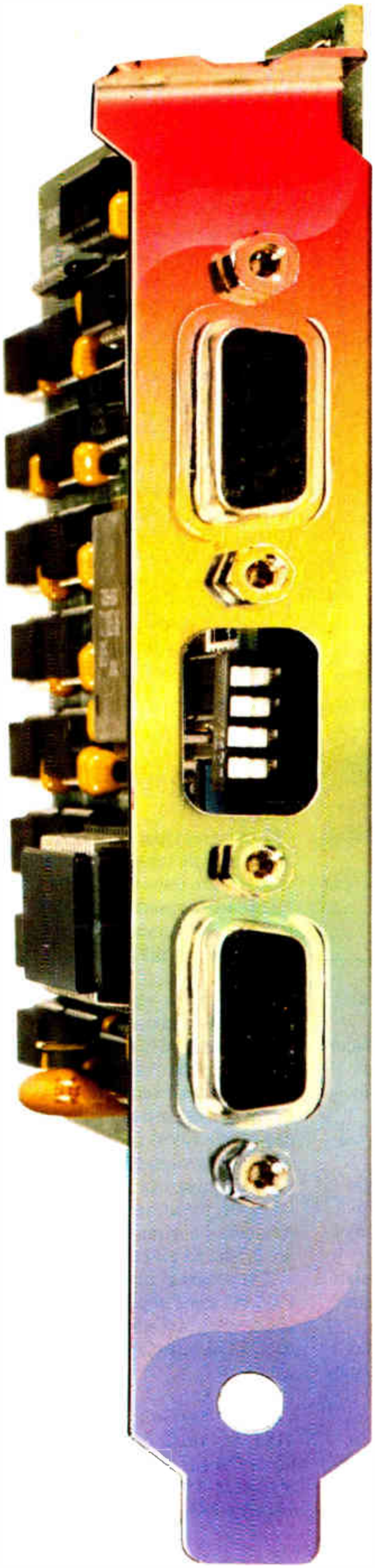
The program is designed for small-business and general-application programs. It runs on the IBM PC and compatibles with 256K bytes of RAM.
Price: $49.95.
Contact: Gentry Software, P.O. Box 4485, Springfield, MO 65808, (800) 346-9475; in Missouri, (800) 634-8439.
Inquiry 775.

Modula-2 for OS/2

Operating in what Logitech calls "dual mode," its OS/2 version of Modula-2 lets you port applications between DOS and OS/2, as well as develop applications that run under real and protected mode.

Included in Modula-OS/2 is Logitech's text editor. It features multiple windows and menus along with a customizable user interface. The OS/2 version of the editor lets you use it with or without a mouse and compile in the background or foreground.
Price: $349.
Contact: Logitech, Inc., 6505 Kaiser Dr., Fremont, CA 94555, (415) 795-8500.
Inquiry 778.

continued



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Circle 111 on Reader Service Card

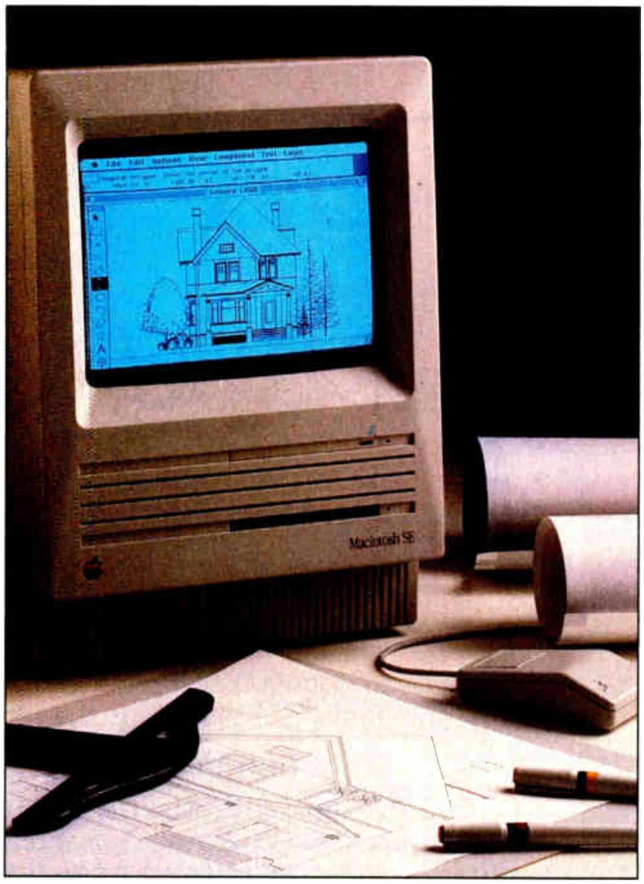
CAD on the Mac

Generic CADD, previously running only on the PC, now runs on the Mac. The Mac program offers the same computer-aided drafting and design capabilities, according to Generic Software.

You can create drawings from a set of simple objects, including points, lines, circles, arcs, ellipses, and B-spline curves. You can draw objects in up to 256 colors, layers, and line types; and you can move, copy, erase, or break objects, rotate them at any angle, and scale them.

The Macintosh version lets you edit multiple drawings in separate windows simultaneously. You can cut and paste objects between different windows within the program and with other programs using the PICT format.

Generic CADD Level 1 for the Mac is also compatible with MultiFinder. It runs on the Mac II, SE, and Plus.
Price: $99.50.
Contact: Generic Software, Inc., 8763 148th Ave. NE, Redmond, WA 98052, (206) 885-5307.
Inquiry 784.



Generic CADD makes its Macintosh debut.

High-Speed Simulation

DSIM, an event-driven, interactive, mixed-level simulator that supports switch- and gate-level simulation, now runs under OS/2. You can use the program for digital simulation, and it has special features for MOS (metal-oxide semiconductor) circuits.

The OS/2 version of DSIM can simulate a maximum of 7000 gates using 1 megabyte of memory. Under DOS, using 640K bytes, it could simulate a maximum of 2500 gates. The OS/2 version supports all the features available in the DOS version, including switch-level simulation, interactive waveform display, and tabular display functions.
Price: $1250 for the OS/2 version; $495 for the DOS version.
Contact: Roche Systems Corp., 1705 North Rankin St., Appleton, WI 54911, (414) 733-6077.
Inquiry 782.

Another CAM?

CAM. This time, it stands for computer-aided mathematics. CompMath 1.02 is a menu-driven advanced mathematics program that contains general, complex, matrix, engineering, and statistical mathematics.

Under the general math option, you can calculate factorials, angular units, log-to-any-base conversion, and rectangular/polar conversion with graphs. You can also calculate *n*th roots. The complex math option lets you perform addition, subtraction, multiplication, and division of complex numbers raised to real powers. You can calculate complex roots and exponents and plot complex graphs.

The matrix math option offers matrix inversion, add/subtract math, multiplication, and transposition operations.

The engineering selection is an introduction to engineering math, with polynomial, quadratic, and simultaneous equation calculations, and derivative and integration.

The statistical option on the menu lets you choose to load numerical data from a keyboard or disk file and store to disk. It lets you perform basic statistical mathematics and plot bar graphs or scatter graphs with regression line plotting.

The program's graphics capabilities let you plot graphs in polar/Cartesian coordinates and a variety of other functions.

CompMath 1.02 runs on the IBM PC and compatibles with at least 256K bytes of RAM, DOS 2.0 or higher, and a CGA, EGA, or Hercules monochrome graphics card.
Price: $49.
Contact: Bsoft Software, 444 Colton Rd., Columbus, OH 43207, (614) 491-0832.
Inquiry 786.

Statistical Software

A program that performs multiple regression analyses on data sets of up to 50 independent variables and any number of observations was announced by YakiSoft of Canada.

YREG reads data from ASCII files and can be used interactively or in batch mode. It produces the usual regression output, as well as predicted values, residuals, influence diagnostics, and a plot of residuals versus predicted values. Univariate statistics, including mean, variance, minimum, and maximum, are produced for each variable.

The program runs on the IBM PC and compatibles with 256K bytes of RAM. You'll need a CGA display for residual plots.
Price: $33.
Contact: YakiSoft, P.O. Box 4151, Station C, Ottawa, Ontario, Canada K1Y 4P3, (613) 733-4563.
Inquiry 783.

continued

Now that the best name in CAD is this affordable, why settle for a generic brand?

What's in a name? When it comes to the Autodesk name, a lot. In fact, it's the best-selling, most well-respected name in the CAD business. There simply is not another company with the credentials to make that claim.

That's why you shouldn't settle for anything less than AutoSketch,® the best way to get started in CAD. AutoSketch is the precision drawing tool from the Autodesk family of products. Not only is AutoSketch priced at just $79.95,* but unlike some entry-level CAD products, you don't have to keep spending more to add the features AutoSketch already has. Standard features like boxes, circles, stretching, mirroring and rotating—to mathematical precision. And advanced CAD capabilities like dynamic PAN and ZOOM and automatic dimensioning and scaling, in up to 10 working layers.

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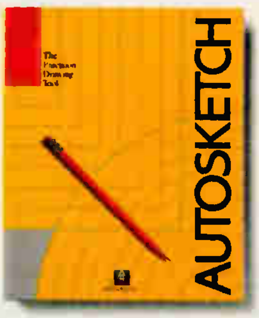
AutoSketch runs on IBM® PC/XT™/AT® and 100% compatible computers, and supports IBM's PS/2.™

So if you're ready for CAD, why not go with the name that rates highest among both critics and users? Anything else is, well, second-rate.

To order AutoSketch call 1-800-223-2521. For the name of your nearest AutoSketch Dealer or for more information, call 1-800-445-5415 Ext. 1 or write to AutoSketch, 2320 Marinship Way, Sausalito, CA 94965.



AUTODESK, INC.

Circle 23 on Reader Service Card

*A speed-enhanced version (9 times faster), requiring a math coprocessor, is available for $99.95.

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UserSoft Business C is the financial C compiler that makes sense to both clients and programmers. It is *not just* another C compiler.

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Compare the Portablity:
UserSoft Business C supports the latest features of standard ANSI C. If you already have a C compiler (MS-DOS, UNIX, VS, VMS, MVS, etc.) our Business Development Tool package will commercialize your compiler for only **$199.95** for PCs. This package is suitable for IBM, Wang, Sun, VAX and other systems.

Compare the Documentation:
The UserSoft Business C manual provides actual programming examples for every function — over 1,000 of them.

Compare the Product:
UserSoft Business C is the capability union of C + COBOL + BASIC + PL/1 + FORTRAN + Make + SCREEN:PC version of UNIX's curses + database tools + graphic tools + IBM mainframe's VSAM + a multiple window graphic debugger and more.

Compare the Price:
It's a fraction of what you might expect — the complete UserSoft Business C package is available at the introductory price of **$249.95** while the Business Development Tool Package is available for **$199.95**.

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Co-Founder of INMOS US
Sole Designer of Mostek 4116
Co-Designer of Mostek 4027

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UserSoft Business C debugger will reduce the time you spend debugging your C programs by at least a factor of 10. It allows you to debug graphics programs on a single monitor.

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- data encryption from file level down to byte level
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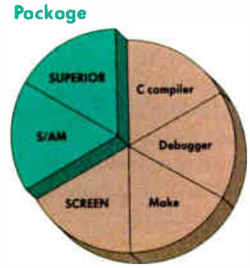
Business Development Tool Package



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Professional Write Adds Features

If you're already a Professional Write user, you'll find that, with version 2.0, you can now read and write to files from other programs, you have a choice of many preset fonts, there's a new file-finder capability, and you have enhanced table-editing features.

Version 2.0 lets you integrate database management and spreadsheet data into your word-processing documents without converting from one format to another. You can even import Lotus 1-2-3 named ranges and coordinate ranges, and you can merge data from dBASE III, ASCII, or Professional Write's own address book into form letters without any conversion.

When it comes time to choose a font, you call up a menu of preset fonts, including those for Hewlett-Packard LaserJet and DeskJet printers, Apple LaserWriters, and other PostScript printers.

The file-finder capability lets you sort DOS directory listings by filename, extension, date, or size. If you forget the name of a file, you can search for it with a string of characters that may be contained in the file.

Professional Write 2.0 lets you manipulate rectangular blocks of text. It also features a built-in five-function calculator that can recalculate rows of numbers.

Version 2.0 runs on the IBM PC, XT, AT, and compatibles with at least 512K bytes of RAM and DOS 2.0 or higher.
Price: $199.
Contact: Software Publishing Corp., 1901 Landings Dr., P.O. Box 7210, Mountain View, CA 94039, (415) 962-8910.
Inquiry 791.

Professional Write 2.0: a word processor for managers.

Wordbench: Tools for Writing

Addison-Wesley's Wordbench word processor runs on the IBM PC and the Apple IIe, IIc, and IIGS.

The program is made up of an outliner, notetaker, add-in manager, writer, print manager, and folder manager. The outliner and notetaker are integrated so you can assign or reassign notes to any point in the outline. If you move headings, the program automatically moves the corresponding notes. You can then merge all the notes and the outline into a first draft.

Notetaker can also work as your information manager, allowing you to search notes by subject, key words, or priority markings. You can also edit and print notes.

The add-in manager lets you integrate future applications and features. Brainstormer is the first add-in included with Wordbench, and it includes freewriting, invisible writing, nut shelling, and goal setting. Freewriting lets you write in a continuous stream, but not edit. Invisible writing conceals words as you enter them. Nut shelling limits the amount of space in which you can write, and goal setting asks for subject, point of view, audience, and purpose of writing.

The writer facility in Wordbench manages the writing, editing, and formatting tasks and also serves as the merging point between the outliner and the notetaker. You can also use the writer to import and export information from other programs in ASCII format.

Some of the desktop tools in Wordbench include the viewer, a window that lets you see and work with two documents at once, a spelling checker, a thesaurus, word search, and a format tool.

The folder manager maintains files; it gives you access to macros and keeps track of all the documents in a folder.

Finally, the print manager contains all the commands and functions that enable you to print a document.

Wordbench runs on the IBM PC, XT, AT, and compatibles with 256K bytes of RAM and DOS 2.0 or higher. The Apple version requires 128K bytes of RAM and ProDOS 8.
Price: IBM version, $189; Apple version, $149.
Contact: Addison-Wesley, One Jacob Way, Reading, MA 01867, (617) 944-3700.
Inquiry 788.

From Integration to Decision Support

The upgraded Framework III represents a new strategy for Ashton-Tate, which no longer views Framework as an integrated package, but as a decision-support program.

Enhancements to Framework include the ability to import and export files with WordPerfect or Lotus 1-2-3 version 2.01, and the ability to run other applications without leaving Framework. It also has support for memory beyond the 640K-byte limit, mouse support, a thesaurus, and electronic mail.

Better performance shows up in the more powerful outliner, easier file management, better dBASE compatibility, a spreadsheet that recalculates 50 to 100 percent faster, and verb tokenization to speed up performance of programs written with Framework's applications language.

The new telecommunications and network support in Framework III uses Action Computing's MHS (Message Handling System) message format.

A local-area-network (LAN) version of Framework III is scheduled to be released soon, according to Ashton-Tate.

Framework III runs on the IBM PC, XT, AT, and compatibles with 640K bytes of RAM and DOS 2.0 or higher.
Price: $695; LAN version, $995.
Contact: Ashton-Tate, 20101 Hamilton Ave., Torrance, CA 90502, (213) 329-8000.
Inquiry 787.

continued

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There's no denying the availability of some outstanding dedicated terminals to access Digital,® Hewlett-Packard, and Data General® host systems. Which makes the task of precisely emulating the performance of those dedicated terminals on an IBM® PC or compatible a rather significant challenge.

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Every SmarTerm emulation is easy to use. It's one thing to make software do what hardware does. It's another challenge to minimize software's human wear. The people designing our products understand the nature of the people using them.

Every SmarTerm emulation is easy to learn. These days, training costs are a hot topic. Software intended to boost overall system efficiency must recognize the value of learning speed. We have.

It's also easy to learn more about how SmarTerm emulations can help you shine. Your software dealer can supply all the details. Or you can contact us at (608) 273-6000 to request complete specifications and a demonstration disk of the SmarTerm emulation that precisely matches your requirements.

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Have a Blast with Your Mac

With MacBlast at each end of a data transfer, you can send data to other vendors' systems from a Mac Plus, SE, or II. MacBlast uses pull-down menus that give you access to DEC VT-52, VT-100/200, and other terminal emulations. The communications program also supports MultiFinder and lets you switch back and forth between other applications.

MacBlast retains many of the features found in other products in the Blast family, including auto-dialing; auto-log-in to remote systems; automated modem operations; and BlastScript, a programming language that lets you set up repetitive tasks or scripts.

MacBlast supports the MacBinary standard and uses a proprietary full-duplex protocol to send data in both directions at once. It operates through RS-232C ports with a hard-wired link or phone line and modem, or over asynchronous links over Ethernet or AppleTalk networks. It can send and receive binary files, text, and console commands.

Price: $195.

Contact: Communications Research Group, 5615 Corporate Blvd., Baton Rouge, LA 70808, (504) 923-0888.

Inquiry 794.

MacBlast performs simultaneous sends and receives.

Share and Share Alike

You can share hard disks and printers with one to four other users with Connect-PC. The utility gives you access to the servers' disks on a file-by-file basis. And you can use it in multiuser applications, as it supports DOS file and record locking.

The utility also supports up to three serial or parallel printers at the server. It can send up to 1000 characters per second to each printer, according to Micro Advice. Using the advanced print options, your printer output is saved on disk, allowing you to generate output whenever you need it.

Micro Advice reports file transfer speeds of up to 115,000 bps for Turbo XTs, ATs, and 80386s, and 56,000 bps for XTs.

Connect-PC comes in two varieties. The first is the software server, which has no hardware other than the COM ports. The second type is the hardware server, which includes software and a board.

Price: $199 for two PCs; $299 for three; $649 for four (includes board); $749 for five (includes board).

Contact: Micro Advice Corp., 400 Phillip St., Unit 9, Waterloo, Ontario, Canada N2L 5R9, (519) 884-4231.

Inquiry 793.

Track Action Across a Network

Track action of workgroups with ActionTracker, a project-management program from Information Research. The network version of ActionTracker integrates the activity of each member of a network so everyone knows who's responsible for what and when.

The network version runs on Novell's Advanced Netware 286 and any DOS 3.1 NETBIOS network, according to the company. It includes Project Query Language (PQL), ActionTracker's relational report writer.

Price: $1498.

Contact: Information Research Corp., 2421 Ivy Rd., Charlottesville, VA 22901, (800) 368-3542; in Virginia, (804) 979-8191.

Inquiry 795.

continued

Fast File Transfers

Fastwire II lets you exchange data between 5¼-inch and 3½-inch floppy disk drives or hard disk drives on different machines. When running in parallel mode it transfers at a rate of 500K bits per second, Rupp Brothers reports.

In what the company calls Turbo Serial mode, it transfers at 200K bps using seven-wire serial cable. Fastwire II features error-checking and three user interfaces.

With the basic version of Fastwire II, you have a choice of one 6-foot serial or parallel cable, both with thumbscrews that fit IBM PCs, laptops, and PS/2s. A 4-head serial cable comes with 25-pin and 9-pin AT-style connectors. To use Fastwire II, you connect the cable to your system and load the software onto each computer. No changes to the config.sys file are necessary, and the program automatically connects the machines and selects the proper serial or parallel ports.

The three levels of user interfaces include the split-screen mode, which displays current directory files on both computers; macro/script form mode, which lets you write and record customized scripts for daily or routine transfers; and advanced command mode, which provides you with a command-line interface that allows you to enter complex transfer commands with just a few keystrokes.

You can also use Fastwire II to back up and manage files on a hard disk. You can back up only the most recent files or those that have been altered since a specified date. You also have options to view, rename, or delete files on either system.

Fastwire II runs on the IBM PC and compatibles with at least 170K bytes of free memory and DOS 2.0 or higher.

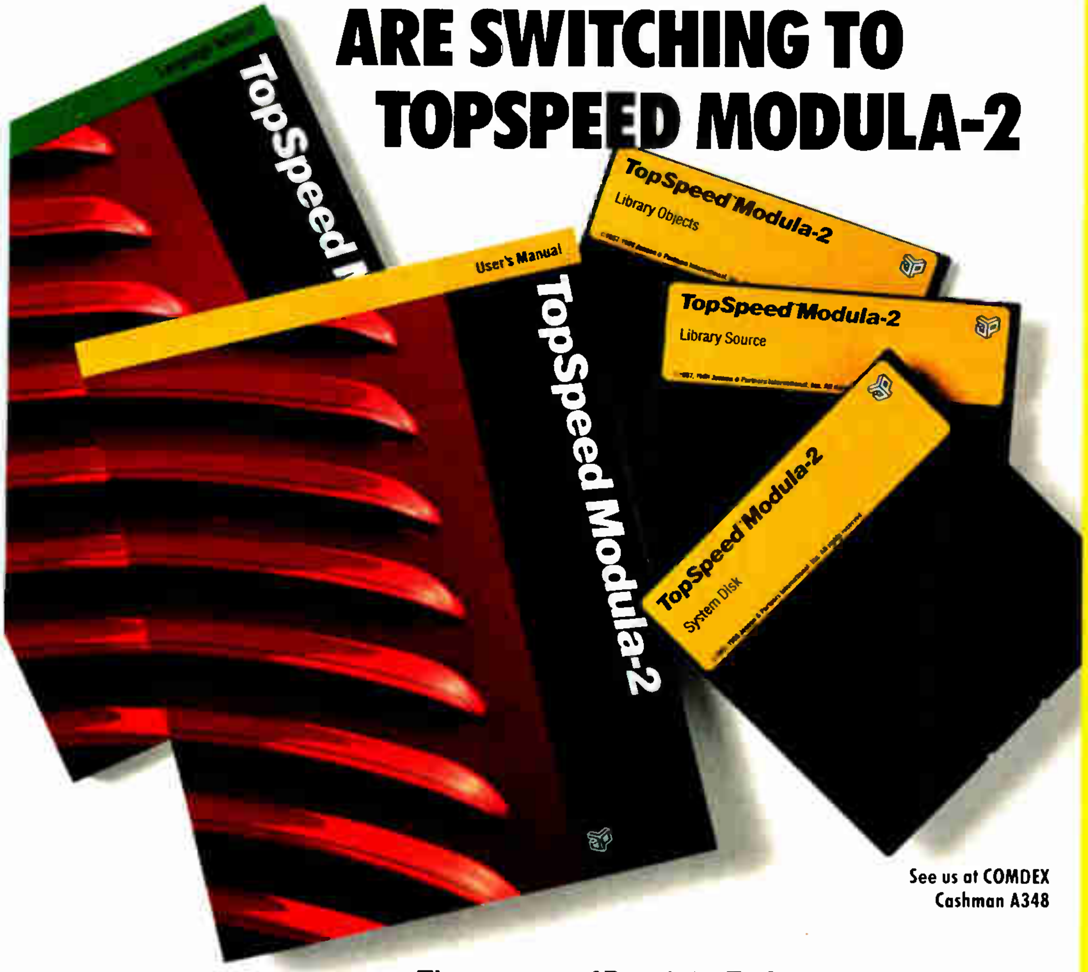
Price: $129.95 for basic version; $159.95 for deluxe version with both serial and parallel cables.

Contact: Rupp Brothers, P.O. Drawer J, Lenox Hill Station, New York, NY 10021, (212) 517-7775.

Inquiry 792.

FACT:

MORE AND MORE PEOPLE ARE SWITCHING TO TOPSPEED MODULA-2



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"JPI Modula-2 looks like another classic in the making. It generates code as good as or better than leading C compilers and the programming environment is a genuine pleasure to use."
Dick Pountain
BYTE Magazine

"After months of frustration with Logitech Modula-2/86, I bought TopSpeed Modula-2... I am delighted with it. Not only did it perfectly compile my 10,000 lines of existing source, it's just more fun as well."
Hans U. Gerber
ETH, Switzerland

"I liked all of the hard-disk space that was recovered after I deleted my BORLAND, MICROSOFT, and LOGITECH compilers, because with TopSpeed Modula-2 all the rest are obsolete."
Robert D. Randall
Donnelley Marketing

The successor of Pascal: JPI TopSpeed Modula-2 produces better code than Microsoft C, Turbo C, Logitech Modula-2, and Turbo Pascal 4.0.

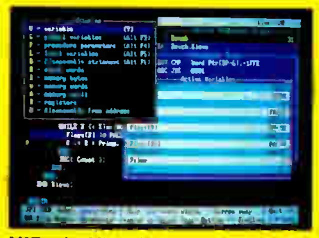
JPI TopSpeed Modula-2 is a professional Modula-2 development system with full support of memory models, multi-tasking, long data types, structured constants, long and short pointers, 80x87 inline code and emulator, separate compilation, direct BIOS/DOS calls, etc. The comprehensive library includes CGA, EGA and VGA graphics support, math functions, sorting, file handling, window management, a time-sliced process scheduler and more.

The Compiler Kit includes: High-speed optimizing compiler (3,000-5,000 lines/min. on a PC AT 8MHz), integrated menu-driven environment with multi-window/multi-file editor, automatic *make*, fast smart linker. All Modula-2 sources to libraries included. BONUS: Complete high-speed window management module included with source. 258-page User's Manual and 190-page Language Tutorial.

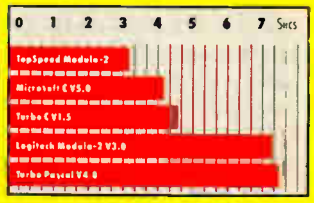
The TechKit includes: Assembler source for start-up code and run-time library. JPI TopSpeed Assembler (30,000 lines/min). TSR module, communications driver, PROM locator, dynamic overlays, and technical information. 72-page manual.

System Requirements: IBM PC or compatible, 384K RAM, two floppy drives (hard disk recommended).

TopSpeed's seamlessly integrated environment.



VID, the Visual Interactive Debugger, coming soon.



Sieve benchmark measured by the British Standards Institution (BSI)—25 iterations on an 8MHz AT.

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Circle 137 on Reader Service Card

Maintenance Program for Your PC

Like the original Disk Technician, the advanced version identifies disk problems before they cause errors. The new version tests the overall condition of the hard disk first and moves any data in the unsafe spots to good locations. If it finds a reliability problem, it will perform a low-level reformat and then continue with testing.

Other additions include four different seek tests, an automatic screen-saver function, a data- and file-allocation table recovery for down systems, and a bundled copy of SafePark Advanced.

Disk Technican Advanced works with two hard disk drives, up to 136 megabytes each with MFM-type controllers, or 208 megabytes each with RLL-type controllers. You can partition each drive into C through Z with up to 32 megabytes in each.

The program runs on the IBM PC, XT, AT, PS/2s, and compatibles.

Price: $189.95.

Contact: Prime Solutions, Inc., 1940 Garnet Ave., San Diego, CA 92109, (619) 274-5000.

Inquiry 799.

Disk Technician Advanced performs hard disk analysis.

Remote Control for Your PC

With Remote2 you can operate PC programs from other modem-equipped IBM PCs. The program consists of the Host and Call. The Host is installed on the host computer and includes Remote2 Manager, which you use to configure the Host software and maintain the user database.

Call is a communications program that calls Remote2 Hosts. With the Host program, Call provides you with exact screen and keyboard mapping of the host computer, file transfers, remote printer redirection, CGA graphics, and a data-compressed link.

Remote2 lets you call files and programs on LANs. It also features a chat window for typed discussions and explanations. Keyboards and screens at both ends of Remote2 are live, and either can control the host. The caller can also choose to lock out the host's keyboard.

Security is provided by individual user passwords. Each user must go through a required action at log-in time, giving control over the system to the manager.

The program also has a callback feature that lets the host call the caller back at a predetermined phone number. This not only adds another level of security but saves you money if you are calling long distance.

Remote2 runs in restart, manual, or always ready mode. Restart mode lets you reboot the host PC between calls. Manual lets the operator tell the host to accept a call. Always ready answers an incoming call with no operator intervention.

Remote2 runs on the IBM PC and compatibles with DOS 2.0 or higher and 48K bytes of free RAM for color and 36K bytes for monochrome.

Price: $129 for Host; $89 for Call; $195 for both.

Contact: Digital Communications Associates, Inc., 1000 Holcomb Woods Pkwy., Roswell, GA 30076, (800) 241-6393; in Georgia, (404) 998-3998.

Inquiry 797.

Keeping a Watch on Your Battery

If you use a battery-powered laptop, you don't want your batteries to get low. With Battery Watch from Traveling Software, the terminate-and-stay-resident (TSR) software pops up a gas gauge–type display, showing you how much power is left in your laptop's battery. The gauge shows how much time you have left based on how you've been using the system during the current session, and the information is updated every 2 minutes.

To prevent the batteries from running low, the program has a deep discharge feature that overrides your laptop's automatic shutoff feature and discharges the battery. This is necessary to keep nickel-cadmium batteries from running low as a result of short charge/recharge cycles.

Price: $39.95.

Contact: Traveling Software, Inc., 19310 North Creek Pkwy., Bothell, WA 98011, (206) 483-8088.

Inquiry 798.

A Window on Your dBASE Files

With Q&E, you can query and edit dBASE II and III, FoxBASE, Clipper, and other dBASE-compatible files. You can view multiple dBASE files simultaneously in different windows. Its query capability supports ad hoc and stored queries, the results of which you can copy into word processors and other Windows products.

The program's editing capabilities let you update fields and delete and add records. It allows WYSIWYG editing, and you can create new database files and modify existing file definitions.

The program functions as a stand-alone database system or as an integrated Windows interface to dBASE-compatible files. You do not need a copy of dBASE to use Q&E.

To run Q&E, you need an IBM PC or compatible with at least 512K bytes of RAM and DOS 2.0 or higher. The company reports that Oracle and SQL versions of Q&E will be available soon.

Price: $129.

Contact: Pioneer Software, 4900 Waters Edge Dr., Suite 135, Raleigh, NC 27606, (919) 859-2220.

Inquiry 800.

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- 80286 CPU 12 MHz/0WS
- Small footprint to save space
- Mono card
- Monochrome monitor

* All systems come with 1.2MB floppy drive, and FD/HD dual controller.

SUPER-286/12 — $2490
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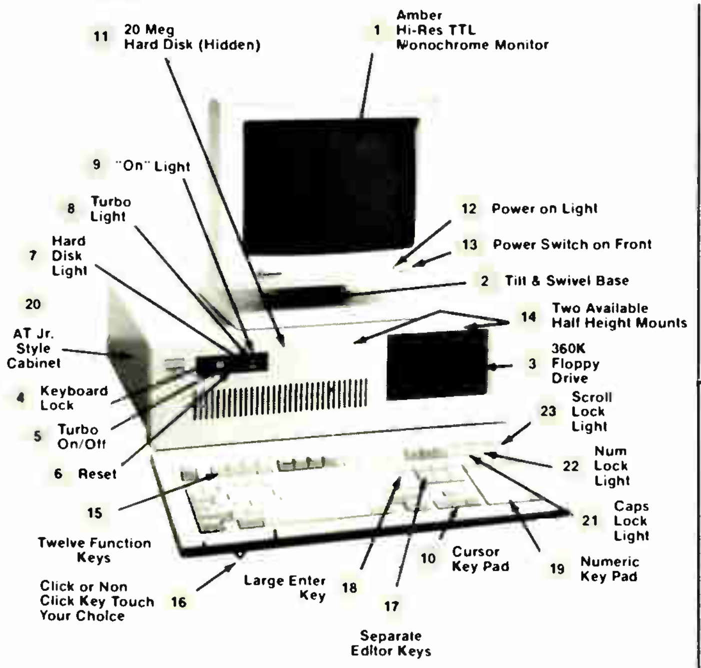

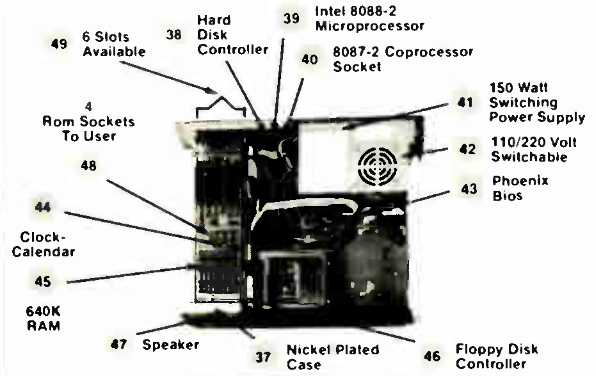

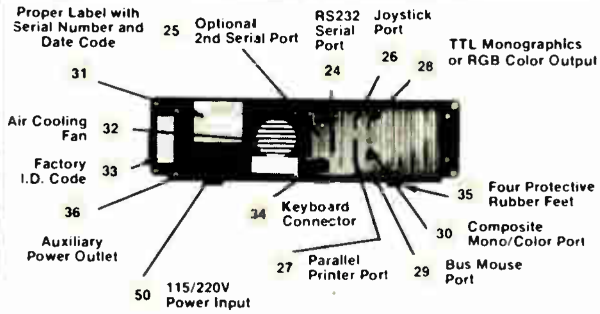

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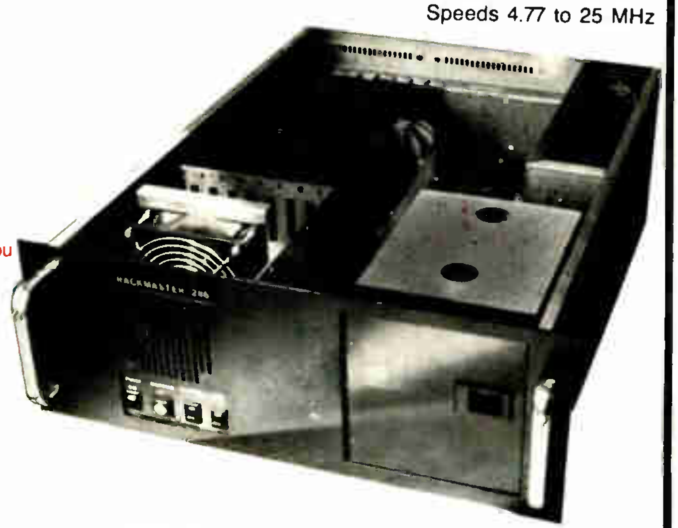

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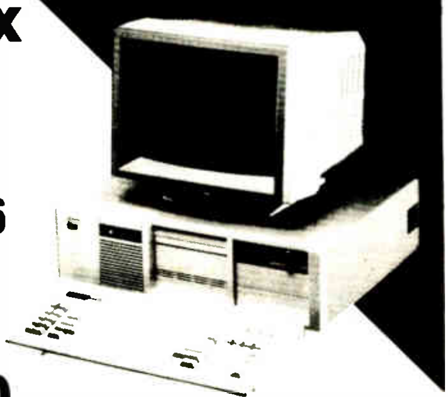

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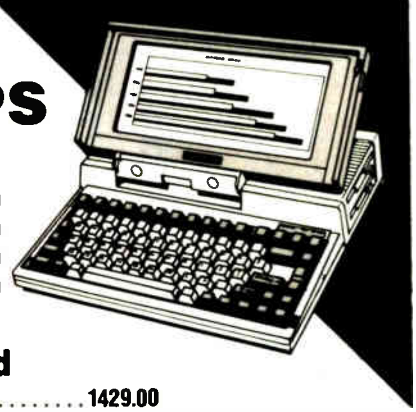

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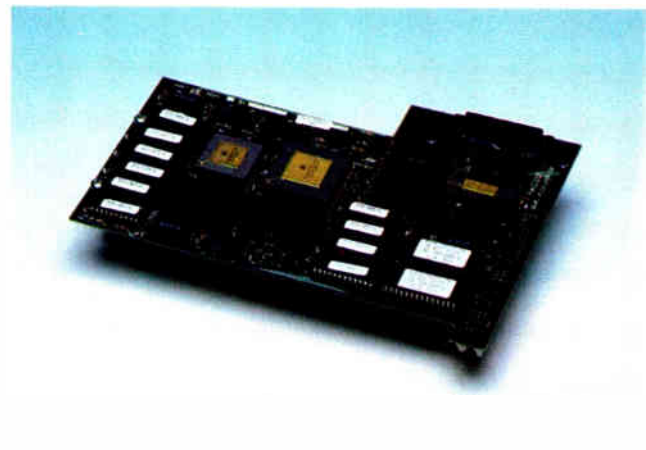

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THE FACTS

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TSI
99 West 10th Ave.
Suite 333
Eugene, OR 97401
(800) 874-2288
Inquiry 855.

THE FACTS

Radius Accelerator 25
$1695 without 68881 coprocessor; $2195 with 68881

Requirements:
Mac SE running System 4.3/Finder 6.0 or higher

Radius, Inc.
404 East Plumeria Dr.
San Jose, CA 95134
(408) 434-1010
Inquiry 856.

The computer industry is engaged in an interesting war: The Pace Race. Not long after IBM PC-compatible manufacturers had unleashed their 25-MHz 80386 machines upon the market, third-party Mac vendors countered with 25-MHz 68020 accelerator boards for the Mac SE. That single slot in the Mac SE has proven its worth, because this newest generation of accelerator boards boosts the SE's computing performance well past that of a Mac II.

I looked at the **TSI-020MX** by Novy Systems (marketed by TSI) and the **Radius Accelerator 25** by Radius. Both boards use the same basic 16-MHz accelerator design, but with 25-MHz components. The TSI-020MX is equipped with a 25-MHz 68020 CPU, a 68881 floating-point unit (FPU), and 1 megabyte of 32-bit RAM that's expandable to 4 megabytes. The Radius Accelerator 25 board has a 25-MHz 68020 CPU, an optional 68881 FPU, and a 32K-byte RAM cache composed of 32-bit static RAM. Both boards come with a disk of installation software.

Installation requires that you open the Mac SE's case, remove the motherboard, and plug the board into the slot. This operation shouldn't be attempted by a novice. That's because of the shock hazard from high-voltage circuits inside the Mac, or the possibility of damaging electronic components due to electrostatic discharge.

You also need to check the position of jumpers on both accelerator boards during installation. For the TSI-020MX, these jumpers set the board's memory size (1 or 4 megabytes) and number of wait states for a memory access (1 or 2 at 25 MHz). For the Radius board, one jumper is used to indicate the presence of an optional 68881, and another jumper sets the clock rate of the 68881 (16 or 25 MHz).

Support software for the TSI-020MX consists of three files: `NovyInit`, `NovyStartup`, and the MAC20 Control DA. `NovyInit` and `NovyStartup` install certain resources that determine the board's mode of operation. Control DA lets you adjust certain parameters (i.e., use the 68020 instruction cache, intercept MacWrite traps, route SANE traps to the 68881, copy and use the Mac ROMs in 32-bit fast RAM, indicate whether or not to use the SE's native 16-bit memory, and install a RAM disk) while the SE is running or when you restart the machine. For the Radius Accelerator 25, a `Radius SANE` INIT patches the Apple SANE traps to use the 68881 (if present), and an `Accelerator` CDEV lets you toggle on or off a code cache (the 68020 instruction cache) and a data cache (the accelerator board's 32K-byte cache).

I put both boards into a Mac SE and ran some of the BYTE Small-C benchmarks. For an accurate comparison to the Mac SE's native CPU, the benchmarks used 68000 code. For the TSI-020MX, the times (in seconds) were Matrix, 12.3; Sieve, 23.8; and Sort, 24.8. For the Radius Accelerator 25 board: Matrix, 10.5; Sieve, 20.1; and Sort, 19.6. The timings for a conventional SE are Matrix, 67.1; Sieve, 170.2; and Sort, 154.2. Mac II timings are Matrix, 21.2; Sieve, 40.2; and Sort, 44.2.

The results indicate that a Mac SE equipped with one of these boards runs five to seven times faster than a conventional SE, and twice as fast as a Mac II. But keep in mind that these tests evaluated only CPU throughput. Applications that make extensive use of a hard disk drive or work with more memory than can fit in the cache won't perform as well. However, if you need the power of a Mac II but have a limited budget, these boards deserve a serious look.

—Tom Thompson

continued

Borland's New Prolog: Even Better

Turbo Prolog 2.0 is a significant step forward for this popular version of the language. It has the same high speed and nicely integrated environment of the previous versions, and it presents a number of new features, like an external database and a user interface that is more consistent with that of other Borland products.

For those who are not familiar with it, Prolog is an ideal language for developing applications that are highly recursive or that involve complicated IF. . .THEN control structures. Prolog can be used, for example, to build expert systems and sentence parsers, or to solve the traveling salesman problem. It can also be used for prosaic tasks like figuring your expense account.

In the past, Turbo Prolog has been faulted for not conforming to the standard Edinburgh dialect. In this new release, Borland addresses this problem in an interesting way: It provides an Edinburgh-style Prolog interpreter that is written in Turbo Prolog itself. Of course, like any interpreter, the Prolog Inference Engine, as it is called, is slow and does not claim to be completely compatible with the Edinburgh or Clocksin and Mellish dialects. But over time, users may be able to turn it into an interesting Prolog system in its own right.

Perhaps the most significant addition is the capability for external databases. In the older version, your database was limited by the size of your RAM. The new version lets you store information either in RAM, as in the past, or externally, on a disk file. For fast sorts and data retrieval, these databases can be indexed with a B+ tree.

There are also a number of nice features. For example, Turbo Prolog predicates can now have more than one arity (i.e., the same predicate can mean different things depending on how many arguments it has). One-line comments can be indicated by simply placing a % at the front of a line. When you compile a program, you can control how much memory it will take up, which suggests that we will soon see memory-resident Prolog applications. And it is now possible for other languages to call Turbo Prolog routines. Of course, all these additions take up code space; the program has grown to the point where you pretty much have to have a hard disk drive.

There is almost no change in performance: The new version was about 1 percent slower in running my traveling salesman program than the previous version. But the executable file of the program was 2 percent smaller and 3 percent faster than that on the older version.

As for documentation, the new Turbo Prolog comes in a two-volume package similar to that of Turbo C. The new version has roughly four times the amount of documentation provided by the old version's single 200-page manual. Much of this is used to describe the new features added, but the extra space also lets the documentation writers go into more detail on elementary aspects of the language.

If you're interested in Prolog and you haven't tried Turbo, you're in for a treat. A warning, though: Once you get the hang of it, Turbo Prolog can be very addicting.

—Rich Malloy

THE FACTS

Turbo Prolog 2.0
$149.95

Borland International
4585 Scotts Valley Dr.
Scotts Valley, CA 95066
(800) 543-7543
Inquiry 852.

Requirements:
IBM PC or equivalent with 384K bytes of RAM. A hard disk drive is recommended.

Options:
Turbo Prolog Toolbox, $99.95

Running OS/2 on an IBM PC

Yes, you can run OS/2 on an IBM PC, but it's expensive. I took a look at the **SOTA MotherCard 5.0** and the **Microsoft Mach 20**, 80286 accelerator cards that can run OS/2. But before looking at the products, let's consider what you need to run OS/2 on a PC.

First, you need an accelerator board that can run the 80286 instruction set (either an 80286 or 80386). You also need at least 2 megabytes of extended memory. It pays to have 3 megabytes, since many OS/2 programs require that much memory (Paradox OS/2, for example). Finally, you need a high-capacity 5¼-inch or 1.44-megabyte 3½-inch floppy disk drive to load OS/2 software.

Adding these features to your PC is a formidable investment. With SOTA's MotherCard 5.0, it will cost you around $2000. At first glance, Microsoft's Mach 20 seems cheaper, but if you want 3 megabytes of memory and a high-capacity drive, the Mach 20 system will cost as much as, if not more than, the MotherCard 5.0 setup. In addition to the hardware, you'll have to buy OS/2. If you're using the Mach 20, you'll have to upgrade to DOS 3.2 if you want to use high-capacity or 3½-inch drives.

SOTA's MotherCard 5.0 comes in 10-MHz and 12-MHz configurations with 1 megabyte of RAM ($895 and $995, respectively). An additional DaughterCard, which installs on the MotherCard, is available with 1 or 2 megabytes of RAM (the 10-MHz DaughterCard with 2 megabytes costs $895, and the 12-MHz version costs $995). The MotherCard 5.0 is essentially an IBM PC AT on an expansion board. It has its own real-time clock and an 80287 socket, and it supports monochrome, CGA, and EGA. The DaughterCard uses 256K-bit single in-line memory mod-

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THE FACTS

SOTA MotherCard 5.0:
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SOTA DaughterCard:
$995 for 12-MHz version with 2 megabytes of RAM; $895 for 10-MHz version with 2 megabytes of RAM
Floppy I/O Plus multimedia controller:
$149

Requirements:
IBM PC or compatible with 64K bytes of RAM and DOS 3.1

SOTA Technology, Inc.
657 North Pastoria Ave.
Sunnyvale, CA 94086
(408) 245-3366
Inquiry 853.

ules (SIMMs) and supports 1-megabit SIMMs for expansion up to 8 megabytes.

My test unit was a 12-MHz version with the 2-megabyte DaughterCard. In addition, SOTA provided its Floppy I/O Plus controller and two 1.2-megabyte 5¼-inch floppy disk drives, which you would have to purchase separately. The Floppy I/O Plus controller also supports 3½-inch floppy disk drives or a combination of drive types and runs under DOS 3.1 or higher.

The SOTA MotherCard 5.0 runs only IBM OS/2. At the time of this writing, it does not support the Microsoft SDK (Software Developer's Kit) version of OS/2. The MotherCard 5.0 uses a unique reconfigurable BIOS, which lets you install a "patch" to the BIOS to run OS/2. You must also install a special SOTA driver on the IBM OS/2 installation disk. Be forewarned that the 5¼-inch version of OS/2 is not easy to come by. Most dealers don't stock it, so you'll most likely have to special-order it. The alternative is to get a 1.44-megabyte 3½-inch floppy drive for your PC.

Installation of the SOTA MotherCard and the Floppy I/O Plus controller is straightforward. You remove the 8088 processor from its socket, install it on the MotherCard, and plug the supplied cable into the 8088 socket. Next, remove the existing floppy disk drive controller and install the Floppy I/O Plus controller and the new disk drives, if necessary. After installation, you boot up in 80286 mode and run the company's Setup and software installation programs to install the OS/2 patches. You can use your existing system board memory as a RAM disk or for disk caching, using SOTA's supplied Expanded Memory Specification (EMS) and disk-caching drivers.

I ran OS/2 on the MotherCard with no problems. I tried Paradox OS/2 and ran multiple tasks and the DOS-compatibility window. The 12-MHz version of the MotherCard offered faster performance than our MicroServe 10-MHz AT clone. I ran BYTE's 80286 benchmarks, and they all ran faster than on the AT clone.

The SOTA MotherCard 5.0 is a well-engineered and elegant solution for running OS/2 on a PC. Although the MotherCard is very easy to install, one weakness of the package is SOTA's user manual, which doesn't clearly explain how to run the software installation. An important step is running the Setup program to determine the memory configuration and the types of floppy disk drives you're using. Unfortunately, this step is not mentioned in the user manual. But aside from the large expense, I would recommend installing the MotherCard 5.0 in a PC.

The Mach 20 setup for OS/2 consists of three components: the Mach 20 board, which is an 8-MHz half-length 80286 accelerator card; the Memory Plus option; and the Disk Plus floppy disk controller card. These three components connect together and require only a single slot. Note that these three components alone cost

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Circle 158 on Reader Service Card

THE FACTS

Mach 20
$495

Requirements:
IBM PC or compatible with 64K bytes of RAM and DOS 3.2 if you want to use high-capacity or 3½-inch drives

Options:
Memory Plus card with 512K bytes, $395; Disk Plus multimedia controller, $99

Microsoft Corp.
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Redmond, WA 98073
(206) 882-8080
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almost $1000—and that doesn't include the additional 2 megabytes of RAM and the high-capacity disk drive you'll need. And with 256K-bit chips, you can install only 1.5 megabytes of RAM on the Memory Plus board. You'll need to find, buy, and use more expensive 1-megabit chips to install 3 megabytes of memory in your system.

Installing the Mach 20 is not a trivial matter. To start off, you have to plug the three pieces together, which is a simple operation. Then you have to go through a lengthy installation program, which explains how to set the myriad jumpers on the Mach 20. You may also have to modify the switch settings on the system board of your PC. The installation program writes a series of drivers to your boot disk. I made the mistake of trying to use a floppy disk as a boot disk. Problems arise if you later want to change your drives and have to modify the settings for the floppy disk controller. Therefore, it is best to install the drivers on the hard disk drive.

Nevertheless, I got the system running. However, the floppy disk drives behaved very strangely under the supervision of the Disk Plus controller. They made groans and grinding noises I had never heard when they were connected to the original controller. In addition, drive A's light would go on immediately when I booted the computer and would stay on throughout the normal POST memory test. These quirks didn't hinder the operation of the Mach 20, but they certainly made me nervous.

I ran the BYTE 80286 benchmarks on the Mach 20, which has an 8-MHz clock speed, and it was about 25 percent slower than our 10-MHz MicroServe AT clone and about 40 percent slower than the SOTA MotherCard. While the system seemed to be working at this point, I was getting periodic boot errors (301 system board) and was becoming increasingly disturbed by the odd noises that the floppy disk drives continued to make.

The next step was to install OS/2. Microsoft provided a beta copy of its special Mach 20 OS/2 version. The package came with a menu-driven installation program, and you can use 360K-byte 5¼-inch drives to install OS/2. However, OS/2 won't do you much good without a high-capacity drive, because no software is available in 360K-byte format. Unfortunately, I was unable to get OS/2 to run. I installed it on the hard disk drive, but then the hard disk drive wouldn't boot. In fact, the light on drive A stayed on continuously, and I had to turn the machine off.

It's hard to recommend the Mach 20 at this time. Even in spite of its quirks (and I'm sure Microsoft will get OS/2 running eventually), it's not a cost-effective way to run OS/2. You would be better off saving your money for an AT clone. The SOTA MotherCard 5.0 is also an expensive solution, but at least it works reliably and seems to be a solid product.

—Nick Baran

continued

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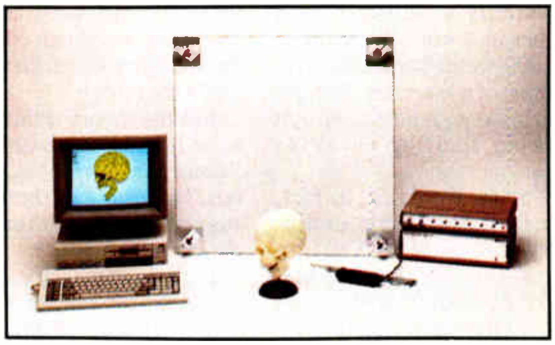

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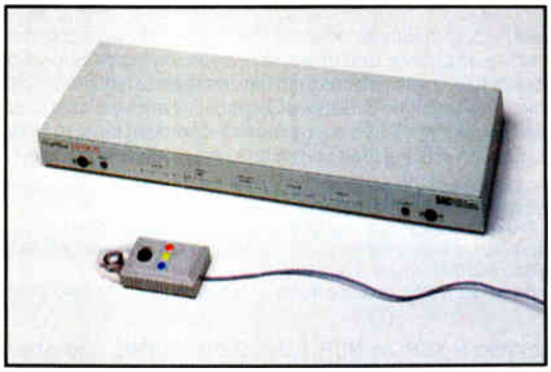

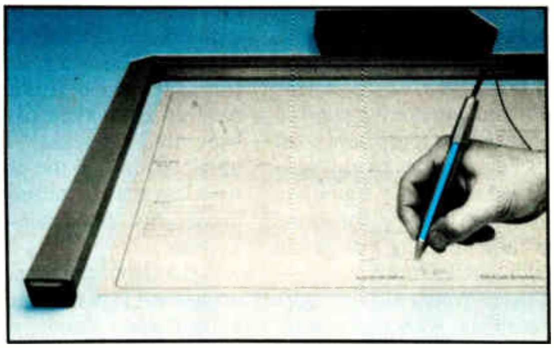

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A Dictionary on a Hard Disk Drive

When it comes to writing, I believe in the 3-foot rule. That is, you ought to keep a dictionary no more than 3 feet away from the spot where you're working. That's where Proximity's Choice Words comes in. Choice Words is an 80,000-word, hard disk drive version of a Merriam-Webster dictionary. And we're not talking spelling checking here.

Choice Words is, in fact, the first electronic dictionary—complete with definitions—that works on an MS-DOS computer without an optical disk or some other exotic storage device that costs enough to make many users decide to stick with a printed dictionary. Specifically, it takes up less than 2 megabytes of hard disk drive space. Because it's RAM-resident, it also needs about 100K bytes of RAM.

Best of all, it works within almost any word processor. Just place the cursor on a word, hit the hot key, and you've got the definition of that word. Just hit the hot key, and you can type in any word you wish. If Choice Words can't find a matching word in its dictionary, it displays a list of its best guesses of alternate spellings. I usually found the word I was looking for in the alternate spelling list—even when I *tried* to fool it.

Choice Words also includes a thesaurus. Although a number of good word processors already have a thesaurus, this one is a little different. Instead of just providing a list of synonyms, Choice Words first forces you to choose the appropriate definition for the word you want to replace, and then it gives you only the synonyms for that definition. This way, you don't mistakenly use a replacement word that connotes the wrong message. Or at least that's the theory.

But the theory didn't work so well with some words. For "continual" and "continuous," for example, the thesaurus provides you with only one definition.

Both the dictionary and the thesaurus let you replace the word at the cursor position in your word processor with any word you select from the Choice Words display. You can also toggle to and from the thesaurus and the dictionary.

Installed on the 20-megabyte hard disk drive in my 10-MHz IBM PC AT clone, Choice Words usually responded in about 2 seconds (when the spelling was correct) to about 5 seconds (when the spelling was wrong). Although that's probably faster than anyone can find a word in a printed dictionary, there is a trade-off: The definitions are roughly equivalent to an abbreviated "pocket" dictionary. Given that the program uses less than 2 megabytes of drive space, that trade-off is a fair one.

Aside from the thesaurus's occasional lack of definitions, I like Choice Words, and at a cost of only $99, I recommend the program.

—Dennis Allen

continued

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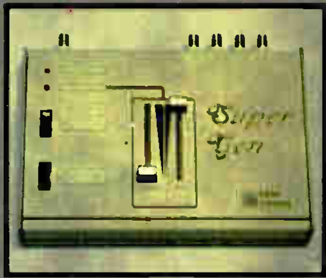

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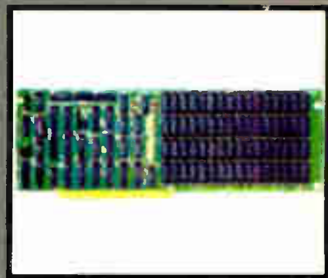

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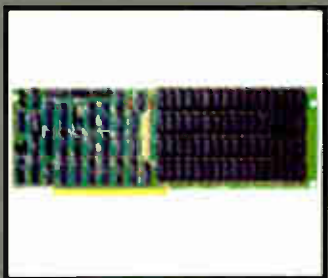

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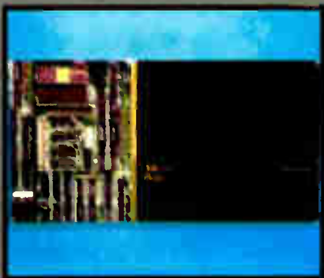

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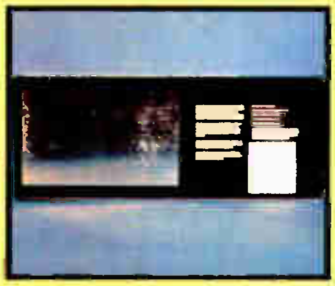

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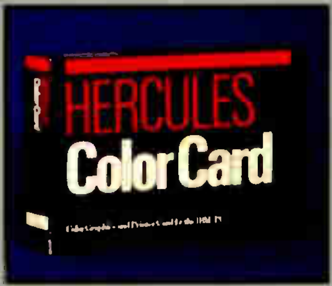

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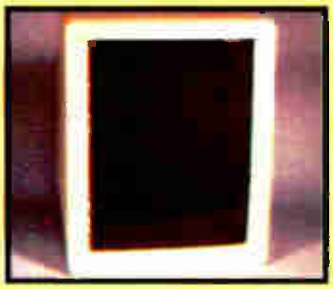

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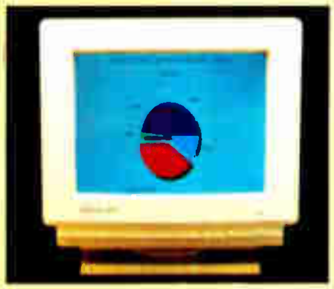

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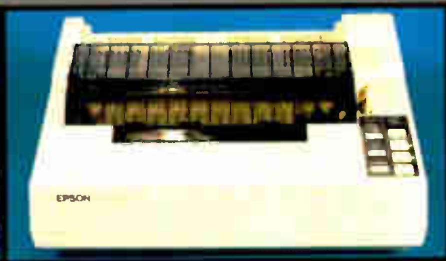

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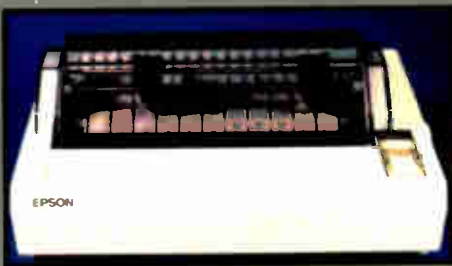

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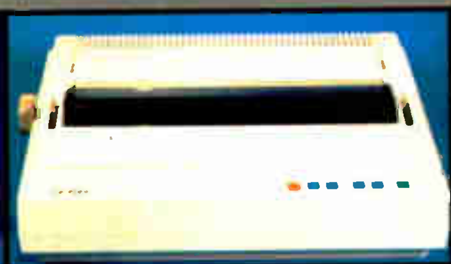

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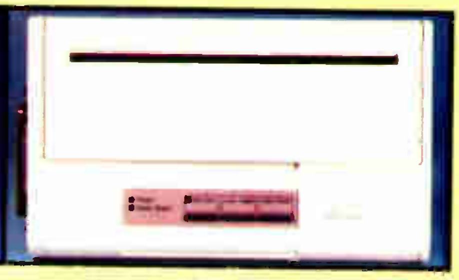

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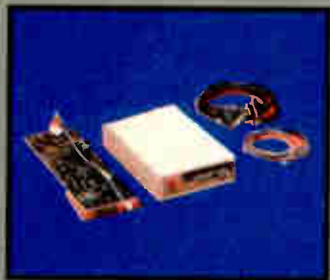

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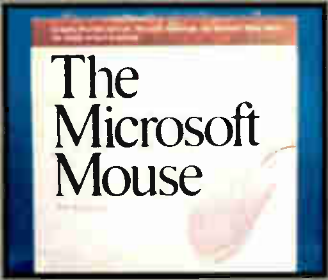

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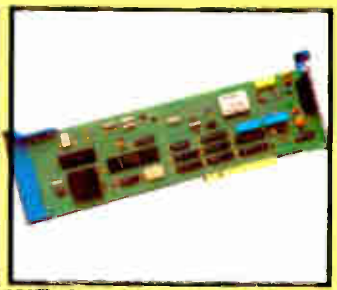

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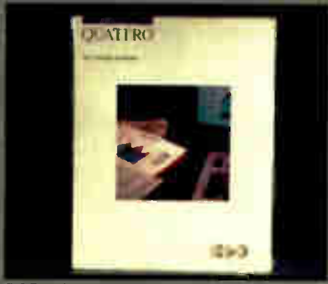

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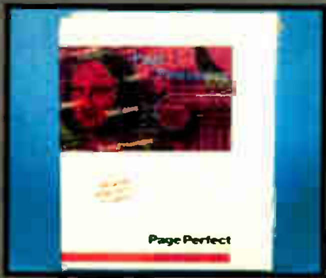

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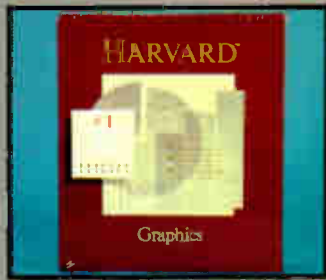

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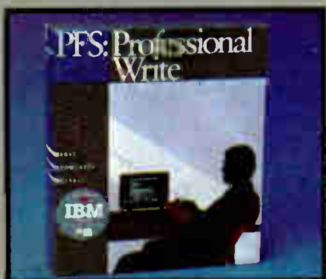

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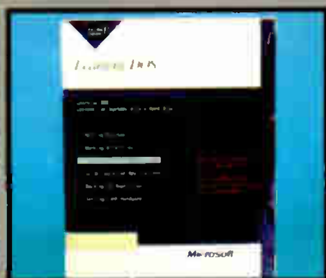

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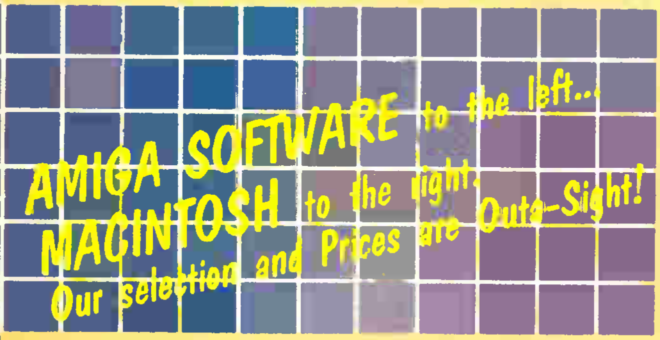

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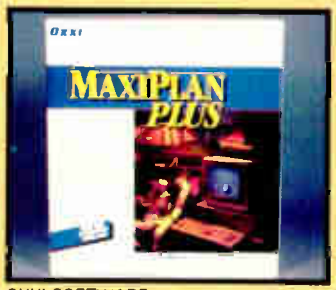

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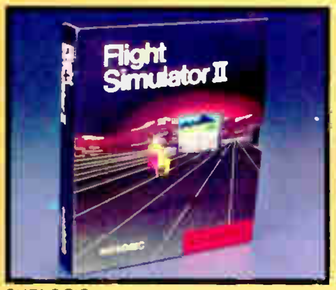

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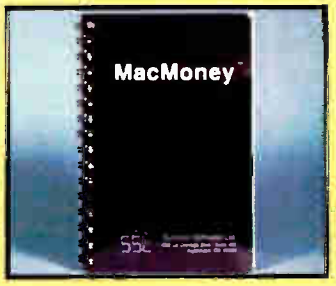

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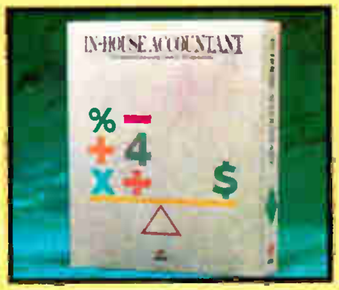

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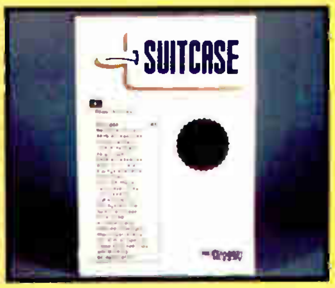

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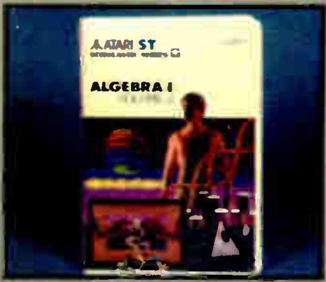

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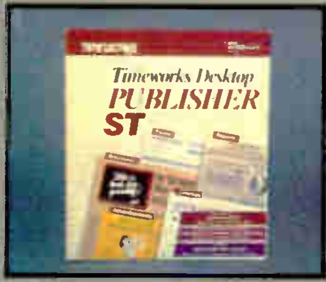

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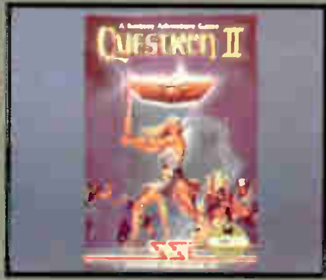

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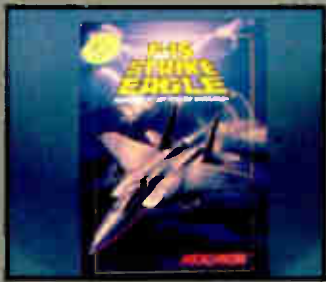

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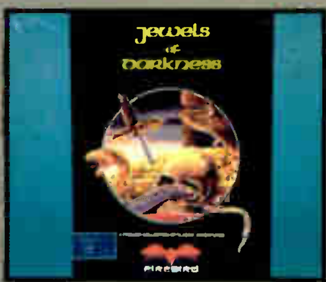

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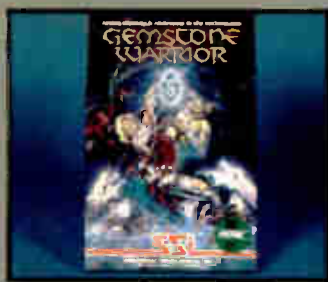

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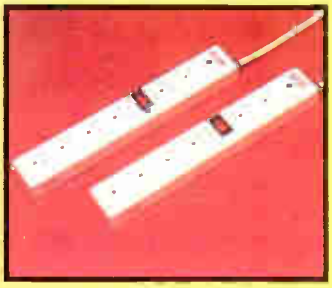

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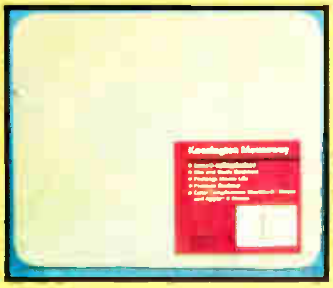

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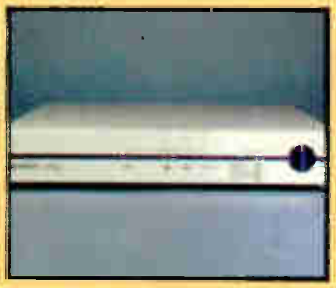

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Konan's new **Tentime** is an IBM PC AT-compatible "intelligent caching" disk drive controller with an impressive resume.

It boasts 128K bytes of on-board RAM with a 4-year lithium-battery backup. It needs the battery because the cache is not "write-through." That is, when your system issues a write command to the controller, the Tentime doesn't send the data immediately to disk. Instead, the Tentime puts the data in its cache, and when it *must* perform a write operation, it sorts the data prior to writing to the disk. In this way, head movement is reduced (e.g., if you issued writes to tracks 12, 90, 8, and 66, the Tentime would actually write them in this order: 8, 12, 66, 90). Since the battery is there, even if you shut the system off before the controller flushes its cache, your data is retained for the next time you power your system up.

Next, you get an optional on-board floppy disk drive controller, so you can use the Tentime to completely replace your AT's current hard/floppy disk drive controller. (The Tentime with a floppy disk controller can handle up to two ST-506/412 hard disk drives and two 3½-inch or 5¼-inch floppy disk drives—360K bytes, 1.2 megabytes, or 1.44 megabytes.) I already had a hard/floppy disk controller card in the machine on which I tested the board, so I disabled the Tentime's floppy section and ran two hard disk drives on the system. I was more interested in the board's performance as a hard disk drive controller, anyway.

The manufacturer claims that this controller has an 80 percent to 95 percent hit rate on the cache. The controller's name says it all: You should expect the Tentime to operate 10 times faster than other controllers. Does it?

I ran the Tentime through a number of tests and got mixed results. I used a 10-MHz AT clone with two hard disk drives. One, a Seagate ST-225, hooked to the Tentime; the other, an ST-4038, connected to an AT-clone hard disk drive controller. The BYTE low-level benchmark FILEIO test (which creates, reads, and writes a series of arbitrarily complex files) and 1-megabyte File Read and Write tests showed the Tentime turning in performances anywhere between 2 and 11 times that of the other controller (Read operations did much better). However, when I ran the Coretest on both drives, the drive in the Tentime simply left the other drive in the dust. The access times reported for the Tentime were down around 0.7 millisecond—between 12 and 30 times better than those shown for the other drive.

The price for the Tentime, however, is steep. It says something when you pay $595 for a controller board and you can get a 20-megabyte hard disk drive for half that much. (I've seen ads for a 20-megabyte hard disk drive *and* controller for $250.) I'd say this is definitely a product for the power user. If you need lots of megabytes and you need them fast, the Tentime probably deserves a slot in your AT.

—Rick Grehan

THE FACTS

Tentime
TNT-1050 (with floppy disk controller), $695;
TNT-1000 (without floppy controller), $595

Requirements:
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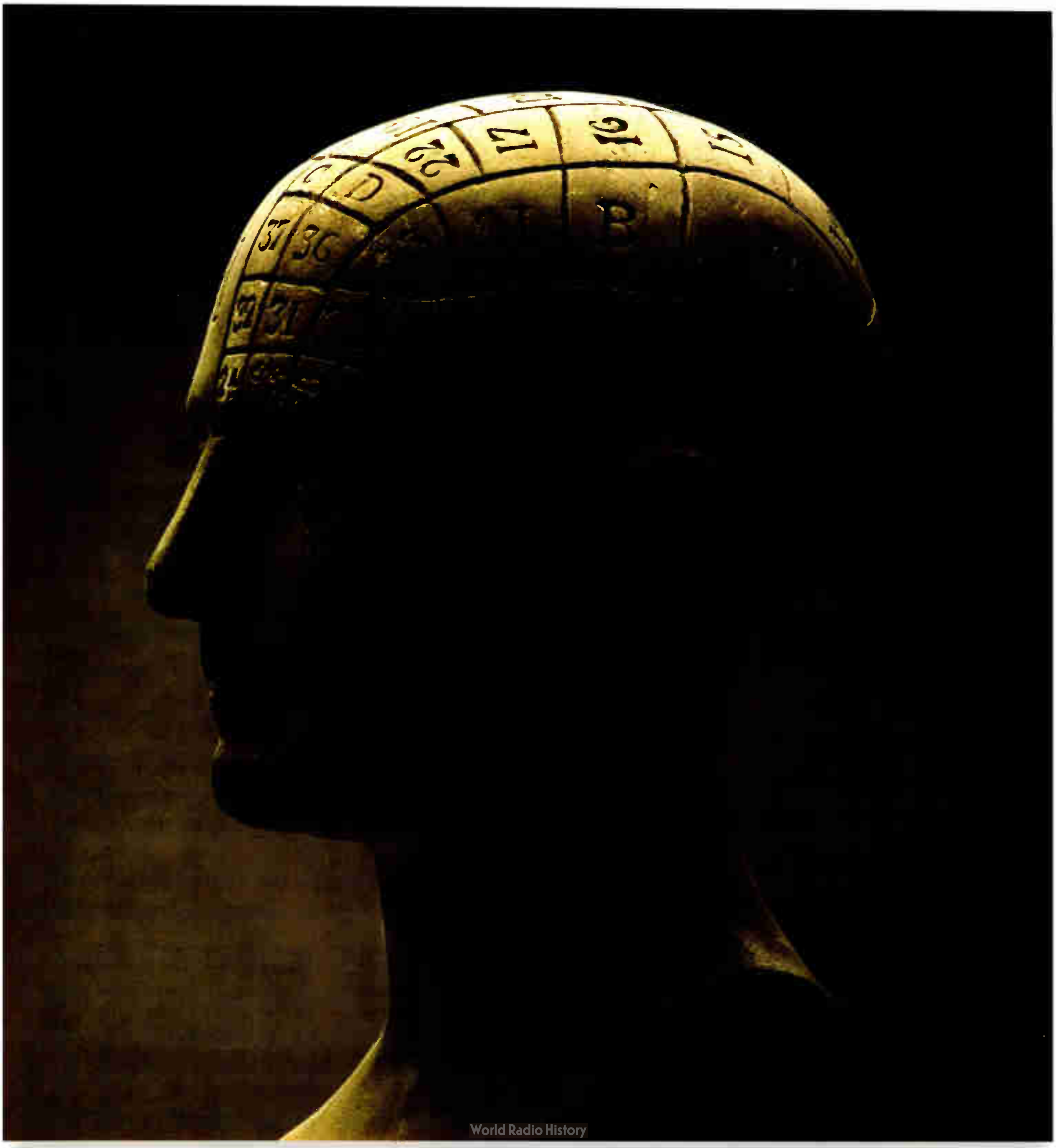

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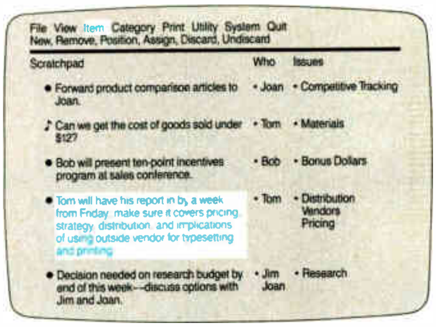

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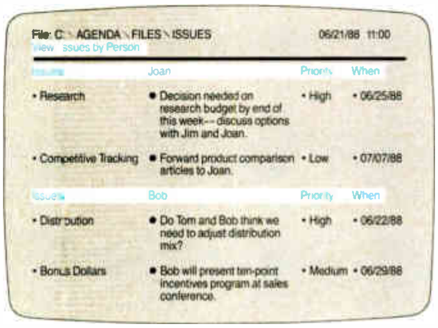

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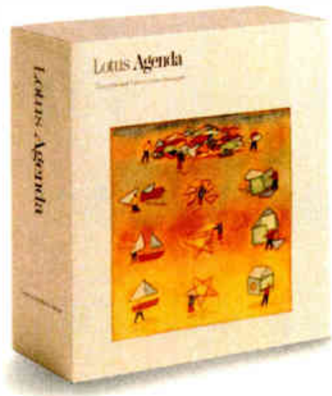

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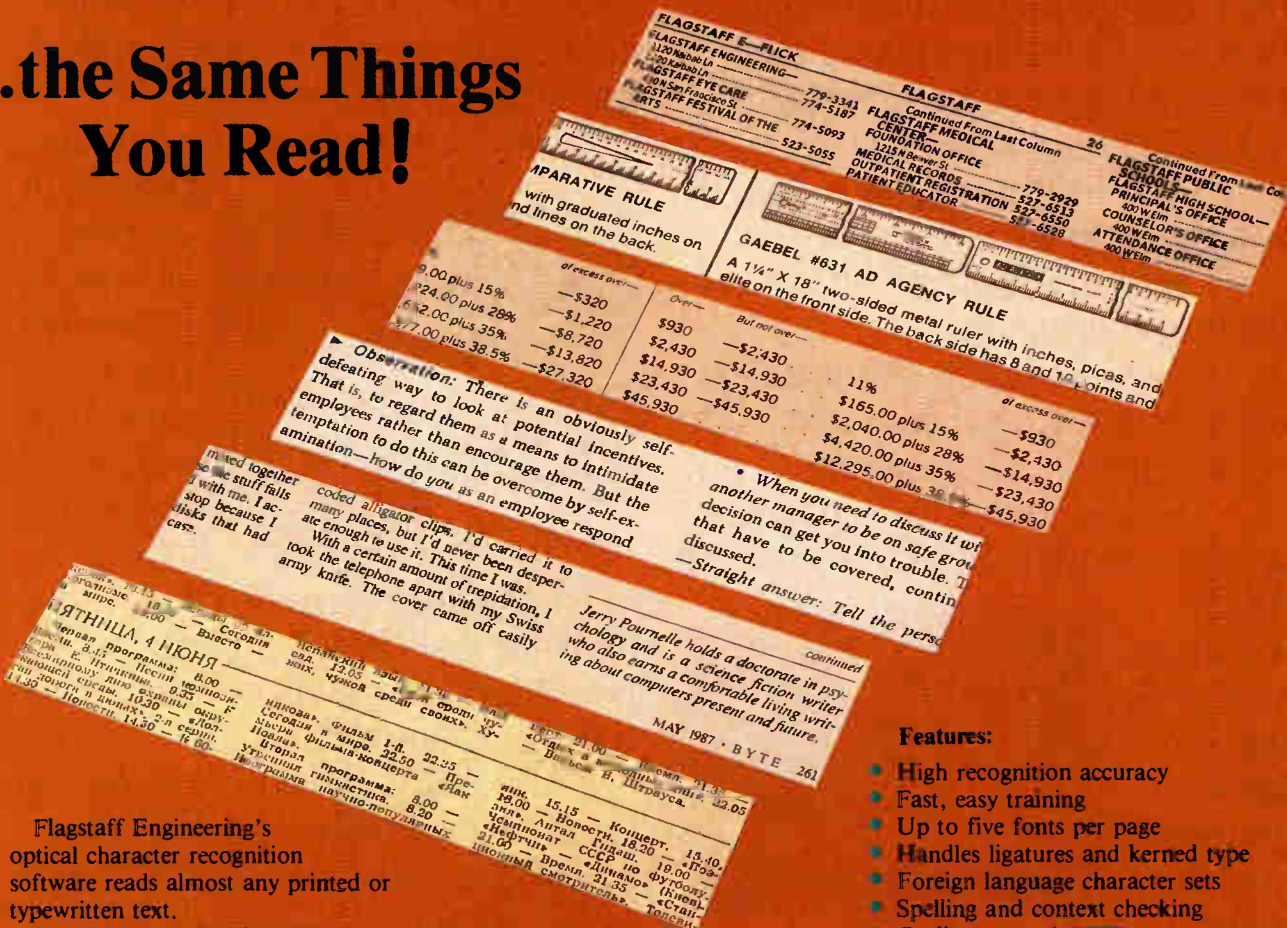

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Circle 101 on Reader Service Card (DEALERS: 102)

COMPUTING AT CHAOS MANOR ■ Jerry Pournelle

THE EDGE OF THE ENVELOPE

This month, Jerry combines his right stuff with the right hardware and the right software

Although these columns are a major activity at Chaos Manor, the real work here is writing novels, as for example *Prince of Mercenaries*, which went out the door to Jim Baen this afternoon. For that matter, there are two parts to writing the columns: the writing itself, which usually doesn't take long, and puttering around with new hardware and software so that there's something to write about, which can be quick or take forever, depending on what we're puttering with. There's a *lot* of stuff people want us to examine.

On that score: if you have programs you want me to look at, send them to BYTE with *my name* in the address. Include a *cover letter* that tells precisely what your program does, and why you do it better than anyone else. You'd be amazed at how much stuff we get that looks wonderful but no one can figure out what it's supposed to do. We also get a lot of what I call "yet another" programs: programs that seem to do the same things I'm already doing with something else. Sometimes the "yet another" programs turn out to be real improvements, and, of course, we're always interested in those; but often their advantages aren't at all obvious.

Given my hectic schedule, there's no way we can look at everything that comes in no matter how good it sounds; sometimes what I get to is just a matter of luck. Still, I do work at this, and a surprising amount of software does get run at least once. Realistically, I don't suppose we can take a close look at more than about 10 percent of what comes in, but that's still quite a lot of software, and the activity consumes a lot of time.

In addition to all that, Mrs. Pournelle is writing two books while overseeing the development of her reading program. The Atari ST version of that has just finished beta testing in both public and private schools, with amazing results. All the participating kids learned to read, and the teachers are enthusiastic, since the program allows teaching assistants, volunteer parents, or even older students to act as instructors. One thing we found was that the "rewards"—pictures and music—built into the program are useful in getting the kids started; once they begin learning, the reading experience itself is enough to keep them going.

Anyway, the result of all these activities is that I always have at least three Main Machines here: the one I write on, the one Mrs. Pournelle writes on, and the experimental machine to be used for puttering around.

In fact, there are usually several more, since I like to write about stuff other than PCs. A Mac II has as prominent a place in the system as my main PC's, while an Atari Mega ST is only one step away, and there's an Amiga 2000 set up in the next room. Still, most of what we do is done on PCompatibles, if for no other reason than they're what most of the readers have, and they're far and away what most of the software I get is written for.

For the moment, the "conservative" main machine is the Zenith Z-386. At least, it was supposed to be. Alas, I got talked into using the Zenith as a testbed for Unix with the result that, of the 80 megabytes on Zanna Lee's hard disk, there's only about 30 megabytes available for DOS programs; and that's just not enough, given what I generally keep on my machines.

Of course, the notion was that I'd run DOS programs under Unix. That turned out to be a mistake. There may be a good "DOS under Unix" system somewhere out there, but I guarantee you I don't have one, or if I do have it, the instructions on installation are beyond my ken. What I've got is a Unix that can—sometimes—run some DOS programs, provided that the DOS programs are *very* well behaved and I hold my mouth just right.

Of course, I can also run standard Unix programs, but why bother? All the Unix programs that do the things I want to do have been pretty small potatoes compared to what's available on DOS. Sure, Unix has unique features. If you have a real need for multiuser access to a very large database, Unix is fine. If you've simply got to have a bunch of users working off one central system, it's wonderful. There are things Unix can do that DOS wouldn't dream of. On the other hand, most Unix application programs are very vanilla in features (for example, almost no Unix program knows about color), they are overpriced, and hard to use. I've looked at a dozen or more Unix application programs, and for the kind of work I do, there aren't any that I'd prefer to what I have on DOS (and for that matter, I had better word processors and accounting programs on CP/M than the stuff Unix users put up with). Most PC users will not care to give up what they have on DOS for what they can get from Unix.

This whole situation puzzles me. I've had a dozen people try to explain why you can't simply fire up Unix and use it as the master operating system to run multiple DOS programs, and the usual answer is "You can, but nobody's done it." None of them can answer the next question.

Anyway, the result is that there wasn't enough space on the Zenith Z-386 to fit all the files from the Kaypro and still have room for everything else; so for the moment, the Zenith has become the experimental system, and the big 20-MHz

continued

Cheetah 386 has been put next to my chair.

Moving the Files

The first thing we needed to do was transfer all the files from the Kaypro 386. Since I was sending them to the Cheetah, which has the Priam 330-megabyte hard disk drive, the idea was that I'd duplicate the Kaypro's C drive onto the Cheetah's E, and the Kaypro's D drive onto the Cheetah's F. That way, I wouldn't lose any files, and I would still have my files on the Cheetah's C drive.

I had several file-transfer programs. The obvious one was Traveling Software's DeskLink, which I knew would work reliably between the Cheetah 386 and the Zenith, because I'd used it before on both machines. Unfortunately, I had trouble getting DeskLink to work with the Kaypro 386, and when I called Traveling Software, I was told that I'd probably be better off using LapLink (which comes in the package with DeskLink anyway). If all you want to do is send files from one system to another (as opposed to running programs on one machine when they're resident on another), LapLink is faster and more convenient. Besides, they said, there's a new version of DeskLink coming out (it's now available), so I might as well wait for it.

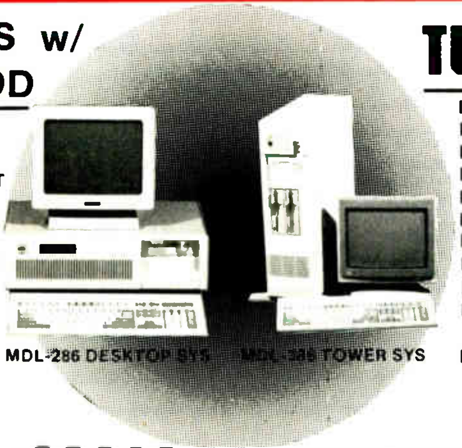
I had a bit of trouble with LapLink, but it wasn't the program's fault. For some reason, the Kaypro 386's COM1 port didn't want to work faster than 56,000 bits per second. It's easy enough to set LapLink for the slower speed—I've yet to open the LapLink manual—and after that, things went fine. The `Options` command in LapLink will let you slow things to a real crawl (300 bps) if that's what it takes. Incidentally, I can remember in CP/M days when we thought 1200-bps serial-port file transfers were *fast*.

LapLink is a perfectly symmetrical program; that is, you can do all your transfers from either computer console. No need to designate one a "master" and the other a "slave." LapLink also has an option to "transfer subdirectories." This seemed wonderful, since there were *a lot* of subdirectories on the Kaypro. Alas, when I used the option, I found that LapLink transfers the files all right, but it doesn't create new subdirectories; what you get is one enormous directory with everything stuffed into it. This wasn't precisely what I wanted.

Next thing, then, was to do `LD > LPT1:`, which as most of you know tells the Norton Utilities to list directories and send that directory list out the printer port. That gave me a paper list of all the directories and subdirectories. From there, it was an easy (if tedious) job to create the Kaypro's C directory structure on the Cheetah's E drive, then go back into LapLink and fire away again.

That worked fine. Later, I found that LapLink does know how to create subdirectories; I don't know what I did wrong before. If you go into options and set the Subdirectories toggle properly—it's obvious how to do that—and get it to stay on (apparently, I hadn't), then LapLink will in fact do the whole job. Incidentally, when the Subdirectories toggle is properly set, you'll see a big *S* down near where it gives you the COM port and data transfer rate. Once that's done, it really will create subdirectories, unless you do whatever it was I did wrong. Traveling Software says that while LapLink works fine in conjunction with most memory-resident software, some terminate-and-stay-resident programs (TSRs)

continued



can interfere with subdirectory copying. If you have a glitch, check that.

Incidentally, LapLink isn't the only program that sometimes has TSR interference with subdirectories. DOS's XCopy can also get confused.

Alternatives

If it ain't broke don't fix it, but in the past few weeks I've received a lot of file-transfer programs, and this seemed like a good time to test them.

First I tried PC-Hooker. This is a nice little serial transfer program that works about the same as LapLink. It also has a feature that lets you create directories from within the program. There's another provision to let you see how much space is available on the target disk. There's a little text editor, and it can use the XMODEM protocols to send files out through a modem.

This is the kind of program that gives me problems: if I'd got it before I got LapLink, I'd probably have adopted it. Now I've no reason to. True, I like the Add Directory feature, but in fact LapLink loads and drops so fast that it's just about as convenient to go out and use DOS when I need to do things like that.

Second, there's Fastwire II. This claims to be "The World's Fastest, Most Reliable Way to Exchange Information Back and Forth Between All IBM-Compatible Desktop, Laptop, and PS/2 Computers." It seemed worth a look.

Setting up Fastwire is simple. It comes with a four-headed serial cable so you can connect to either AT (9-pin) or XT (25-pin) serial ports; I wouldn't even look at a program and hardware that didn't. Fastwire also says you can use the parallel port.

My first objection to Fastwire is that, unlike LapLink and PC-Hooker, Fastwire isn't symmetrical. You run a master program on one machine, and a slave program on the other; and the only way to reverse which is which is to start over. You can't change on the fly.

Fastwire's documents claim it will automatically create subdirectories on the target machine. This sounds like a wonderful idea. When I tried Fastwire in subdirectory mode, it did, in fact, do the job; but it only created one subdirectory at a time, so I had to tell it to do it again for each one. It may be I wasn't doing something right, because the documents clearly imply that it can make a complete backup copy from one machine to the other.

As to speed, Fastwire may be faster than LapLink; I didn't time the two programs. However, Fastwire isn't *a lot* faster than LapLink; not so much so that I'd give up LapLink to have it. In other words, this is another of those programs that's good enough, and had I got it first, I'd probably continue using it rather than change to something else; but it doesn't have quite enough going for it to get me to switch.

The nice thing is that there are a lot of "good enough" transfer programs. I can remember when there weren't any at all.

Incidentally, all these programs will transfer data using the parallel ports of the two machines; it's said to be marginally faster than serial. I haven't tried it, since serial ports have always worked fine for me.

Training the Cheetah

Once we had all the files over, the next step was to configure the Cheetah. I

continued

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wanted to use the Zenith Flat Technology Monitor (FTM), so Mrs. Pournelle could borrow the big 19-inch Electrohome monitor. When I installed the Zenith 448 video board in the Cheetah, though, the board wouldn't work. Apparently 20 MHz is too much for it.

I was in a hurry, so I put the Award EGA/VGA video board back in the Cheetah and set up the Electrohome; Mrs. Pournelle had to be satisfied with the Logitech Autosync monitor. That's no real hardship, of course; the Logitech is one of the best of the smaller EGA/VGA systems. The Zenith 448 board and FTM went back on the Zenith 16-MHz Z-386 where they'd always been. Later, I found that if I plug the Zenith FTM into the 15-pin VGA outlet on the Award video board, it works fine. Now all I have to do is carry this 70-pound, 19-inch monitor back downstairs....

One thing I did find in fooling around with monitors: it's pretty easy to get them all "gaussed up." That is, if there are stray magnetic fields around, they can affect the monitor. The result looks almost as if someone had stained the monitor's glass front. There's a wild color patch that stays in place when you scroll the display.

Most expensive monitors—such as my Electrohome—have a degaussing button; press it, and the display swims around a bit while the monitor's hardware gets rid of the unwanted magnetism that has invaded the screen. Unfortunately, neither the Zenith nor the Logitech monitors have degaussing buttons, and both of them caught bad cases of "the gausses" while we were moving things around. (If you have a bunch of computers running outside their cases, you can expect this.)

In the past, I've always been able to remedy this problem by turning the monitor off for a minute or so, but this time it didn't seem to work. The color patches just stayed there. They weren't *that* bad; you could still make out what was supposed to be on the monitor screen. Still, it was ugly, and I wanted something done. I have no doubt that with a bit more patience, the problems would have gone away by themselves, but I was running out of time.

The remedy was the bulk eraser. This is a standard item (we got ours at Radio Shack) used to erase magnetic tapes. It also works fine on floppy disks, which is what it's mostly used for here. The trick to using one with a disk is to turn on the eraser, move it in a spiral pattern up close to the disk (leave the disk in its protective jacket), then with the eraser still on, spiral it away again. This gets all the little magnetic molecules into a random pattern. It seemed to me that if that would work on a magnetic disk, it ought to work on a monitor screen; and in fact it did fine, although it looks a little weird while you're doing it. I was a bit astonished at just how far away you could hold the eraser and still see the effects on the screen.

The next thing was to get the Maximum Storage WORM (write once, read many times) drive and the Amdek Laserdek 2000 CD-ROM reader working together. This turned out to be simple: when you get these two machines, they are both by default addressed to ports beginning at 300 hexadecimal. You have to change the address for one of them.

The easiest to change is Maximum Storage's WORM, because the exact procedure for readdressing the WORM

continued

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drive is clearly described in the manual. I decided to address the WORM to 200 hexadecimal; I flipped the little DIP switches as the manual told me to, and put "200" in place of "300" in the Maxsys driver instructions in the CONFIG.SYS file. I used the default installation for the Laserdek 2000. The whole thing took about 5 minutes, and now I have both CD-ROM and WORM drives.

Alas, while those will work together, by the time I've got a mouse and the CD-ROM and WORM memory-resident drivers and DOS extensions installed to *use* them, I'm down to 360K bytes of system RAM. Add SideKick, and it's even smaller.

I did some experimenting with Quarterdeck's Expanded Memory Manager (QEMM); this is a program for the 80386 that, among other things, lets you get at some of the unused memory that sits between 640K bytes and 1 megabyte. You can use the QEMM `LOADHI` command to put the mouse software up there. Sometimes other stuff can be put there as well. If I sound vague, I intend to: it turns out that using that memory is a bit tricky. For example, if you install part of the Microsoft Bookshelf software up there and then use Procomm Plus, the communications program will lock up the machine so thoroughly that you can't even reset. Thus, I don't recommend QEMM `LOADHI` for the squeamish. If you do use it, test thoroughly before entrusting anything critical to your system.

Procomm Plus

Crosstalk used to drive me nuts sometimes, but I did learn to use it, and it served me pretty well on machines from an early PC XT up through the Kaypro AT, Zenith Z-248, and Zenith 386; but when I transferred it to the 20-MHz Cheetah, it wouldn't work at all.

The problem isn't the computer or the modem. The modem is the USRobotics' Courier HST, and that works fine. It's Crosstalk itself, which just seems unable to keep up with the Cheetah's speed. I'd tell Crosstalk to dial, and it would act as if it had; but the modem never got the message. Crosstalk would then tell me there was "No Connection" and offer to try again. Retries got the same result.

That left me with a problem, since I really need communications.

"Try Procomm Plus," Alex told me. It seemed like a good idea; I'd heard about Procomm for a long time. The original is shareware; now there's a Procomm Plus that's for commercial sale. We had both, or at least I thought we did. It turned out that I had at one time copied my review copy of Procomm Plus onto my hard disk, but then the manual got lost in the general swim here. I'm sure it's no more than 8 feet away from me, but for the life of me I can't find it.

That turns out not to matter. Procomm Plus has context-sensitive Help screens that do about as well as the manuals can. It takes a bit of deciphering to figure out precisely what some of the instructions mean, but in fact it took only about a half hour to get the program all set up and running.

That's when we made several discoveries. I had always run Crosstalk at *no* parity, 8 data bits, 1 stop bit, and that worked fine; but when we tried that with Procomm Plus, Tymnet had a fit. We could connect all right, but all we got was garbage. Eventually we changed to *even* parity, 7 data bits, 1 stop bit. I forget precisely what caused us to try that combination, but it works fine.

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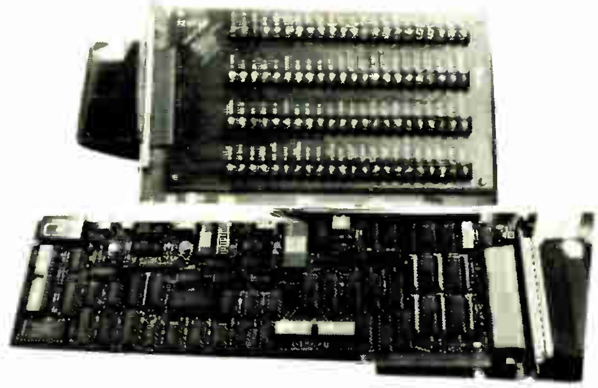

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• TECHNICAL DATA

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RESOLUTION - 12 bits
INPUT CHANNELS four differential

INPUT MODES	unipolar or bipolr user selectable
INPUT RANGES	
unipolar	0 TO +10 volts user-selectable
bipolar	±5 and ±10 volts user selectable
OUTPUT MODE	
unipolar	straight binary
bipolar	offset binary
INPUT IMPEDANCE	>100 megohms with 100 picofarads
INPUT CURRENT	limited to less than ±4 mA
INPUT VOLTAGE	
Normal mode	±30 volts maximum without damage power on or power off
Common mode	±11 volts maximum
COMMON MODE	
Rejection ratio	72 db
Integral linearity error	±1 LSB maximum
DIFFERENTIAL Linearity	
Error	±½ LSB maximum
Stability	±5 ppm/degrees C of FSR (max)
GAIN	
Error	±0.1% between ranges (max) any range adjustable to 0
Stability	±32 ppm/degrees C of FSR (max)
OFFSET	
Error	adjustable to 0
Unipolar stability	±24 ppm/degrees C of FSR (max)
Bipolar stability	±24 ppm/degrees C of FSR (max)
MONOTONICITY	0 to 50 degrees C
THROUGHPUT to memory	15 000 conversions/second min

The analog output functions of the adapter operate in programed I/O mode. The analog output functions provide 12 bit relative accuracy

RESOLUTION	12 bits
Number of output channels	2
OUTPUT modes	unipolar or bipolar user selectable
OUTPUT ranges	
Unipolar	0 to +10 volts user selectable
Bipolar	±5 and ±10 volts user selectable
INPUT CODE	
Unipolar	straight binary
Bipolar	offset binary
OUTPUT Current	±5 milliamps min with normal loading and protection from damage with the output shorted to common
OUTPUT Impedance	2 ohm max
CAPACITIVE loading	0.5 microfarads max
GAIN	
Error	0.1 betweem ranges (max) any range adjustable to 0
Stability	[illegible] ppm/degrees C of FSR(max)
OFFSET	
Error unipolar	±3.25 millivolt max
Error bipolar	adjustable to 0
Unipolar stability	±8 ppm/degrees C of FSR (max)
Bipolar stability	±24 ppm degrees C of FSR (max)
MONOTONICITY	0 to 50 degrees C
SETTLING TIME	10 microseconds max to within 0.1% FSR for a 10 volt step with 1000 of load
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I have since discovered what's happening. Tymnet does in fact use even parity. If you don't, and thus look at all 8 bits, that can have the effect of converting much of what's sent to you to non-ASCII characters. Crosstalk has a filter system that takes care of the situation. So does Procomm Plus, but unlike Crosstalk, Procomm Plus doesn't automatically do it; you have to go work on a conversion table.

It turns out that it's easier simply to use E-7-1 for Tymnet communications. I was a bit worried that this would prevent me from downloading binary files, but that's not true: when you go into a file-transfer protocol such as Kermit (or XMODEM, which is what I use), the system automatically switches to 8-bit transfers.

We tested that by entering BIX listings and pulling out a small COM file; it works perfectly. I've since used Procomm Plus to upload my columns. Works like a charm. I'm fast becoming attached to it, and it looks as if the change is permanent.

Incidentally, Wayne Rash reports that he's been using Procomm Plus for months now and likes it a lot. It even works from overseas.

Procomm and Procomm Plus are fundamentally alike, except that Procomm Plus is niftier. The Plus version has shadowed windows and other pretty displays. It has a nice menu system. It's also supported, whereas the older Procomm is shareware.

The best feature about Plus is the context-sensitive help, which, as I said, is good enough that I've not really needed the manuals. There are also terminal emulations, and the setup is nicer. On the other hand, the old shareware version is good enough for a lot of people. Probably the thing to do is try the shareware—it's available on BIX and elsewhere—and if you like it, go ahead and buy the Plus.

Alex swears by it. He says, "If you use a lot of different machines, this is the right program because it's portable among just about all PCompatibles." I haven't used it as long as he has, but I've seen no reason to disagree. It certainly works when you're stretching the envelope.

Recommended.

Printer Optimizer II

A few months ago, you may remember, I had a problem with the power supply for my Applied Creative Technology Printer Optimizer. It wasn't a big problem, but the people at ACT read about it, and they

continued

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decided this would be a good time to update my Optimizer, which, after all, I've had for about 6 years now. (I've never had a problem with it, either, except for stepping on the power supply cord and breaking it.)

The Optimizer is a small computer with a lot of memory—up to a megabyte—that sits on top of the printer. It accepts inputs from any computer I have—at the moment, the Concurrent CP/M Golem, and the Cheetah, but I'm always stringing other cables over to it—and squirts the output into the HP LaserJet or the NEC Spinwriter. On the way, it can perform all kinds of transformations, such as substituting one control character for another, or initializing the LaserJet before sending it text. It can also put print jobs in a queue, and you can even interrupt the current job to send something else directly over to the printer.

The computer thinks the Optimizer is a very fast printer; now that it has a full megabyte, the Optimizer can accept a whole novel. *Prince of Mercenaries* was sent from computer to Optimizer in less than half an hour. Meanwhile, the Optimizer is pouring the text into the LaserJet. The upshot was that I had my computer back in service in half an hour, and the whole novel printed in less than an hour and a half.

The Optimizer is one of those gizmos that make life easier; you can't know how much you'll like it until you get one.

Highly recommended.

Multitasking

Once I had the Cheetah working with all his essentials—CD-ROM reader, Logitech mouse, modem and communications, WORM, 300-megabyte hard disk drive—it was time to set up my operating environment.

As I noted above, it's very easy to fill a machine with memory-resident software. The WORM and CD-ROM readers alone can darned near do it. Add SideKick and you're finished—and this in an 80386 with nearly 8 megabytes of memory! It just doesn't seem fair.

Of course, OS/2 is supposed to fix that problem, but we don't have it yet. Well, that's not quite true. We have OS/2, but since we don't have much software to run under it, it hardly matters. Incidentally, I do have Paradox for OS/2, and that works fine. The problem is that I don't have anything else, so even though Paradox is an excellent relational database manager, I've little temptation to go to OS/2 yet.

What I do have is DESQview. That, it turns out, works very well with the 20-MHz Cheetah except for one thing: the mark-and-transfer program doesn't always work. Sometimes when I try to move a few paragraphs from one DESQview window to another, I get horrible squeals from the computer, and only part of each line is copied. I haven't the foggiest notion why. Machine's too fast for the software, I suppose.

I set up everything with DESQview, and it works; I'm writing this now in Q&A Write running under DESQview with half a dozen open windows including SideKick, SideKick Plus, Ready!, and Norton Commander. While all those were open, I went to Procomm Plus and logged in on BIX. That worked, too.

DESQview on an 80386, when coupled with Quarterdeck's QEMM, is pretty good stuff. I suppose I ought to be satisfied with it, but of course I'm not.

continued

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The problem is window size. DESQview allows 80386 machines to make use of all that high memory by fooling DOS into thinking that each DESQview window is down there below the 640K-byte boundary; but the price is that you can't have a DESQview window much larger than 500K bytes. Actually it's worse: if I want to load all the device drivers for my Priam hard disk drive, Maximum Storage WORM, and Amdek Laserdek 2000, DESQview gets really choked up. As a practical matter, I can run the Priam all right, but if I want my other devices I have to dump DESQview and reboot.

That's hardly what I want, so I've been looking for alternatives.

The most obvious alternative is the VM/386. This is a system that allows you to run two virtual machines at the same time, each potentially as large as 640K bytes, and each with its own CONFIG.SYS file. In theory, I could attach the WORM and CD-ROM drives to one of those virtual machines, SideKick Plus in another, the CD-ROM reader (but no WORM) in yet another, and so forth. Not only would each virtual machine have 640K bytes of main memory, but I could also assign more memory to act as enhanced expanded memory for programs that can make use of that.

In practice, I don't know: VM/386 won't work with any machine I have. The people at IGC swear this is sheer bad luck: VM/386 will work with a Zenith Z-386, even with the Z-448 video card, but it won't work with the FTM monitor. It will work with the Cheetah at 20 MHz, but it won't work with the Award video board, and for that matter, if I use VM/386, I won't have but one logical drive on my Priam hard disk drive; VM/386 doesn't know how to find the others. It will work with the Kaypro 386, but not with the Orchid EGA/PGA video board. And so forth.

All I have to do is use a plain vanilla 80386 with a standard EGA board and monitor, and I can use VM/386; or so they tell me. I suppose I'll have to try that sometime. Meanwhile, I'm still looking for a good multitasking system that works with what I have.

Candy Cable

The Cheetah is in a "tower" configuration, meaning that it's designed to stand on end on the floor with the floppy disk drives at the top. This works fine in that it keeps the machine out of the way, and the airflow is better than in the standard lay-down PC.

There are some drawbacks. First, it's a little harder to get the case open. In practice, you end up sitting on the floor when working on a tower. The second problem is cables. They're almost never long enough.

The mouse cable, for example, won't reach back behind the table, up over its top, and then forward far enough for me to use the mouse. Even with the most direct route there's not enough slack. The solution is an extension cable, a regular 9-pin male-to-female.

The modem cable, which is 9-pin to 25-pin, is usually long enough, but the video cable probably won't be; for that you need another 9-pin extension, male-to-female.

The real kicker is the Amdek Laserdek 2000 cable, 37-pin male-to-male. The one that comes with the system is far too short for a tower.

When I was setting up the system, I naively assumed that all I had to do was go to a local ComputerLand and get the cables I'd need. I blithely hopped into the Bronco and headed down the avenue where I'd seen, every day for a year, a ComputerLand sign at a mini-mall where there used to be a grocery store.

When I got there, I found they had a parking attendant collecting money to let you into the mini-mall. I muttered some curses and voiced the intention of never visiting *that* mall again—as indeed why would anyone when there are better shops with free parking nearby? Worse, though, when I got into the mall, I discovered that ComputerLand had been closed for weeks; they'd just never bothered to change the signs since no one seems to want to rent space in a mall that charges parking fees. (Talk about ways to discourage impulse buying!)

I went back home in a stew, and Mrs. Pournelle quite reasonably pointed out that I ought to have called first. This time I tried it: and found that in all of Los Angeles there was about one EGA video extension cable, one modem cable, and no 37-pin cables at all. Now what?

However, one ComputerLand told me that although they were out of cables, I ought to try Candy Cable of San Diego.

It was good advice. I called and described what I needed, was given some advice about alternatives, and shortly after, I was through. They make up cables within 24 hours of the order; mine, including the unobtainable 37-pin, came by UPS two days after I phoned.

Mapping the Future

My new novel *Prince of Mercenaries* will be published with maps. I'd intended to draw those maps on the Atari ST, but there's been some odd delay in getting an Atari laser printer. I waited as long as I could, then drew them on the Mac II.

But that's nothing new. Everyone knows you can draw maps on a Mac II.

I used MacPaint. The first map came out quite well, especially considering that the printed version will be smaller (and thus higher-resolution) than what I printed on the LaserWriter.

I could have gotten higher quality, of course, by using MacDraw. MacDraw is harder to use, since what you're doing is manipulating symbols rather than just freehand drawing, but the result is a drawing that can be output to printers with far better resolution than the LaserWriter's 300 dots per inch. There are several commercial outfits that will take your MacDraw files and print them for you at resolutions between 1200 and 2500 dpi.

Grammatik III

Mrs. Pournelle has been working hard on a nonfiction book. She says it's too early to say what it's about.

For most of her life she has been a teacher. For the last 15 years she was the teacher of last resort in the Los Angeles juvenile justice system: she got the kids that no one had been able to teach to read. They ranged in age from 12 to 17. Some were quite bright, too, although no one would ever suspect that of an illiterate.

During that time she didn't have to do much writing, and what little she did was short. Now she's doing a lot more: not only her book, but magazine articles on education technology. The problem is that it's hard for me to edit her work, and doubly hard for her to try it herself. Over the past year the writing has improved a lot, but it was slow progress all the same.

continued

No longer. She recently started using Grammatik II (and now we have a beta-test copy of Grammatik III). The program comes with Ron Bauer's "World's Shortest Writing Course."

When I first tried Grammatik, I wasn't impressed. The program tended to natter at me about things I already knew. Some of the natterings were interesting, but it didn't seem worth the effort to run everything I wrote through the program. Of course I've been writing about a million words a year for the past 20 years, too; maybe it's not surprising that a program won't do me much good.

Mrs. Pournelle, on the other hand, loved it from the first moment. Here was a program that really went through and tore up her text—worse than I'd ever done—but did it impartially and impassively. No one would ever have to see all those comments, or even know that the machine found so many mistakes.

She's been using Grammatik III for nearly a month, and I can already see great improvement in her writing. Her book always was interesting because of the subject matter; now it has a much improved style going for it. It's been enough to make a believer out of me.

The previous version of Grammatik wasn't all that easy to use, because you had to save an ASCII copy of your file, let Grammatik play with it, then read that back into the system to edit. Grammatik III works directly with files created by most word-processing programs.

I've decided to let Grammatik have a look at my text once in a while. It can't hurt to be reminded when I overuse passive voice.

Highly recommended.

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Norton Commander Revisited

I'm not very big on straight DOS shells, those things that are supposed to make DOS easier to use. Most of them are as hard to learn as DOS, and when you're done, you don't have anything, since the next computer you encounter isn't likely to have the utility you just learned.

On the other hand, DOS is limited and can be awkward to use. This is especially true when you're trying to get a job done and run out of disk space. (That can even happen to me with my 330-megabyte hard disk drive: I haven't filled the disk, of course, but I have overfilled the C drive partition.) When you are in a hurry, it can take forever to go through and locate expendable files to be sacrificed for more disk space.

I've generally used a shareware program called Sweep—you can get it off BIX—but the program interface is a bit sticky, and it has its limits, as I found when I had the massive job of reorganizing all the files on the Cheetah's hard disk drive. Then I remembered we had a new version of Norton Commander, and I put that up to see if it would help.

It did. Norton Commander has a lot of features, and nearly all of them are easy to learn. You can use it to cruise through disk directories—transferring and eliminating some files, looking at others, and generally getting things organized. Commander knows about hidden files and makes it easy to find and erase them if you want to. It also makes it simple to deal with read-only files. I was surprised at how quickly the work went.

Norton Commander is intended to be a sort of resident DOS shell, which you invoke on power-up and leave in place the whole time you're using your computer. I suppose you could do it that way. What I've done is set things up so that DESQview allocates 400K bytes to the Norton Commander window. That's enough memory to run nearly every DOS utility I need, including Golden Bow's Vopt (if you don't have Vopt, you ought to), and thus the Commander's window serves as an easy-to-use DOS shell. So far, I haven't had any problems with that at all, even on the fast Cheetah.

Norton Commander is one of those programs that no one really *needs*, but it is nice to have and it can save some time.

Sprint

I'm about out of space, and I haven't had a chance to talk about Sprint, which is Borland's new editor/word processor. Sprint is loosely based on Mark of the Unicorn's Final Word, which is in turn

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derived from Richard M. Stallman's EMACS, but that's all of historical interest only. Sprint isn't like any of those.

Sprint's strong point is that you can reconfigure the commands to suit yourself. The command system is contained in a table. You enter the table and find a whole series of commands: commands you might want to be able to use. Some, like Delete Line, are already bound to a command (Control-Y in this case). Others, like Delete to End of Line, are just floating free; you can invoke them, but only by using multiple menus until you get down to where they are. Suppose, now, that you want Control-Y to mean Delete to End of Line, and Control-U to Delete Entire Line. No problem: you merely enter Control-U and Control-Y in the proper places in the table. Once you're through making changes in the table, you can tell Sprint to print out a sheet listing all the commands it currently understands.

There's a lot more to Sprint; in fact, it looks like it's got more features than the next two editors put together. Fair warning: my major experience with Sprint was at Philippe Kahn's home, and he's very enthusiastic about the program. He also uses it himself, and the entire Sprint manual—three volumes—was produced with Sprint. I was duly impressed.

When Philippe first mentioned Sprint, I told him I'd heard that it was slow. He laughed. We used LapLink to move Sprint from his Compaq to my Zenith Z-183 laptop, after which Philippe built a file about a megabyte long and I played with jumping from, say, line 120 to line 12,435. The Z-183 is a good machine, but it's not particularly fast, even for an XT. I guarantee you, Sprint isn't slow.

More when I've had more time with it, but I predict it will be a huge success.

Winding Down

Now I'm really out of space. The book of the month is Tom Clancy's *Cardinal of the Kremlin* from Putnam. Like all of Tom's books, you won't put this down after you start it.

The computer book of the month is Richard Maran's *HyperCard Quickstart* from Que Books. If you have any interest at all in trying to make HyperCard programs for the Macintosh, this is the book to start with; it makes clear what the HyperCard manuals make obscure.

The program of the month is MemoryMate from Broderbund Software. All those good things my colleagues have said about this program are true. The only problem is that it's yet another memory-resident program, a new way to eat computer memory. I now have enough memory-resident programs to fill my computer five times. Maybe by next month I'll have figured out VM/386 and *have* five computers filled with memory-resident programs.

The game of the month is still Dungeon Master on the Atari ST. I've got the firestaff—now if I can just corner the evil dark lord. . . . ■

Jerry Pournelle holds a doctorate in psychology and is a science fiction writer who also earns a comfortable living writing about computers present and future. Jerry welcomes readers' comments and opinions. Send a self-addressed, stamped envelope to Jerry Pournelle, c/o BYTE, One Phoenix Mill Lane, Peterborough, NH 03458. Please put your address on the letter as well as on the envelope. Due to the high volume of letters, Jerry cannot guarantee a personal reply. You can also contact him on BIX as "jerryp."

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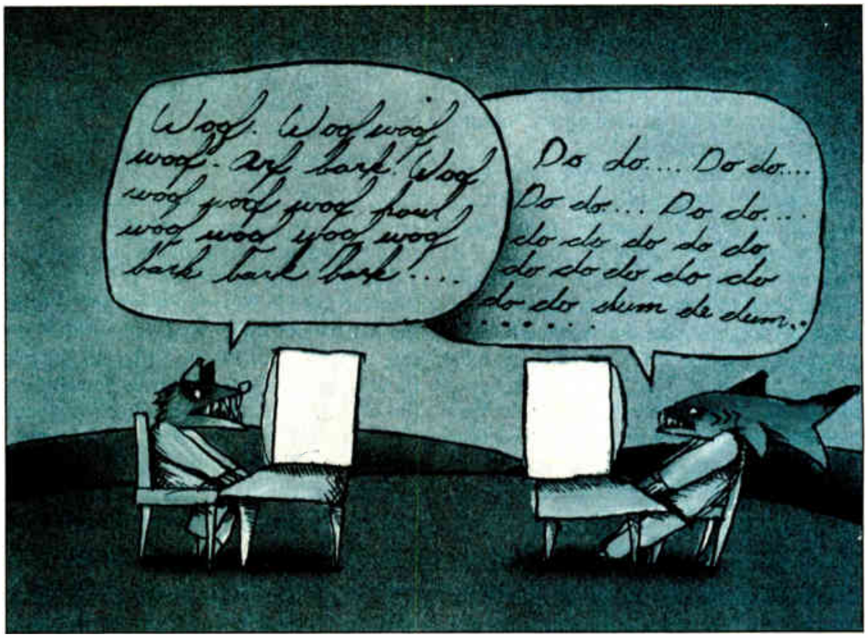
A WOLF AND A KILLER SHARK

After moving to Hollywood, our columnist pits Word against FullWrite Professional



A few months ago, I moved from San Francisco to the Greater Los Angeles Sprawl. Why? Well, I've always had a secret yearning to become a matinee idol, and I figured that if there was room in Hollywood for Howard the Duck and ALF—good-natured, odd-looking, tactless extraterrestrials to whom friends tell me I bear a striking resemblance—there was room for me.

The process of moving was a major nightmare; I'm still living in a landscape of unopened, mislabeled boxes. There were, of course, the usual computer headaches. Since I save the original cartons when I buy components (a practice I heartily recommend), packing was effortless and everything made the trip with no physical damage.

However, sometime during the process, the lithium battery in my Tandon IBM PC AT clone gave up the ghost. This is the little devil that keeps the parameter RAM alive; when it passed away, the Tandon forgot everything it had known about system configuration. To make things worse, the computer is equipped with some setup routines in ROM, one of which lets you select a hard disk drive option from among 32 choices. This meant that the machine knew there was some sort of fixed drive attached (I could hear it power up, and the little light flickered appropriately), but it didn't know enough to actually read the disk.

So I hauled out the Yellow Pages and began calling some computer stores that looked big enough to handle lithium batteries. I figured I was in for a rough time because the Tandon's battery was rated at 3.6 volts as opposed to the 6.8-V unit in IBM machines, but this turned out to be immaterial—nobody had any batteries of either sort.

Half a dozen places told me they didn't have anything like what I was describing. One technician dimly recalled some lithium batteries a long time ago, but he knew his store had stopped stocking them. Three outfits told me to call Radio Shack, which I did—to no avail. I called two computer supply firms, which sold paper, disks, cables, daisy wheels, and similar stuff; they had no batteries. Two more computer stores gave me the names of the largest electronics supply houses in the region, which carried batteries but not the one I needed. However, one of the electronics stores told me about a company called Battery Specialties in Long Beach. I called; they had the battery; victory was within my grasp.

The following afternoon, I drove out to deepest Long Beach, near the border with Orange County, and picked up two batteries (to be safe). Round-trip mileage: 78 miles. Total elapsed time for the mission: 3½ hours. This is a big city.

Got home, plugged one in, and the Tandon came to life. Neither it nor I knew the specs for the hard disk drive, though. I spent several hours trying to figure out which option to select by trial and error. I knew the disk was a 40-megabyte job, but was it actually 40, 42, 44, or a fractional variation? How many heads did I have (on my hard disk drive, that is)? How many cylinders? No luck. The drive itself, of course, had no identifying label, and the documentation was written to cover all possibilities. Ouch.

The next morning, I called a friend with an identical machine and learned that I had a type 25 drive. I selected that option, and I was in business until I discovered that the drive had been wiped clean. I don't know how this happened,

continued

ILLUSTRATION: JAMES YANG © 1988

but I was able to reformat successfully and begin rebuilding my system. And to this day, I believe with all my heart that I will, someday, locate the packing box that contains my backup floppies.

Why am I telling you all this? Two reasons. First, I'd like to warn you to start building a collection of spare parts for your computer(s), and to make some notes on paper of little things like system configuration parameters. This can happen to you.

Second, I would like to express extreme annoyance to any representatives of the computer industry who read this column. I wasted three days on all this. The L.A. region is one of the nation's largest markets for computer equipment, and I came close to giving up and using mail order, which, in retrospect, should have been my first move.

The fact that none of the dealers I called could help me is appalling. Luckily, I'm the sort who doesn't mind poking around inside computers, but what if I weren't? I'm pretty sure I would have been forced to turn the Tandon over to a service shop, pay an outrageous hourly minimum, and lose the use of the machine for a week. That's just not acceptable. Until the industry as a whole figures out how to cope with situations like this, personal computers will continue to be seen by many users as a menace.

Items Discussed

FullWrite Professional $395
Ashton-Tate
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Torrance, CA 90502
(213) 329-8000
Inquiry 934.

Word 3.01 ....$395
Microsoft
16011 Northeast 36th Way
P.O. Box 97017
Redmond, WA 98073
(206) 882-8080
(800) 426-9400
Inquiry 935.

Head to Head

Let me start off this comparison of Word 3.01 (Microsoft, $395) and FullWrite Professional (Ashton-Tate, $395) by declaring flatly that I probably wouldn't use either package on a regular basis. That's not to say they're bad programs, but they're not suited for what I do.

I grind out text, which I usually transmit electronically, either via BIX or MCI Mail. Sometimes I write letters. Occasionally, I need a fancier layout, so I pump my text into PageMaker. When I want to generate an outline, I use More or the variant of Acta that uses the More command set. I rarely need headers or footers, and when I do, they're simple one-line affairs. I do not have to generate tables of contents, indexes, bibliographies, footnotes, or end notes. I'm perfectly happy to be writing this column using Microsoft Works (with the addition of WorksPlus Spell and WorksPlus Command from Lundeen & Associates).

If those programs didn't exist, I'd be content to use WriteNow, the excellent word processor from T/Maker, or MacWrite 5.0 from Claris, an improved descendant of the original Mac editor. I suspect my habits parallel those of many, many computer users, but be warned that I don't fit the mythical mold of the "power user." For my own work, I take the utilitarian route, and I reject the notion of insurance buying, that is, getting the largest number of features possible on the off chance that I'll need one of them someday. When the blue moon rises, thank you, I'll invest in new software.

Further, the hardware and operating-system people tell us that multitasking is just about with us at last on popular microcomputers like the Mac and the IBM PC. If that is true, it would suggest another reason to go for simplicity. Surely, the model of multitasking we'll have in the next few years will let us bolt simple, effective tools into our systems only as we need them. Why burden yourself with ungainly software monsters?

This may seem like a digression, but understanding your text-handling needs is critical to determining whether you should even bother with Word or FullWrite Professional. In many ways, both programs represent the same kitchen-sink philosophy; it's up to you to determine if you need a word processor with running water and a garbage disposal. Both packages push the concept of word processing into the area of heavy-duty desktop publishing; you've got to decide if you'd rather purchase two separate programs, or take the reverse route instead and go for a layout program that incorporates word processing, like Quark XPress or Ready-Set-Go!. Some concentrated soul-searching and a long session of needs analysis are in order here.

On to the analysis. I burned myself badly with a column about Word 3.0 in January 1987. I wrote an embarrassingly exuberant preview of the product, noting that I hoped the bugs I encountered in my beta-test edition would be squelched by the time the program was released for general consumption. When the product shipped with bugs intact, the only thing that saved me was that I had noted the unfinished nature of the software in the column. True, Microsoft fixed the flaws and sent its customers free updates, but the features that had impressed me became more and more cumbersome as I used the program. Sadder and much wiser, I retreated into Works, which has always been adequate and has never crashed on me.

As a result, I was edgy about evaluating FullWrite Professional. Rather than attempting to play with a prerelease version, I waited until Ashton-Tate shipped shrink-wrapped copies to its dealers. The first two copies I received, a month apart, had unreadable program disks. The support disks were fine, which led me to be suspicious of Ashton-Tate's quality control. And within the first week of testing, I had three ominous crashes (the cursor simply froze in place) for which I had no explanation.

Since then, I've been unable to duplicate the crashes, and I have not been able to pinpoint any specific problem areas. Maybe I have been witnessing an evil synergy between FullWrite Professional and my Radius accelerator card; that seems unlikely, but you never know.

The next warning sign was FullWrite Professional's appetite for memory. It is sold for 1-megabyte machines, but it really requires more. If you have a 1-megabyte Mac Plus or SE, be prepared to strip your system file to a bare minimum, heaving desk accessories and fonts willy-nilly, if you want to have enough memory to make the program do its thing. For this reason alone, I wouldn't recommend it to anyone with less than a 2-megabyte system, which cuts out a majority of Macintosh owners. Not good.

But let's assume you've got a loaded Mac with memory to spare, and that the crashes I've experienced are unique to my system and its idiosyncrasies. How do the two programs stack up?

FullWrite Professional has some decided advantages over Word. Editable display of multiple columns is much more convenient than the back-and-forth jumps to get into Word's page-preview mode; if you regularly produce short two- or three-column documents, FullWrite Professional is the winner. Selecting items to be flagged as index en-

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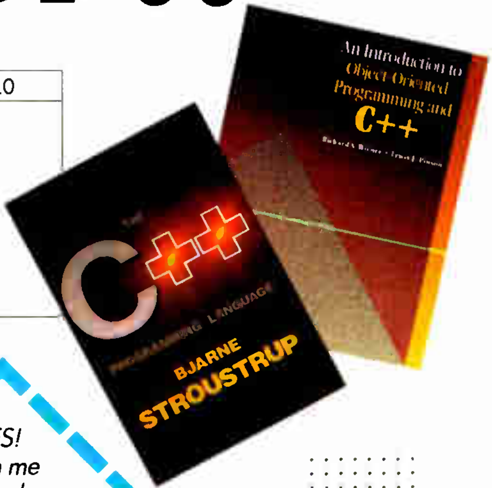
Rsieve	20.49	20.54	23.62	22.03
Integer	1.32	1.38	6.31	6.49
Float	0.17	0.22	52.29	51.03
*Float	32.73	37.74	52.39	51.63
Pointer	17.91	17.96	17.13	16.87
Rpointer	17.79	17.91	17.14	16.64
Loop	3.90	3.90	3.90	3.90
Optimize	0.49	0.60	8.46	8.79

Benchmarks were run on an 80286 based IBM compatible at 6Mhz with no 8087.

*The float benchmark was re-run without optimization.



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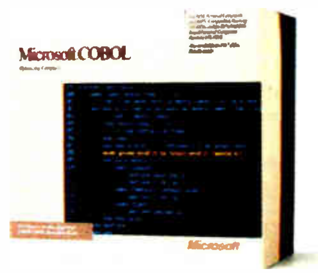

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tries, footnotes, end notes, and so on by clicking icons on an "icon bar" is much more reasonable than resorting to the arcane WordStar-like system of embedding control symbols that Word uses, although figuring out FullWrite Professional's icons takes some doing.

The addition of marginal notes (called "posted notes"—obviously a steal from 3M's trademarked Post-it Notes) is a plus when editing if you don't want to rip up the original; whether or not you call it "hypertext," it's handy. Likewise, editors will appreciate the visible "change bars" along the edge of your text that indicate revisions since the last version. And FullWrite Professional's system of dividing "documents" into "chapters" sucked into RAM is a nifty, easily understandable method of defining virtual memory techniques in word processing.

In day-to-day use, the two programs come up equal in spelling checking and glossary capability, although FullWrite Professional has a few more tricks than Word, including "variables," drop-in placeholders for text that is frequently redefined. The outliners are different, but neither of them approaches the ease of More, so I'd call it a dead heat. Ditto for file import/export, help screens, and many other features. Both come with excellent documentation.

FullWrite Professional will wrap text around an irregular graphic, but this is a novelty for anyone but the most passionate tinkerer. And you can't just slide a graphic as you can with Word; you have to create an independent sidebar in order to position it. FullWrite Professional is more precise, but Word is easier.

Style sheets can be defined and named with both programs, but Word lets you chain styles into a running format with a smoothness lacking in FullWrite Professional. Longer documents flow without conscious effort. More points for Word.

But to me, the most important area of distinction is that of "feel." Word takes great pains to mask its power; it's very easy to ignore those functions not germane to the task at hand. FullWrite Professional feels more like a big program; you always have the sense that there are menus and submenus and sub-submenus lurking beneath every operation. And FullWrite Professional's extensive use of sidebars, windows, and cryptic icons adds to the impression of complexity. Word can do fancy stuff, too, but it comes across as a wolf in sheep's clothing, while FullWrite Professional is a killer shark of a program.

Overall, I have to give the nod to Word as the better program for a larger number of people, if only because of the memory required to run FullWrite Professional. I also like its feel. However, although FullWrite Professional at this stage in its development is alarmingly fragile and a memory hog, it's better designed for the person with tough word-processing needs. You pick which you prefer.

But returning to software philosophy for a moment, remember, these are both programs that seem best-suited to those who want to live their lives inside their word processors. Although the accompanying manuals make light of this, both take a lot of time to learn thoroughly. To tap the industrial-strength aspects, you'll have to plow through the documentation and devote hours to experimentation. I don't really like this approach. I find it much more comforting to have several programs, each good at specific functions, than one big program that claims total flexibility. The counterargument is that it's easier to have to learn only one environment. I leave it to you to declare which camp you're in.

You Saw It Here First

Back in April 1984, BYTE ran a special What's New section that parodied high-technology product introductions, and I wrote a couple of items. The first heralded two new computer languages, ORTHFAY (which combined postfix notation and pig latin to produce code so elegant it was incomprehensible immediately after it was written) and LIMP (an artificial-intelligence language that forgot what it was doing and crashed if the word *Eratosthenes* was even mentioned in the room with it).

The other item was entitled "Looking for Mr. Dos." It detailed a nonexistent operating system from a company called Marginal Research, hence MR-DOS. All good clean silliness.

Now, Apple Computer has entered the picture by announcing that it's building a new operating system called "Multitasking Realtime DOS" or "MR-DOS." Sound familiar? You betcha.

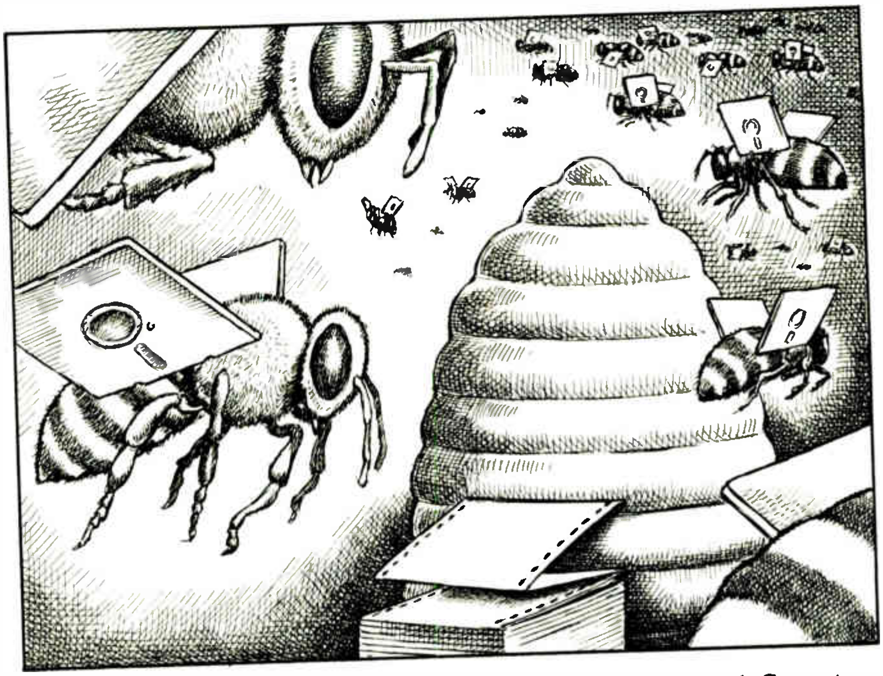
At present, I'm wondering if I could sue Apple for "look and feel," or at least a bit of copyright infringement. After all, it seems the thing to do these days. ■

Ezra Shapiro is a consulting editor for BYTE. You can contact him on BIX as "ezra." Because of the volume of mail he receives, Ezra, regretfully, cannot respond to each inquiry.

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

IS MORE ALWAYS BETTER?

Too often we opt for the pricey solutions because they feel good, but they may not even solve the problem



It was enough to bring visions of yuppies talking in acronyms, just like in those controversial Wang commercials on radio and TV. The Wang salesman explained to me just how he had convinced his customer to abandon the idea of a small, microcomputer-based local-area network (LAN) and instead buy a Wang VS minicomputer. I knew that the customer had only minimal office automation requirements and was planning to do a lot of database work using a LAN with a Structured Query Language (SQL) server. The Wang salesman was quite proud of the way he had overcome the customer's objections to the sale.

In effect, the Wang VS would replace an IBM PC AT–compatible machine at over 10 times the cost. To complicate matters, there was no indication the Wang-based network would work with the SQL database server.

The customer convinced himself to go with the Wang VS partly out of emotional reasons. His DP managers were comfortable with the brand and knew little about microcomputer-based LANs. What's more, the customer knew that a LAN looked good on paper, but since he knew little about LANs, he wasn't in a position to reassure his managers.

The result, of course, was a familiar scenario. The customer really needed a network and he got one, with the Wang VS acting as the file server. But because the work required of the file server was minimal, the VS spent most of its time idling. At last check, the SQL database server still wouldn't work with that setup and the customer never got his database, even though the database was the primary reason he needed a network.

Finding Another Way

Although it's a pricey substitute for a PC AT, the Wang VS is a nice departmental system. I'm really not picking on Wang or on Wang's hardware. The problem is that many installations are made on the basis of comfort rather than functionality. Choices made the easy way happen for a variety of reasons, some of which are impossible to solve.

Still, most companies really would rather not pay for solutions that feel good but don't solve the problem. The difficulty is finding the alternative. While emotional decisions played a part in the selection of the Wang system, there were other factors involved.

The customer planned to eventually install several similar networks in areas where he now used Wang word processing on Wang Professional Computers. These computers connected to the current word-processing system with Wang's Local Interconnect Option (LIO) wiring. The DP managers didn't want to scrap the Wang computers or rewire their offices. Thus, the decision was more than just a question of comfort; to them, it made good technical sense.

Had more research been done, however, the customer would have discovered that there was another answer. For example, the network wiring is compatible with ARCnet hardware. If he had found a way to have the Wang computers use some industry-standard network software, he could have used most of his installation, as is, for a microcomputer-based LAN, at a fraction of the cost of buying one based on a Wang VS.

Magna to the Rescue

The Wang Professional Computer, as it turns out, will support Novell NetWare

continued

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Circle 11 on Reader Service Card

just fine, if you add a small adapter card to the LIO network card in the machine. Wang's LIO is really ARCnet, so once you've installed this card, you can use your machine on a microcomputer-based network. Because most Wang Professional Computers come with IBM PC-compatibility options, they will run PC software.

The adapter card, from Magna Computer, is on the pricey side, but it's cheaper than buying a new computer and a network card, and you can use all that cable. Once you install Magna's adapter card, you can use the Wang Professional Computer on a Novell network just as if it were an IBM PC.

Once you eliminate the side issues, such as what to do with all your old workstations and old cable, then you get down to the real issues, such as the fact that many DP managers simply aren't used to the idea of microcomputers replacing minicomputer and mainframe systems. They'll waste a mainframe on microcomputer tasks, simply because they haven't seen a micro handle such an application before. There are a couple of ways you can overcome this problem.

The easiest way is to set up a prototype. It's pretty hard to argue with an operational system that is functioning well. In some cases, especially if the mainframe application was designed for a single user (and many were), you can simply move the source code over to the microcomputer and recompile it. Of course, you have to be prepared to handle nonstandard extensions, and you'll find some really old COBOL systems quite bizarre due to the many patches that have been made over the years.

When you can't recompile—and sometimes you can't—you can design the same functions (and the same feel) into the microcomputer version. The results can be quite impressive, because if you design the prototype right, you can improve response time, a situation that will impress the users.

If you can't do a prototype, you can often find equivalent software for the microcomputer. Sometimes you can find the same software, since there is some cross-fertilization between computer types. Often, because each user has a dedicated CPU, equivalent software for a microcomputer or a microcomputer-based LAN is better and faster than what was being used on the mainframe.

Sometimes More Is Better

Certainly using the Wang VS (or a VAX, or an IBM 9370, for that matter) as a file server is not always a bad idea. If you have a lot of users, and if you have the support staff to handle a minicomputer like the Wang, it might make sense.

A good example of this would be an office automation environment with a heavy word-processing load and the need to communicate with a couple of mainframes. Naturally, for success in an environment such as that, you need to select the right file servers and gateways. Microcomputer users may face a quandary in such a situation. As systems get bigger and harder to manage, the freedom and flexibility that come with the use of small computers begin to disappear because individual users can no longer manage them. Once again, the DP manager starts controlling the system.

You've probably seen the AT&T television ads about this trend. They feature two executives, one of whom is equipping his office with stand-alone microcomputers. He's being intimidated by another executive, who tells him in a very nasty scene, "Stop blowing your budget" on personal computers and hook all your users to a central system. This is one view of workgroup computing, although AT&T has the perverse idea that the intimidator is the forward thinker in the scene.

As is indicated by the growth of network installations, there are some good reasons to connect users. Sharing of

continued

Items Discussed

Lap-Link Mac..............$139.95
Traveling Software, Inc.
18702 North Creek Pkwy.
Bothell, WA 98011
(206) 483-8088
Inquiry 965.

LIO adapter card..............$595
Magna Computer Co.
24 Keewaydin Dr.
Salem, NH 03079
(603) 898-3555
Inquiry 966.

Z-1000..... Price not yet announced
Zenith Data Systems
1000 Milwaukee Ave.
Glenview, IL 60025
(312) 699-4848
Inquiry 967.

scarce resources (such as laser printers) and communication with other users in the outside world are two of those reasons. The problem comes when department managers have to decide whether the users should control their own work, or the tasks should be handled centrally.

The Zenith Z-1000

One reason the workgroup issue often seems so fuzzy is that the line between microcomputers and minicomputers has blurred and almost disappeared. Part of this is due to machines like Zenith's latest, the Z-1000.

The Z-1000 is aimed squarely at the workgroup market. It is a machine that starts at about $20,000, contains as many as five 80386 microprocessors, has a dual bus, runs Unix, and supports as many as 64 users. Zenith says it's a microcomputer.

Clearly, the Z-1000 is based on microcomputer technology. One of its two buses is a standard PC AT bus. You can plug standard PC cards into it. The other bus was designed at MIT by the same people who developed the NuBus used by some minicomputers and the Mac II. This bus is for the processors only, but it is similar to some proprietary minicomputer buses.

Whether you call it a mini, a micro, or something else, the Z-1000 is designed for user-supported workgroup computing. Zenith says it developed the machine for use in the average office. While it's too bulky to fit on a desk, it fits beside a desk very nicely. The machine supports users with terminals, or it works with a LAN as a node or as the file server.

Moving the Info

The concept of workgroup computing implies that information can be shared among the group's users. For example, if you have a spreadsheet and a text file, you should be able to send them to another user for inclusion in a document. The concept of personal computing, on the other hand, implies that you have the computer that's best suited for your specific job.

The problem is, there are certain jobs you can do better with an IBM compatible and others that you can handle better with a Mac. These machines are not compatible. How do you fit them both into a workgroup? With difficulty. At least, until recently, that was the case.

Now, there are ways. Apple has announced an Ethernet card for the Mac II; there's the AppleTalk board for the IBM (which will help some); there's TOPS (Transparent Operating System), a LAN operating system that connects Macs, IBMs, and Sun workstations; and there's Lap-Link.

Lap-Link? You thought that was for moving stuff from your laptop to your personal computer, right? Well, it is, but there's also a version that does file transfers between PCs and Macs. For more detailed information, see the text box "Exchanging Data" in the *Macintosh Special Edition*, August BYTE, page 62. I'll report on Mac-to-PC networks as I get a chance to look at them. ■

Wayne Rash Jr. is a member of the professional staff of American Management Systems, Inc. (Arlington, Virginia), where he consults with the federal government on microcomputers. You can reach him on BIX as "waynerash."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

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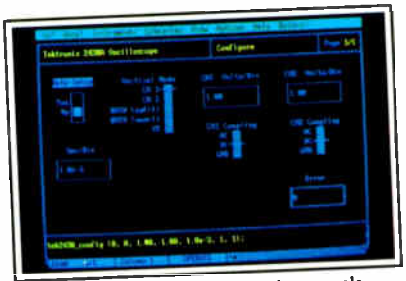

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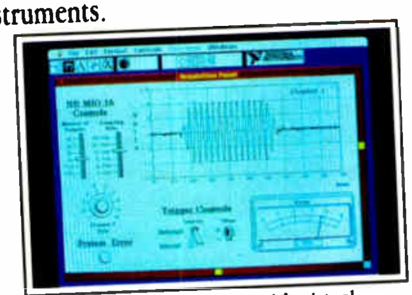

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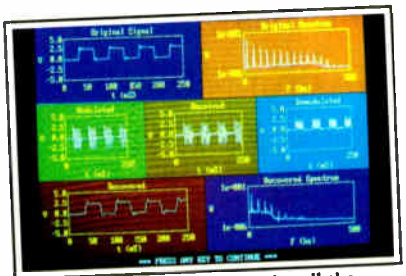

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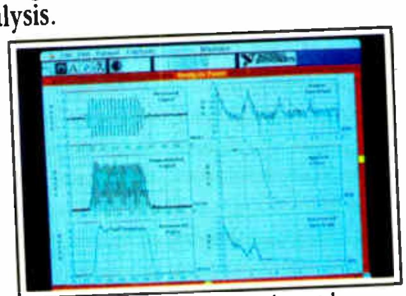

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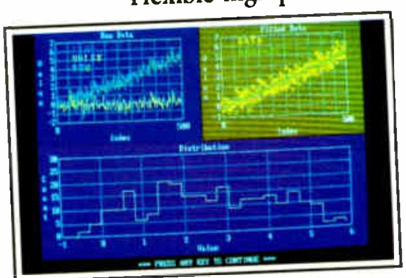

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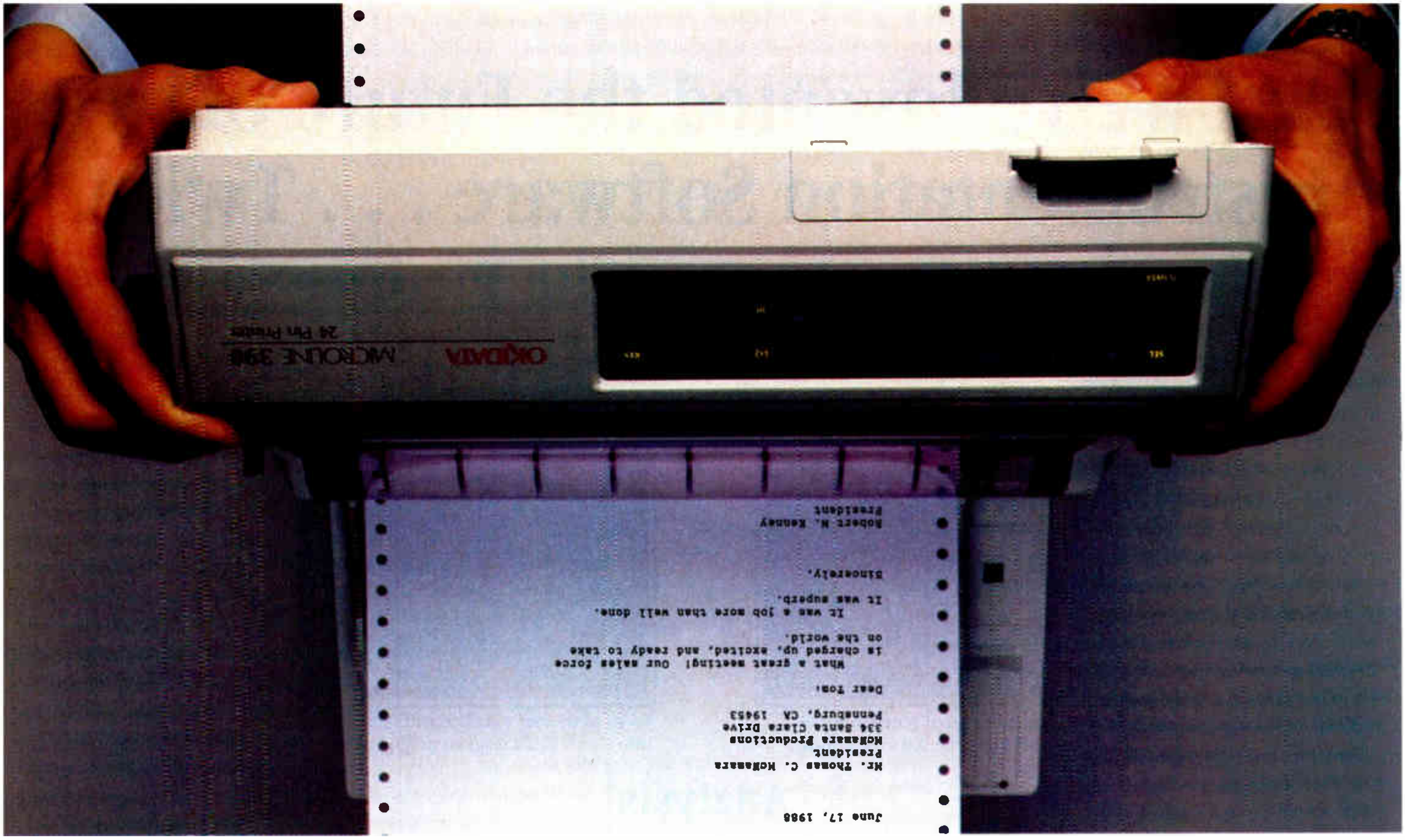

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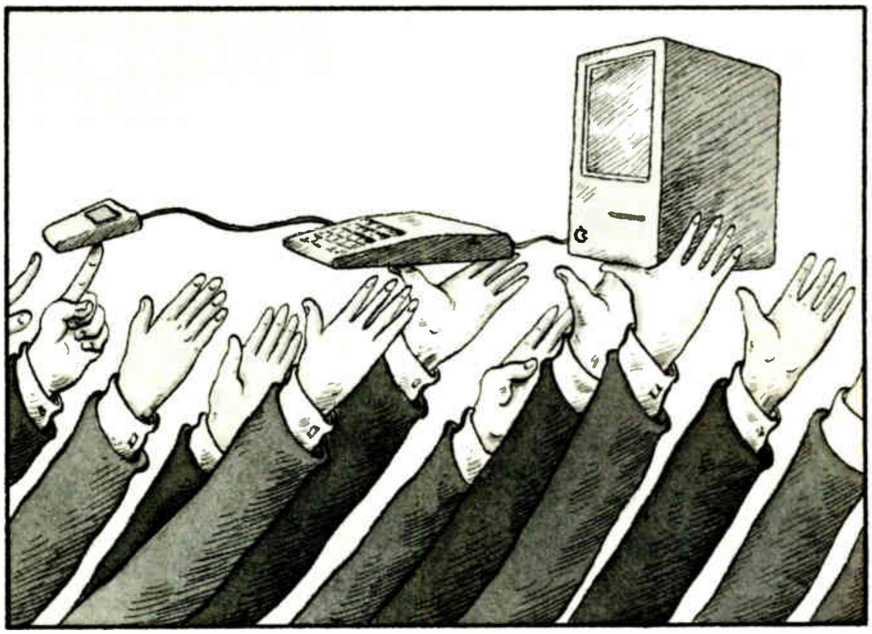
COMEBACKS, BACKUPS, AND UPDATES

Some Macintosh software is born great, some is made great, and some is merely updated



If you're a savvy Macintosh user who has also fiddled with IBM PCs, you've probably come to respect the window/icon/mouse interface inherent in all Macintosh software. DESQview and Microsoft Windows notwithstanding, you simply can't navigate around the directories of a PC the way you can on a Mac.

Unfortunately, for a number of us, special applications are often available only on the PC. For example, the number of third-party applications that have been written using dBASE III Plus (and earlier variants) is staggering. Until recently, inveterate MacFolk like myself were locked out of that market.

About a year ago, Nantucket Software improved the situation by rescuing an obscure West German program called dMacIII from the waste bin of bad programs. The program could run dBASE III code on a Mac and read the dBASE database files that you had moved from a PC. But it didn't follow the Mac interface; its documentation had been badly translated from the original German; and its U.S. distributor was weak, to be charitable.

Nantucket bought the rights to dMacIII, cleaned it up, renamed it McMax, fixed the bad bugs, improved the documentation to mediocre, and put it on the market for $295. Its two virtues were its speed and dBASE compatibility. But unless you happened to be a dBASE guru, it was pretty tough to figure out how to program McMax to create new applications.

Using FoxBASE+/Mac

Fox Software, the FoxBASE+ people of PC and dBASE III Plus clone fame, have a much better idea, as I briefly reported last month: FoxBASE+/Mac. This program has all the dBASE compatibility of McMax and more, since it also handles report-definition and label-definition files, memory-variable files, and other file types created by dBASE III Plus.

I was a beta tester for FoxBASE+/Mac, and I've worked with the release version (1.0) since the end of April. I'm not a FoxBASE cheerleader, but the company did a lot of things right with the product.

FoxBASE+/Mac is not a quick port of the PC version. It combines its dBASE compatibility with a strong list of features and a work environment with which Mac users will feel comfortable. FoxBASE+/Mac provides multiple window support on any Mac.

The program supports a picture data type (PICT), so you can cut and paste graphics into your applications. It also supports multiple typefaces, type sizes, and type styles in any combination you desire, so there's no limit on the aesthetics of your application. On a Mac II, FoxBASE+/Mac gives you color, and it will print reports in color on an Imagewriter II or an HP PaintJet.

You can build input forms for your application using all the Mac I/O tools you're used to: radio buttons, check boxes, pop-up menus, pull-down menus, and editable text fields. FoxBASE+/Mac also includes the standard dBASE I/O tools, such as input validation. Its method of setting up file relationships is similar to that of 4th Dimension and dBASE Mac. Novice database programmers will find it a cinch to use.

FoxBASE+/Mac lacks some of the features found in competing Macintosh relational databases, especially such features giant as 4th Dimension. For example, FoxBASE+/Mac doesn't have

continued

the built-in business graphics or fancy graphics forms editor of 4th Dimension, and it also lacks 4th Dimension's host language interface, so you can't write external functions or procedures in Pascal or C and use them with your FoxBASE application. Multiuser and run-time versions are also not yet available. The program also lacks a full-blown report generator, à la 4th Dimension. For a version 1.0 release, though, FoxBASE+/Mac is surprisingly complete and well done. It's also remarkably fast, as in, "You mean it's finished indexing all those records already?"

The one fly in the FoxBASE+/Mac ointment is the demo version. The application includes two serial number validation keys that you use to install it. One key installs the complete version, and the other key creates a crippled demo that holds only 120 records. Unfortunately, the demo is not up to the standards set by the real application, and it lacks many of its features. If I had tried only the demo, I would have returned it to my dealer for a refund: It bombed with a variety of spectacular memory errors on an 8-*megabyte* Mac II. It also simply hung when I tried some fancy record lookups.

HyperCard 1.2: CD-ROM Support, But Still No Exponential Notation

Apple's HyperCard 1.2 includes a slew of improvements over version 1.1. The most important are as follows:

- Support for read-only media, like the Apple CD SC CD-ROM drive
- Multiuser access to individual HyperCard stacks through an AppleShare file server
- Improved search and retrieval capabilities, with speed increases of 4 to 6 times that of version 1.1
- Hiding and showing card and background pictures using script commands
- Write protection for stacks
- New keyboard shortcuts that make script editing much easier

Despite all the improvements in version 1.2, Apple still needs to improve the programming (scripting) capabilities that HyperCard/HyperTalk provides. One important omission is the lack of exponential notation in HyperTalk scripts. Engineers and other developers simply must have exponential notation for their scripts.

HyperCard 1.2 was developed primarily to support Apple's CD-ROM drive (which can "play" both CD-ROM data disks and music CDs). I've tested that aspect of version 1.2 over the last week using a borrowed Apple CD-ROM drive and a CD-ROM Educational Connections disk I was given at an Apple show in March. This disk is a sampler of several large and impressive HyperCard stacks. HyperCard 1.2 worked flawlessly with them, as did the CD-ROM drive (about which I'll have more to say in a future column).

System Tools 6.0

Last month I reported on the beta version of System Tools 6.0. I found it buggy and difficult to install and use. I'm happy to report that most of the bugs I found have been fixed in the released version, even though installation problems remain.

When I installed System 6.0 on an 8-megabyte Mac II using the supplied install script, I immediately ran into difficulties. Things seemed to work fine when I switch-launched to the new Finder, but then the mouse froze.

When I rebooted the machine, all my INITs were successfully installed (or so I thought), but the machine froze again after the desktop was displayed. Rebooting again, the Mac didn't make it all the way through the start-up sequence, with the screen breaking up before the desktop was displayed. Additional rebooting resulted in the same screen breakup. After fiddling with this problem for 3 hours, using a separate start-up floppy disk, I finally traced the problem: I had some incompatible INITs in my system folder that just wouldn't work with System 6.0. The biggest offender was the SavesDeletes INIT from Central Point Software, which lets you recover files you've deleted by mistake. I also had trouble with SCSI Tools, MF Keys, and MenuClock 1.0 and 1.01.

To play it safe, I copied my fonts, INITs, CDEVs, and desk accessories (DAs) to other folders and deleted these and my updated System 6.0 from my hard disk system folder. I copied the virgin System 6.0 from the System Tools 6.0 package of four disks and then reinstalled all my system goodies, fonts, and DAs. After I had completed this extended process, everything worked fine. The moral of the story: If you've customized your system with lots of goodies, up-

continued

Items Discussed

Apple Macintosh System Tools 6.0 .... $49
Apple Computer, Inc.
20525 Mariani Ave.
Cupertino, CA 95014
(408) 996-1010
Inquiry 955.

FoxBASE+/Mac 1.0 .... $395
Fox Software, Inc.
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Perrysburg, OH 43551
(419) 874-0162
Inquiry 956.

4th Dimension 1.06 .... $695
ACIUS, Inc.
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Cupertino, CA 95014
(408) 252-4444
Inquiry 957.

FullWrite Professional 1.0 .... $395
Ashton-Tate Corp.
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Torrance, CA 90502
(213) 329-8000.
Inquiry 958.

HyperCard 1.2 .... $49
Apple Computer, Inc.
20525 Mariani Ave.
Cupertino, CA 95014
(408) 996-1010
Inquiry 959.

McMax Summer '87 version $295
Nantucket Corp.
12555 West Jefferson Blvd.
Suite 300
Los Angeles, CA 90066
(213) 390-7923
Inquiry 960.

MindWrite 1.1 .... $195
Access Technology, Inc.
200 G Heritage Harbor
Monterey, CA 93940
(800) 367-4334
Inquiry 961.

QT-Mac40 .... $1395
Tecmar, Inc.
6225 Cochran Rd.
Solon, OH 44139
(216) 349-0600
Inquiry 962.

date to 6.0 by installing a clean copy of it, installing your INITs, CDEVs, fonts, and DAs afterward.

Tecmar QT-Mac40

If you're like me, you preach to your colleagues on the importance of backing up their hard disks every day. This gospel is hard to accept, considering the slow and/or expensive backup alternatives for the Mac. I've been using a GCC Hyper-Tape DC-2000 tape drive for about a year, and I've found it reliable when I use the MacUp backup program available from APDA. But it's slow. It takes as much as an hour to back up a single day's worth of work.

So when I got an opportunity to work with a new DC-2000 tape drive that was supposed to be the fastest on the market, I jumped at the chance. In a month's worth of abuse, the Tecmar QT-Mac40 proved its mettle and its speed. It connects to the Mac's SCSI port and has worked reliably with the Mac Plus and Mac SE, as well as the Mac II. The QT-Mac40 transfers data at about 2.5 megabytes per minute. It backs up data faster than any DC-2000 drive I've tried, and I've tried them all.

You control the QT-Mac40 using the supplied backup/restore software, which is very good. Under MultiFinder, the Tecmar software lets you back up your data in the background while running any other foreground application. This is a handy feature that I haven't found with any other drive or backup software.

The Tecmar software supports file-by-file, incremental, and full-image backups, which pretty much covers the kinds of backups you might want to do. The Tecmar drive can mix file-by-file and image backups on the same tape—another feature many other drives lack.

In a month of testing, I haven't found anything to gripe about with the Tecmar QT-Mac40. It lists for $1395, although I've seen it discounted for as little as $999. At that price, I think I'll get two—one for my office Mac II and another for my home Mac II.

FullWrite Professional—Redux

Last month, I complained about the speed of FullWrite Professional on a 1-megabyte Mac Plus. With that hardware, the program is almost unusable. But now I'm using it exclusively on an 8-megabyte Mac II. The result is editing nirvana. On the fast, memory-rich Mac II, FullWrite moves along nicely. And all those features are really useful. I don't know how I got along without FullWrite's note and sidebar capabilities before.

The outliner is not as easy to use as MindWrite 1.1's, but it's far superior to Microsoft Word 3.02's. Add to that its document information tally (counts for characters, words, and lines, and a readability index), and you've got a great tool for writers. And that doesn't even touch on its built-in desktop publishing and graphics features. If I were Microsoft, I'd be worried. For my money, FullWrite Professional is everything that Word promised but has never delivered. As long as you have lots of RAM, that is. ■

Don Crabb is the director of laboratories and a senior lecturer for the computer science department and the college at the University of Chicago. He is also a consulting editor for BYTE. He can be reached on BIX as "decrabb."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

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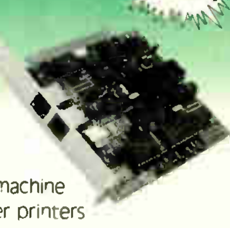

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Seagate ST251 42.8MB/Half-Height/11 watts pre-formatted into a pair of 21MB/28ms partitions

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286[10] Computer

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FH	Maxtor 2190	30ms	150MB	$1999

Orchid

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Circle 245 on Reader Service Card

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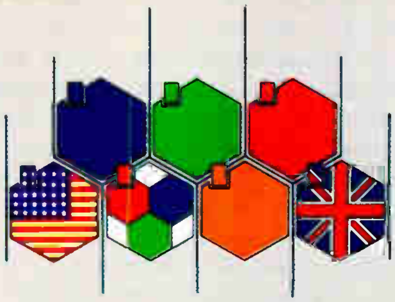

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ALL TOGETHER NOW

From LAN Manager to device monitors, OS/2's features let programs and peripherals live and work in harmony

Last month, I started looking at OS/2's new features. This month, I'll continue the discussion, but first I want to share some test results.

Recall that OS/2 offers virtual memory to applications. If an application requires more memory than the RAM available, OS/2 can use free disk space in place of RAM. I tested OS/2 1.0's virtual memory manager with the simple BASIC program shown in listing 1. This program allocates an integer array, fills it up, and then reports total execution time. Table 1 shows the test results for various array sizes. It shows the array size used (in number of elements and in K bytes), how long it took to allocate and fill the array, and then total time divided by bytes to yield a rough seconds-per-byte number.

Notice the large jump between 400 and 500 elements. Up to about 400, the array is kept entirely in memory, and the program requires about 0.02 second to process a byte. At 500 elements, virtual memory takes over. As the drive light was on continuously throughout the program's execution, it appears that *each* memory access becomes a disk access once virtual memory is activated.

Granted, virtual memory should be slower than RAM, but look at the difference: 0.02 second per byte versus roughly 13 seconds per byte. That's a factor of 650. At that speed, my 80386 is about 30 times slower than a Commodore 64.

Multitasking virtually (no pun intended) dies when this test program is running. Pressing Ctrl-Esc to get to the Session Manager yields a Session Manager screen after 10 minutes' wait.

In case you are wondering what kind of underlying hardware I used to test this, I do much of my work on a PS/386, a 16-MHz Compaq Deskpro clone made by Trillian Computer. It uses 4 megabytes of 32-bit static column RAM. The hard disk uses the standard Western Digital AT-type controller and a 26-millisecond Priam disk drive. I use the Compaq VGA board (which I highly recommend for speed and compatibility).

LAN Manager

A major difference between DOS and OS/2 is that OS/2 was designed with networking in mind. OS/2's LAN (local-area network) Manager is an add-on program that brings LAN capabilities to OS/2. LAN Manager brings many new features to Microsoft's networking software. In the process of writing LAN Manager, Microsoft also rewrote its DOS-based LAN software, MS-Networks.

LAN Manager and the accompanying rewrite of MS-Networks include many new Novell- and Banyan-type LAN operating-system features. Security locks are now user- and file-specific. The system can nag users to change their passwords periodically, as the LAN Manager keeps password age information. Attempts at unauthorized access can be logged.

OS/2 allows more comprehensive resource sharing. One OS/2 workstation can run a program entirely on another computer. The workstation just sees the output screens and supplies keystrokes. Other than that, the workstation essentially becomes a dumb terminal. This is intended so that programs like database servers can be constructed. Consider, for example, a SORT command under dBASE on a LAN. With dBASE known for its glacial sorting speed, and sorts being disk-intensive to begin with, add LAN overhead and the whole thing's out of the question. Remote execution would let dBASE move itself to the server temporarily, just long enough to accomplish the sort.

Imagine other possibilities: One machine with expensive dedicated graphics hardware that computes screens for five CAD stations. Groupware that moves parts of a user's programs to and fro among workstations to provide load leveling. Or, for the nostalgic, one 80386 doing the processing for 15 users with 80286-based dumb terminals. (That sounds silly, but I've heard of a company trying to make OS/2 multiuser through this avenue. Some clients have even told me that IBM has told them, sub rosa, that a multiuser OS/2 is in the works.)

There are many other neat features, and I'll talk about them in a future column. In a few words, the OS/2 LAN Manager is a "fixed" version of MS-Networks, and a welcome one.

Program Harmony

Under OS/2, programs don't step all over each other. SideKick doesn't mess up a Windows screen. One program's manipulation of the keyboard Num Lock/Scroll Lock/Caps Lock status byte doesn't lead to "surprise" uppercase when the next program runs. This makes OS/2's job of multitasking easier.

The reason DOS isn't multitasking has nothing to do with the 80286 or 80386. The main reason that DOS isn't multitasking is that it isn't an operating system (gasp). It's a program loader, a launching pad that starts applications going and then says, "Wake me up when you're finished." DOS is completely inactive when a program is running. The program is supposed to call DOS to do something like print a character or read a file, but many programs are designed to handle such system functions themselves and bypass DOS altogether.

DOS bypass is mainly due to DOS's slowness and incompleteness—for example, DOS doesn't support video graphics

continued

commands. (Unfortunately, neither does OS/2, unless you use the Presentation Manager.) If every program communicated with peripherals via DOS, most programs would have to wake DOS fairly regularly. Every screen write, keyboard read, and disk access would activate it. DOS could then take that opportunity to switch programs, and voilà: multitasking. Microsoft Windows accomplishes limited multitasking in this way.

Using system requests to control task switching won't work if one of the programs doesn't need to make system requests (i.e., doesn't do any I/O). Consider a spreadsheet recalculation or a word processor repagination. Such a CPU-intensive program could grab the system and hold it. Solving the CPU-intensive problem is easy, though: Just add a hardware timer (already built into the IBM PC machines) to force an interrupt and allow the operating system to force a switch to another program.

Programs *don't* always use DOS system requests, however, so the job of switching DOS programs, each convinced that it owns the machine, is almost impossible. OS/2, built to run in the 80286 chip's protected mode, can enforce the rules. It can control I/O ports, memory areas, and access to system services. The silicon itself disallows any attempts to bypass the operating system. (Some readers may know that the 80386 chip contains a virtual 8086 mode that allows DOS multitasking. This is not exploited in OS/2 because OS/2 is designed for 80286 as well as 80386 machines.)

Once all programs are forced to interact with the system through OS/2, multitasking and more become possible. OS/2 creates separate virtual machines called *screen groups*. Each machine has an entire environment: current subdirectories, screen modes, and even keyboard status. One screen group can remember that the keyboard is in uppercase mode, while another remembers that it is not.

Legalizing TSRs

We all love TSRs (terminate-and-stay-resident programs). They're handy. They extend PC capabilities. At the same time, we hate them because they gobble memory, they can't be easily removed from memory once loaded, and they don't get along well with other TSRs.

SideKick is a prime example of what we love and hate about TSRs. It insists on being the last TSR loaded. Every timer tick (18.2 times per second), SideKick checks to ensure that it is the last one loaded. If it finds another TSR after it, it tries to muscle it aside. This often means that the keyboard no longer responds and the system crashes. SideKick tries to deal with the memory problem by removing itself from memory on request, but it doesn't always work, especially if SideKick isn't the last TSR loaded or if you're not at the DOS prompt.

What does OS/2 offer? OS/2 has a means to make TSRs legitimate. It's called a *device monitor*. It's like a TSR, and it can act as a filter on a keyboard. Device monitors improve on TSRs, however, in that they can request that OS/2 ensure that they are essentially the last (or first) device monitor loaded. OS/2 rejects an attempt to load two device monitors that insist on being first or last.

Also, device monitors can be unloaded from memory. A nice example of device monitors appeared in Ray Duncan's "TSRs Past and Future: MS-DOS and OS/2" in BYTE's *Inside the IBM PCs*, Fall 1987.

Listing 1: *This simple program allocates an integer array, fills it up, and then reports total execution time. See table 1 for a comparison of results using different-size arrays running under OS/2.*

```
rem examines virtual memory.  Needs /ah compiler switch
defint a-z
rem $DYNAMIC
input "array dimension";ad
c$=time$
dim a(ad,ad)
for i = 1 to ad
  for j = 1 to ad
    a(i,j) = 100
  next
next
b$=time$
print "start:";c$;" end:";b$
```

Table 1: *Results of the program in listing 1 running under OS/2 and using different-size arrays.*

Array size (no. of elements)	Array size (K bytes)	Execution time (seconds)	Time to process each byte
100	20	0	0.00
200	80	1	0.01
300	180	4	0.02
400	320	7	0.02
500	500	5487	10.97
600	720	10467	14.54

A Platform for Peripherals

Recently, I bought a new printer, a Hewlett-Packard LaserJet II. The excitement faded a bit when I realized that I would have to reinstall several dozen programs, informing them all of the new printer type. OS/2 reduces this pain. A certain measure of device independence is afforded by version 1.0. A greater amount is provided by the Presentation Manager under 1.1. (The main difference between 1.0 and 1.1 is the graphical Presentation Manager.)

Microsoft Windows gives a preview of this device independence. The Windows installation program asks what kind of printers will be used. Drivers for the printers that you specify load in the Windows subdirectory. Then, at any point in the future, you can select a new printer in a few seconds via the Control Panel. From that point on, any Windows applications will talk to the new printer; you need not inform each application of the new printer. In this way, Windows is device-independent. The Presentation Manager—which is essentially Windows for OS/2—offers the same kind of device independence.

Of course, OS/2, like all operating systems, seeks to let programs built on one machine (e.g., an IBM AT) run on another machine (e.g., a Zenith Z-386). OS/2 1.0, without the Presentation Manager, acts like DOS: Applications will require special installation programs.

Open System Interfaces

DOS has a number of useful programming features that Microsoft uses in its programs but won't own up to. This, understandably, makes software vendors jittery, as Microsoft not only writes the platform that their wares run on but often writes the programs that are those vendors' main competition.

Microsoft claims that OS/2 puts an end to undocumented system interfaces. All the hooks that a system programmer would need (well, most of them) are available to developers with the Application Programmer Interface (API). Microsoft technical support claims that there are enough APIs to allow anyone to write his or her own Session Manager. Things that are difficult under DOS, like TSRs or interprogram communication (to name but a few), are directly supported with an OS/2 API call.

OS/2 will be a welcome step up for many DOS programmers, but it will require some getting used to. OS/2 programmers will have to think in an entirely new fashion when structuring code. For example, a word processor is composed of two programs—a text editor and a text formatter. An OS/2 word processor could be structured as a foreground program (the text editor) and a background program (the text formatter). A spreadsheet could be designed as a data-entry process running concurrently with a recalculating process.

OS/2 Tip of the Month

If you're going to use a mouse, you need two device drivers—one for the whole idea of pointing, another for the specific mouse. If you're going to use the Presentation Manager, you need yet another mouse driver for it.

The drivers must be installed in a particular order, or they won't work—first the pointer, then the specific mouse driver, then the Presentation Manager driver. For example, with a serial mouse (the MOUSEA02 driver):

```
device=pointdd.sys
device=mousea02.sys
device=pmdd.sys
```

If you have a serial port, add its driver after all the above ports. Its driver name is COM01.SYS for non-PS/2 machines and COM02.SYS for PS/2s. ■

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Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

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COM1: Brock N. Meeks

Computer Conferencing Homecoming

Although still in its infancy, computer conferencing is locked into a niche market

Information is the life blood of videotex, a catch-all technology that the Videotex Industry Association defines as "easy-to-use interactive electronic services." Admittedly, that covers a lot of ground: from audiotex, which is prerecorded information delivered across the telephone line, to computer conferencing, where information is stored and shared among a geographically distributed group of people.

Historically, computer conferencing is a descendant of electronic messaging networks—like the government's Advanced Research Projects Agency Network (ARPAnet), which began simply as a huge electronic mail (E-mail) network. The first true computer conferencing system came about as a result of President Nixon's wage/price freeze controls in 1970. Known as EMISARI, it was a computer conferencing system designed to handle the time-sensitive information needed by government officials trying to manage the revolutionary executive order.

EMISARI's success proved to be both a blessing and a curse: a time-saving blessing for harried government officials, and a curse for computer conferencing systems, which forever after were set up as applications to solve highly specialized needs, instead of becoming general-purpose tools.

Today, 18 years later, computer conferencing is still in its infancy. In advertising jargon, the technology is locked into a "niche market."

My Niche or Yours?

The number of people using computer conferencing systems has grown steadily over the past 5 years, according to the Stanford Research Institute (SRI) study I mentioned in last month's column. Despite this growth, however, the report's author, Tom Mandel, a senior technology analyst at SRI, says "Interest in and use of (public) computer conferencing has been restricted to a relatively small fraction of the consumer population."

That small fraction actually consists of only 12 percent to 15 percent of all home PC owners. Why? Primarily because of conferencing's niche status. Like special-interest magazines—*Car & Driver*, *Soldier of Fortune*, *Fangora*, and so on—computer conferencing caters to highly focused groups.

The need for specialized information is what keeps niche magazines in business. If one magazine could satisfy an entire community of interest, then we wouldn't need publications like *Golf Digest*; everyone would be happy with *Sports Illustrated*.

So, just as there is no one magazine that covers all the needs of the sporting community, likewise, there is no single computer conferencing system that satisfies the entire computer industry.

Even large on-line services, such as BIX, are only convenient clearinghouses for hundreds of electronic niche markets. On BIX, each conference is a kind of special-interest group, a narrowly defined niche.

Given the competition for our information dollar, not to mention our time, there doesn't seem to be much of a chance that computer conferencing will break out of its niche status any time soon. Even with the introduction of highly touted all-in-one information systems, like Prodigy and U.S. Videotel, computer conferencing systems will continue to be a niche market well into the 1990's.

SRI's Mandel sees computer conferencing growth into the next decade coming from two distinct areas:

- *The spread of computer literacy.* Because the use of technologies like E-mail across local- and wide-area networks is becoming more and more a part of corporate America's daily routine, people will be less resistant to computer conferencing technology. Just as the typewriter migrated from office to home, so too will electronic messaging technologies. From E-mail, it's a short step to computer conferencing.
- *Simpler systems.* Fierce competition will push developers to design mass-market-appeal videotex systems. This will be accomplished, in part, through low-cost access and turnkey software. Most services offer free trial subscriptions. Such a strategy figures to attract lots of new users because of the negligible monetary involvement. The only risk is that of a little time.

The niche market, however, is only partially responsible for the sluggish acceptance of computer conferencing. Another factor is the technology's potential: There's too much of it.

Too Much of a Good Thing

Federal Judge Harold Greene, who presided over the breakup of the Bell Telephone monopoly and continues to guide the level of participation by the "baby Bells" into videotex services, wrote in a March court opinion: "If consumer-oriented videotex services were made available on a large scale, the economic and social welfare of the American people could be substantially advanced. It is difficult to overestimate the significance of this potential."

While computer conferencing's potential is certainly tempting, those seduced by it have grossly oversold its potential. For example, take the following comment found on the Whole Earth 'Lectronic Link (WELL), a conferencing system based in Sausalito, California:

"There are several hundred ways [computer conferencing can be used as a]

continued

new political technology. We can use it to end war, starvation, homelessness, confiscatory taxation, and so on.

"With the technology that you are using even as we speak, we the people can make this primordial dream a reality . . . and use this technology for good instead of evil. All of you now reading these words have been granted with the power to spread this good use of technology all around the world."

This type of rhetoric is typical of the "techno-hedonist," a term coined by Peter Grunwald, a Washington, DC-based communications consultant for organizations seeking to incorporate new technologies, such as computer conferencing, into their day-to-day routines. Grunwald defines a techno-hedonist as "a person who thinks a technology, like computer conferencing, can solve all the world's problems and walk the dog—all in the same day. A techno-hedonist makes unreasonable claims about the potential of the technology. And when the technology fails to live up to the hype, it sours anyone involved—for good—on the future use of the technology."

Grunwald points out that claims about the potential of computer conferencing, like the ones made in the above comment from the WELL, are unfortunate because "there's a good amount of truth in there, but it gets lost in the hyperbole of a techno-hedonist's evangelistic rantings." (I should note that when the above comment was first entered, it was met with incredulity and reproach by the majority of WELL users.)

The "good amount of truth" that Grunwald refers to as a potential for computer conferencing hardly encompasses ending world hunger or the homeless problem. However, it is capable of creating what he calls "legitimate communities of interest." Such communities encompass both the private sector (e.g., corporations and organizations) and the public sector (e.g., CompuServe and BIX).

"It's up to each community of interest to define how computer conferencing fits into their daily routine," says Grunwald. "Computer conferencing doesn't solve problems. However, it can help facilitate the process used to reach a solution. A hammer can't build a house, but used in combination with all the other appropriate tools, it works just fine."

Although computer conferencing won't solve the homeless problem, it's quite possible to gather several leading sociologists into a single computer conference where they could discuss the issues, such as homelessness, without the pressures of academia that are usually associated with their discipline. This is the kind of application that Grunwald sees as a correct use of the medium. He outlines four major advantages of computer conferencing:

- *Auto-documentation*. When a comment is entered into an electronic discussion, an automatic record exists, unlike comments tossed around a boardroom. This virtually eliminates the "but I thought you said" syndrome.
- *Time savings*. Conferences can be carried on with participants across the hall or across the world. Participants contribute within the confines of their personal schedules.

Grunwald points out that computer conferencing isn't intended to replace face-to-face discussions; rather, it eliminates many of the intermediary meetings that take place to simply disseminate information.

- *Multiple tasks*. In a computer conference, you can handle several different dialogues at one sitting and respond to each in like manner. This is impossible when talking in person.
- *Better communication*. People who might never speak up in a heated face-to-face discussion can sit back and, with the freedom of time, contribute just as much to the discussion as a more gregarious personality.

Balancing these advantages are negatives, such as the following:

- *Lack of nonverbal communication*. A nod of the head, stiff body posture, and fingers tapping on the table are all clues we send out during a discussion, and they are missing from on-line conferences. Given the absence of these clues, it's much harder to read the intent (and acceptance) of the message.
- *Lack of verbal clues*. Sighs, a rising voice, shouting, and voice inflection are all difficult to convey on-line.
- *Humor*. An offhand joke, casually tossed across the ether, often suffers something in the translation from the spoken word to ASCII. Humor must be carefully distributed and often annotated with some equivalent of the phrase "Just kidding."
- *Flame now/apologize later*. An on-line syndrome known as "flaming" occurs when users think they can yell on-line without incurring the immediate negative feedback from a group of people. This usually leads to an on-line apology later. It's a cyclical syndrome, and one that never goes away.

The Human Factor

The common thread woven through both the advantages and disadvantages of computer conferencing is the human factor. The critical link, and perhaps the most fragile, is you, the personality be-

continued

hind the message. It is a factor too often overlooked.

The act of putting your thoughts online, in a semipermanent environment, might seem disconcerting. Indeed, a state senator I interviewed once told me that, although he sees great potential in computer conferencing, he would never use it himself. Why? "My every word and thought would be a matter of *printed* public record," he said, "and I'm not sure I'm willing to take that much risk."

To help along the human factor, Walter Orr Roberts, the founder of the National Center for Atmospheric Research and an unselfish pioneer in helping to establish computer conferencing links with the Soviet Union's scientific community, has developed several protocols for participants in his computer conferences. Among the most important of these are the following:

- Encourage people to practice using the system. The old adage "Practice makes perfect" is certainly applicable in the computer conferencing world.
- Develop a buddy system. This gives newcomers someone to go to when they have questions or need some moral support.
- Overcome the fear of typing. Typing speed is of little importance, yet lack of typing skills keeps people from contributing.
- Eliminate grammatical and typographical issues. Spelling and sentence structure are of only secondary concern; ideas and participation from all involved are the important factors.

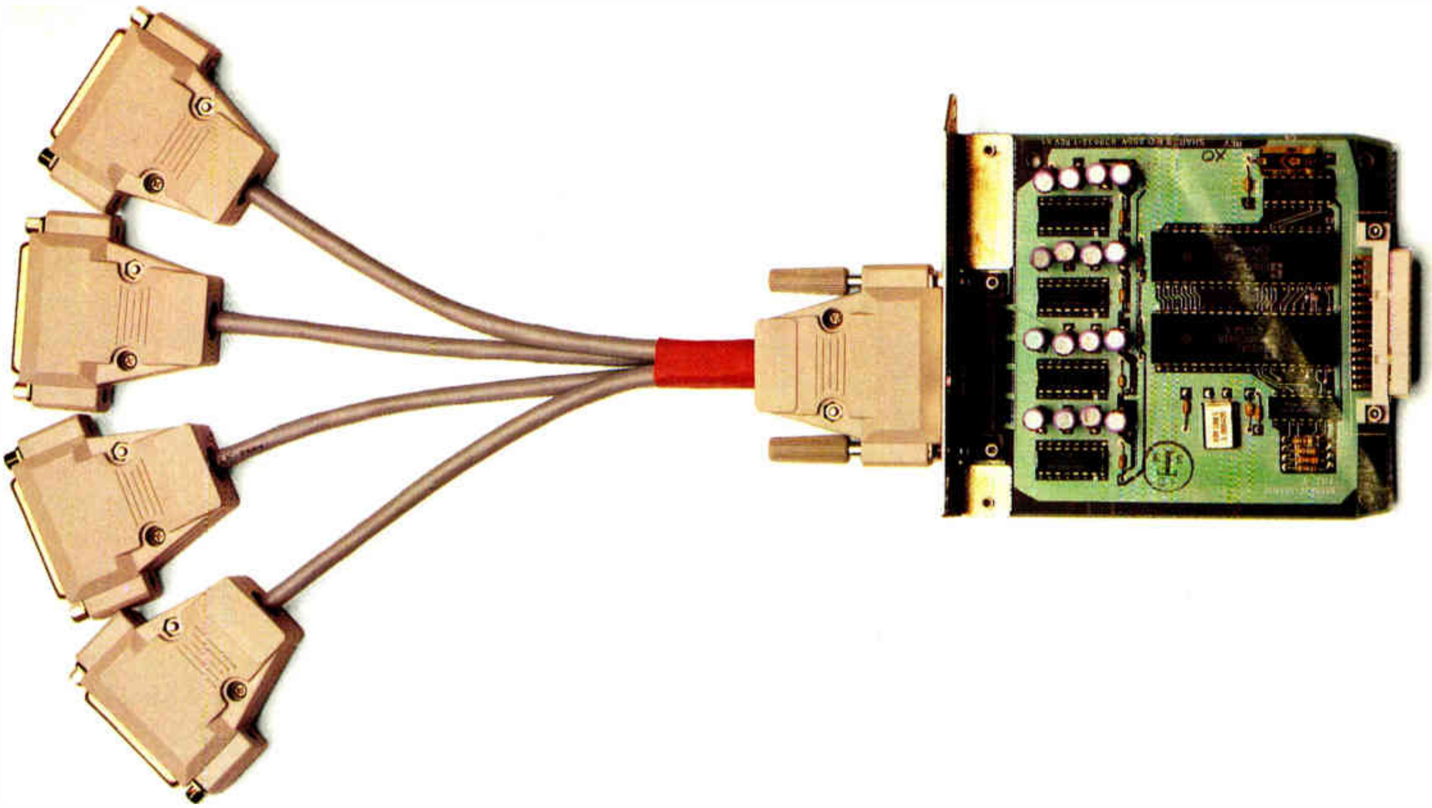
Next Up

Next month I'll look at Prodigy, one of the new videotex systems that have spared no expense to address the critical human factor. Such systems are out to appeal to the common denominator of success: you, the user.

From celebrity endorsements to free subscriptions, these systems are serious about bringing videotex (including computer conferencing) into your household. And perhaps, more important, the households of your neighbors. After 18 years, I think it's a homecoming long overdue. ■

Brock N. Meeks is a San Diego-based freelance writer who specializes in high technology. You can reach him on BIX as "brock."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.



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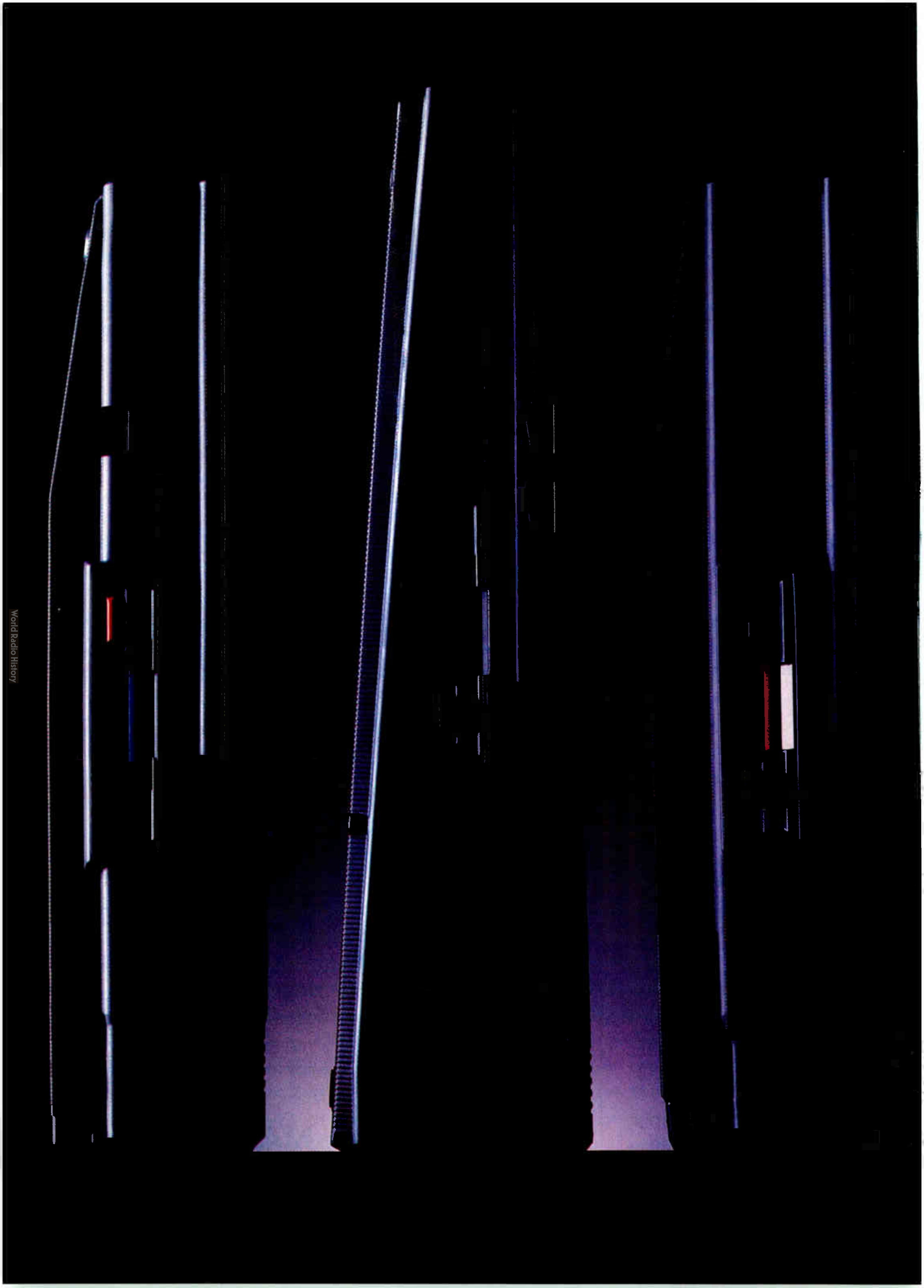

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IBM and Tandy:

IBM's Model 70-A21 supplies 25-MHz performance in a Model 50 housing. Tandy's 5000 MC provides IBM Micro Channel-compatible slots. Both offer a unique design for future growth.

If you have any doubt that 32-bit microprocessors have answered a real need in desktop microcomputing power, take a look at the trend: The first 80386-based microcomputers, introduced in 1986, ran at a clock speed of 16 MHz. Nearly a year later, such systems were operating at 20 MHz, and caching hardware, used to maximize the throughput of these faster processors, became common. This year, various computer manufacturers raised the ante for top-of-the-line performance to 25 MHz (see "25-MHz Computing Buzzsaws" by Rick Grehan, August).

But unless your budget has grown along with your processing needs, you've got a problem. If you already own a 16-MHz 80386-based system, you must sell it before you can hope to afford a higher-performance 20- or 25-MHz system. Worse yet, if your processing needs have grown so rapidly that they require a faster system already, where will they and the computer industry be in a year? Will you have to sell the faster system you're trying to obtain now for next year's model?

IBM and Tandy offer a unique solution to the problem of ballooning processing needs that outstrip the power of today's systems. In a remarkable coincidence of design, both companies' latest systems—IBM's PS/2 Model 70-A21 and Tandy's 5000 MC—feature a removable "processor card." Simply put, the computer's CPU components are mounted on a plug-in board. Although neither company would talk about future plans, both admitted that the intent of this design is to enhance the performance of these systems at a later date by swapping the processor card.

The Tandy 5000 MC provides another significant feature: It's the first microcomputer that offers a bus whose signals and timing are 100 percent compatible with IBM's PS/2 Micro Channel bus.

IBM's PS/2 Model 70-A21

When IBM announced its line of PS/2 systems last year, it was obvious that the series had at least one gaping hole: In the progression from a desktop 80286-based Model 50 to a floor-bound 80386-based Model 80, there was something missing: a desktop 80386-based system. This June, IBM lived up to everyone's expectations and plugged the hole with the PS/2 Model 70.

On the outside, the Model 70 looks exactly like its desktop cousin, the Model 50, with the same small footprint and

Same Channel, Same Plan for Growth

light weight. Inside the machine, the resemblance to the Model 50 ends. The Model 70 uses an 80386 CPU (versus the 80286 for the Model 50) and a larger hard disk drive (your choice of a 60-megabyte drive with a 27-millisecond access time or a 120-megabyte drive with a 23-ms access time, versus the Model 50's 20-megabyte drive). The Model 70 has three Micro Channel slots: two 32-bit slots and one 16-bit slot. The Model 50 has four 16-bit slots, one of which is occupied by a hard disk controller card. The Model 70 gets away with three slots since the disk controller is integrated with the disk drive. This version of the Model 70 comes with 1 megabyte of RAM that's expandable to 6 megabytes on-board, and, using Micro Channel memory boards, you can add RAM to a maximum of 16 megabytes. At the June announcement, you could get the PS/2 Model 70 with either 16-MHz components (the Model 70-E61, with a type-1 system board) or 20-MHz components (the Model 70-121, with a type-2 system board).

In September, the high-end version of the Model 70 became available: The Model 70-A21 features 25-MHz components (an 80386 CPU and an optional 80387 numeric data processor [NDP]) and a 64K-byte RAM cache based on the Intel 82385 cache controller chip. The 120-megabyte hard disk drive is standard. The system board comes with 2 megabytes of on-board 80-nanosecond RAM and is expandable to 8 megabytes. Micro Channel memory cards still allow you to expand RAM to the 16-megabyte maximum. The most significant difference between the Model 70-A21 and the other Model 70 machines is its type-3 system board, which has an additional connector for on-board RAM (providing the 8 megabytes of on-board RAM versus the 6 megabytes of the other Model 70 systems) and the processor card.

With all this going for it, the Model 70-A21 ought to be the fastest of the PS/2 line of machines and possibly one of the fastest on the market. To verify this, we obtained an early preproduction unit of the Model 70-A21 and set it up for a complete round of tests in our BYTE Lab. It came equipped with 16 megabytes of RAM, an 80387 math coprocessor, and PC-DOS 3.30 installed on the hard disk.

Sure enough, with the exception of the color of the power switch (it's now white instead of red) and the marking on the nameplate, you would think the machine was a Model 50. As with the Model 50, you can easily remove the Model 70-A21's cover by loosening two easy-to-access thumbscrews at the rear of the machine. A quick glance through the support bracket (which holds the disk drives) reveals the 32-bit nature of the beast: an 80386 CPU.

IBM has done considerable chip integration, distilling most of the components that make up a Model 80 system board to fit a Model 50 system board and adding a caching system at the same time. Nevertheless, it seems to have been a tight fit: Several chips have been placed on tiny daughterboards that rise up vertically from the system board.

The PS/2 system design makes it easy to disassemble the computer to replace or get a good look at a particular compo-

continued

nent. It took only moments to unplug the disk drives, pop up seven snaps, and remove the support bracket to expose the system board and processor card (see photo 1). Located near the processor card are four memory modules that closely resemble single in-line memory modules (SIMMs). Each memory module clips into a socket on the system board and is packed with chips on both sides. For the Model 70-A21, each module contains 2 megabytes of 80-ns parity-checked RAM. The preproduction system came stuffed with the maximum 8 megabytes, but it will ship with just one module, or 2 megabytes, of RAM. You can buy additional 2-megabyte memory modules for $1495, a reasonable price considering today's memory market. The additional 8 megabytes of RAM on the preproduction unit were provided by a 32-bit Micro Channel memory card.

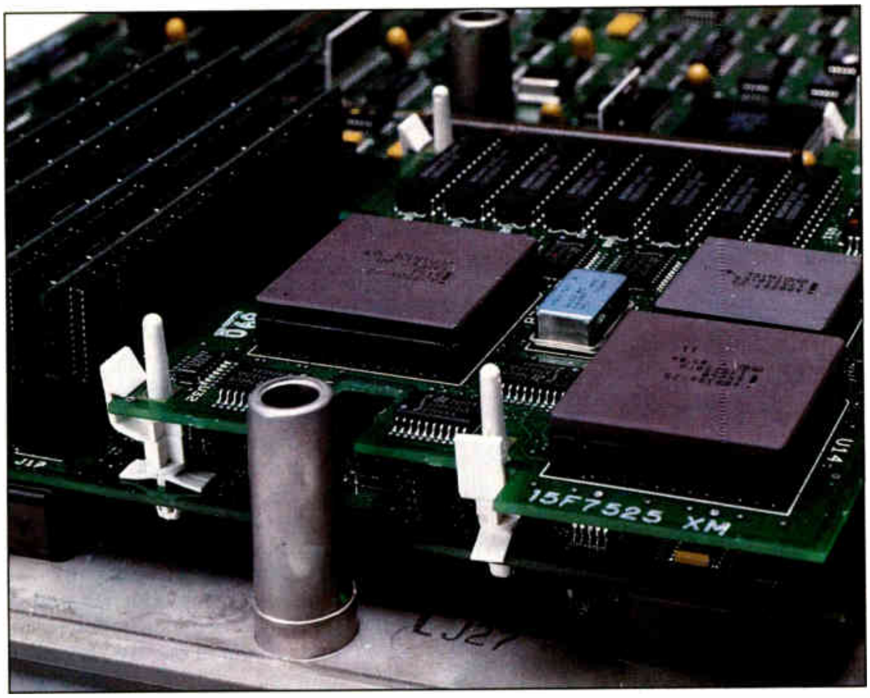

Photo 1: *The inside of the IBM Model 70-A21. At the front, mounted on four white brackets, is the removable processor card. The 80386 CPU, 80387 NDP (if present), 82385 cache controller chip, and 64K bytes of cache RAM are located on this card. Immediately to the left of the processor card is 8 megabytes of SIMM-mounted system-board RAM.*

Table 1: *The performance of a preproduction IBM Model 70-A21 compared with other 25-MHz 80386-based microcomputers. While not as fast as the Everex system, the Model 70-A21 was faster than the Compaq Deskpro 386/25 in certain tests.*

CPU	IBM PC AT	Everex Step 386/25	Compaq Deskpro 386/25	IBM Model 70-A21
Matrix	11.69	2.44	2.47	2.49
String Move				
Byte-wide	80.41	16.02	25.01	18.92
Word-wide:				
Odd-bnd.	80.41	20.01	25.65	23.69
Even-bnd.	40.26	8.02	12.51	9.47
Sieve	73.65	15.25	15.25	15.24
Sort	84.39	11.44	11.45	11.48

Note: Version 1.1 Small-C benchmarks used. All times are in seconds.

Four clips hold the processor card, which contains the 80386, an 80387 socket, an 82385 cache controller, and 64K bytes of 30-ns cache RAM. The 82385 implements a write-through cache (i.e., as the processor writes to RAM, the cache controller writes to both its cache and system memory to keep the two identical), and IBM used some special hardware to double the cache size from 32K to 64K bytes.

To remove the processor card, you simply unfasten the clips and gently unplug the card from its socket on the system board. One nice thing about this arrangement is that it makes the elevated 80387 socket easier to reach. You open the Model 70's hood, remove a disk drive from the support bracket, and plug the 80387 into its socket. IBM says that a 25-MHz math processor should be available by the time the Model 70-A21 ships. But be prepared for the hefty price: $2395.

When we turned the system on, it was quite impressive to watch the memory-check display ripple through all 16 megabytes of memory. Naturally, under DOS 3.30, the system saw only 640K bytes of RAM, and the hard disk was divided into four 32-megabyte partitions. We didn't run any software compatibility tests; after all, this is the machine that sets the standard by which all software and hardware compatibility is measured. We did open the hood and try an assortment of Micro Channel cards in the slots: a Ven-Tel 24/2 2400-bit-per-second modem card, a USRobotics Courier 2400/PS 2400-bps modem card, and an IBM high-resolution 8514/A display card. When the system was turned on, the Programmable Option Select (POS) software on the reference floppy disk drive detected the new cards in the slots and went through its configuration sequence to integrate the cards into the system. This process went smoothly, and the cards worked reliably, as expected.

Handy tip: Copy the .ADF option files from the floppy disk supplied with a expansion card to your reference floppy disk before adding it to the system. This way, you'll only have to go through the configuration sequence once. Otherwise, you can only configure the cards that have option files on the reference floppy, reboot, copy the option files from each card's floppy to the reference floppy, reboot, and finally configure the remaining cards into the system. While POS is supposed to eliminate fiddling with jumpers to set a card's address space or interrupts, it can in some circumstances make getting the system started a major headache.

Of course, the most important feature of the Model 70's class is its performance. We ran version 1.1 of the BYTE Small-C benchmarks on the Model 70-A21 to measure this capability. Since we were working with a preproduction model, we used only the CPU benchmarks. The results shown in table 1 indicate that the Model 70-A21 is indeed the fastest of the IBM line. Compared to the rest of the market, the Model 70-A21 wasn't the fastest 25-MHz system, and, in some instances, it was slower than certain 20-MHz systems, including those from Advanced Logic Research, Compaq, and Dell.

Tandy's 5000 MC

Like a brash Texas oilman at a New York society ball, Tandy chairman John Roach surprised everyone last year by announcing that Tandy could easily overcome any technical or legal obstacles to cloning IBM's new Micro Channel architecture (MCA). This year, with the introduction of its high-end performer, the Tandy 5000 MC, the company put its money on the line.

Why duplicate the IBM Micro Channel? Tandy gave the same reasons IBM did when it first introduced the bus: It has a higher bandwidth and can support multiple processors. Of course, most of the Micro Channel's potential has yet to be realized, but that should change as multitasking operating systems such as OS/2 begin to dominate the market. At any rate, Tandy is betting—like IBM—that at some point having this bus architecture in its machines will prove to be worthwhile.

Even on its specifications alone, the new Tandy system is quite a tempting machine. The system features a 20-MHz 80386 processor with a 32K-byte cache, a 1.44-megabyte 3½-inch floppy disk drive, VGA-compatible graphics, and five IBM MCA-compatible slots. It is, of course, the first IBM MCA-compatible system to become available on the market, and it is also the least expensive system of its type at a base price of $4999. And for a brief time—until the IBM Model 70-A21 became available—it was also the fastest IBM MCA-compatible system on the market.

The Tandy 5000 MC comes in an enclosure that's slightly larger than an IBM PS/2 Model 50. But, unlike the Model 50, it has room for four user-accessible storage devices, including two half-height 5¼-inch-style devices. This allows you to add a 5¼-inch floppy disk drive and tape cartridge unit, as well as 3½-inch floppy and hard disk drives. You switch on the computer's power by pressing a green button on the front panel of the machine. A small hardware reset button, located on the left side of the front panel, makes recovery from particularly nasty system crashes (the type that won't respond to the Ctrl-Alt-Del key combination) painless. Why this handy feature has never appeared on many other systems is a mystery to us.

Of course, the most interesting part of the 5000 MC lies within the system cover. You'll need a Phillips-head screwdriver to remove the three screws that fasten the cover to the backplane; we miss the handy thumbscrews on the IBM PS/2 systems. Inside, you'll find a wide variety of slots (photo 2): a "CPU slot" for the processor card, five IBM Micro Channel-compatible slots (two 32-bit

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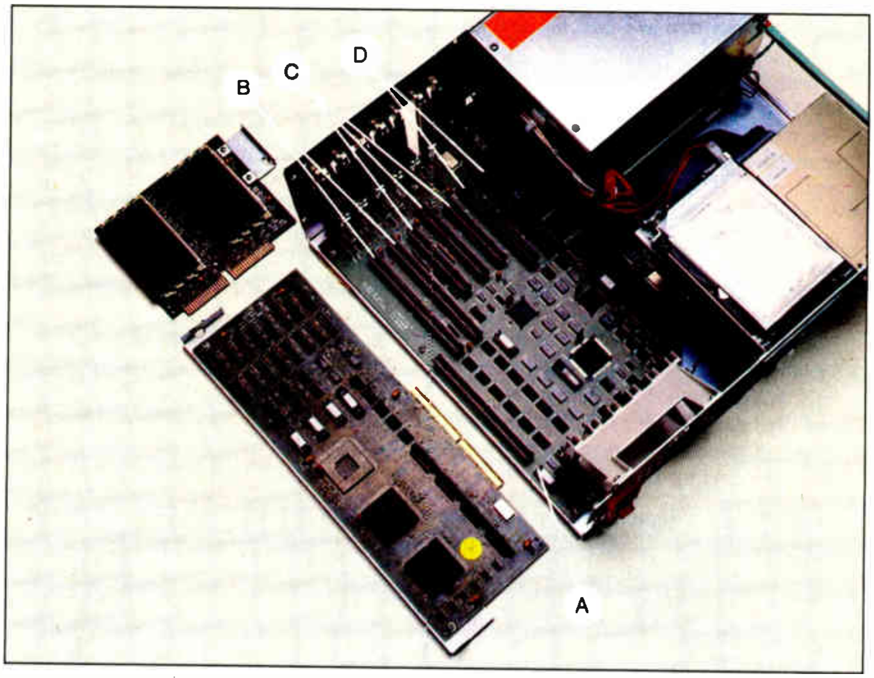

Photo 2: *The inside of the Tandy 5000 MC. Upper left: a Tandy system memory board. The board holds 2 or 8 megabytes of RAM, depending on the density of the RAM SIMMs mounted on the board. Center: The processor card, with 80386 CPU, 82385 cache controller chip, math coprocessor socket, and 32K bytes of cache RAM. Right: the 5000 MC chassis and system board:* **(a)** *the "CPU slot" for the processor card;* **(b)** *32-bit IBM MCA-compatible slots;* **(c)** *16-bit IBM MCA-compatible slots; and* **(d)** *32-bit system memory slots.*

Table 2: *The performance of a preproduction Tandy 5000 MC compared with other 20-MHz 80386-based microcomputers. The 5000 MC was the fastest 20-MHz system we've looked at.*

CPU	IBM PC AT	IBM PS/2 Model 80-111	Compaq Deskpro 386/20	Tandy 5000 MC
Matrix	11.69	4.75	3.06	3.04
String Move				
Byte-wide	80.41	39.51	26.11	23.65
Word-wide:				
Odd-bnd.	80.41	39.09	31.01	29.62
Even-bnd.	40.26	19.66	13.07	11.85
Sieve	73.65	29.11	23.18	19.10
Sort	84.39	33.11	26.89	14.36

Note: Version 1.1 Small-C benchmarks used. All times are in seconds.

Tandy's 1000 Learns to Speak and Listen

"Meet George Jetson. . . ." Thus spake the newest Tandy systems. Or rather, thus sang the systems. A few weeks ago, Tandy introduced two new versions of its popular Tandy 1000 line. In addition to a number of other features, the new systems feature analog/digital circuitry that allows them to digitize and replay sounds and music. As in the above case of the theme song from the TV show "The Jetsons," it can even play back music digitized on other hardware—on a Macintosh, for example.

Both systems are replacements for previous low-end systems from Tandy. The new Tandy 1000 SL replaces the 2-year-old 1000 SX, and the new 1000 TL replaces the Tandy 1000 TX. The sound capability is clearly the most notable feature that the new systems share, but there are a number of other interesting features as well.

Like Tandy's entry-level 1000 HX, the new systems have a ROM drive that includes DOS. But while the HX has only 128K bytes of ROM, the new SL and TL each have 512K bytes. The ROM is used to store a number of things, including DOS 3.3, a new version of Tandy's DeskMate integrated software, and even a spelling dictionary. The advantage of having DOS on a ROM chip is that you can immediately boot up the system without worrying about finding a system disk and the time it takes to load the system from the disk.

Both systems also have better video interfaces. Like the Leading Edge Model D, the Tandy systems now support Hercules-style graphics when connected to a low-cost monochrome monitor. And if you attach a CGA color monitor, the systems will display a resolution of 640 by 200 pixels by 16 colors.

A number of lesser details include an AT-compatible 101-key keyboard. On the back panel, Tandy has finally included a serial port as standard equipment. Inside, each system has five PC-style expansion slots, but each slot follows in the Tandy 1000 tradition of being only 10 inches long.

As for software, Tandy has included with the system a new version of DeskMate. This version has a number of new capabilities and is more compatible with DeskMate application software developed by outside companies. In fact, for low-cost systems, the DeskMate operating environment will almost undoubtedly be a very popular alternative to Microsoft Windows in the low-cost 8088/8086 market.

There are some differences between the systems. The $899 SL features an 8-MHz 8086 and a 360K-byte 5¼-inch floppy disk drive, and it has only 384K bytes of memory, expandable to 640K bytes. In contrast, the $1299 TL features an 8-MHz 80286, a 720K-byte 3½-inch floppy disk drive, a real-time clock, and 640K bytes of memory, expandable to 768K bytes.

But clearly the most interesting feature of the new systems is their sound capability. Both the SL and TL have an 8-bit A/D converter (ADC) as well as an 8-bit D/A convertor (DAC). The converters are capable of sampling at rates of 5, 500, 11,000, and 22,000 samples per second, and they have direct memory access capabilities for transferring sound data quickly back and forth to disk. For sound input, both systems have a microphone jack. For output, there is an earphone jack with a volume control, as well as the system's standard loudspeaker.

To access these sound capabilities, Tandy has enhanced its DeskMate software with two additional applications. A program called Sound allows you to record a 30-second sound, display its waveform, play it back, and edit it. On the preproduction unit that Tandy showed us, the played-back sounds had the fidelity of sounds produced on a Macintosh. The second program, Music, lets you play music using voices sampled or created with the Sound program. One example we heard was a version of the omnipresent Pachelbel's "Canon."

The new ADC and DAC circuitry appears to be one more step toward providing the popular features of non-IBM systems in a low-cost IBM-compatible environment. Tandy had already provided a Mac-style graphical user interface via its DeskMate software. Now it supplies sound capabilities similar to that of the Mac and the Amiga. It is probably no coincidence that this new feature has some of the same sampling rates as those used by the DAC on the Macintosh. For developers who are interested in these possibilities, Tandy will soon be providing a toolkit.

To be sure, the new sound capabilities will probably find little use in the average office, but they appear to be a perfect low-cost perk for home systems.

Two new low-end Tandy systems, the Tandy 1000 TL (left) and the 1000 SL (right). Both feature new sound capabilities. The TL is displaying a new application included with Tandy's DeskMate software, called Sound. The software lets you record, edit, and play back any captured audio sound. The SL is displaying a graphics application included with DeskMate.

slots and three 16-bit slots, one with the video bus connector), and two 32-bit memory slots for Tandy memory cards.

The most significant feature of the 5000 MC is that all its CPU-related parts have been moved to a separate card. This card incorporates a 20-MHz 80386, an 82385 cache controller chip, a math coprocessor socket, the 32K-byte 35-ns cache memory, and a 40-MHz system oscillator. The math coprocessor socket accepts either an 80387 NDP or a single-chip version of the Weitek WTL 1167. This card plugs into the CPU slot on the system board. The setup is remarkably similar to that used on the IBM Model 70-A21, and, as is the case with the IBM system, it immediately suggests that this processor card can be replaced with a faster one. Tandy said that by adding a faster 80386, oscillator, cache memory, and system memory, the company had easily run the system at 25 MHz.

The 5000 MC comes standard with 2 megabytes of 100-ns parity-checked RAM. All system memory resides on a memory card that mounts in one of two proprietary memory slots. This memory card can accommodate either 2 or 8 megabytes of RAM, depending on whether you use 256K-byte or 1-megabyte SIMMs. The RAM on these cards is accessed in paged mode. The memory card is almost identical to the one used in the Tandy 4000; only one minor change was made in the card so it can be used in the new Tandy 3000 NL 80286-based system (see the text box above). If you need more memory, you can add a second such card, providing a total RAM capacity of either 4 or 16 megabytes.

A hard disk drive does not come standard with the Tandy 5000 MC, as it does with IBM's Model 70. However, Tandy gives you a wide choice of hard disk sizes and controller options to pick from for your system. You can get hard disk drives ranging from 40 megabytes to 110 megabytes using an ST-506 controller, 80 to 344 megabytes using a small-computer-system-interface controller, and 120 to 140 megabytes with an enhanced-small-device-interface controller. The hard disk controller card occupies one of the IBM MCA-compatible slots.

One of the things that most interested us was the 5000 MC's IBM MCA compatibility. We used the same IBM MCA cards that we used in the PS/2 Model 70-A21: the Ven-Tel 24/2 2400-bps modem card, an IBM high-resolution 8514/A display card, and a USRobotics Courier 2400/PS 2400-bps modem card. Because of its five slots, we were able to easily pack all three cards into the system. The POS software functioned properly, identifying the new cards and configuring them into the system automatically. We were also able to use this software to manually configure the Ven-Tel modem card to serial port 1, and the USRobotics modem card to serial port 3.

Because we were unable to reach a phone line, we couldn't thoroughly check out the operation of the modem cards. Nevertheless, each card responded to Hayes AT commands as entered by a terminal program, indicating that the computer and software were communicating with the MCA cards on the bus. Connecting an IBM 8514 monitor to the high-resolution 8514/A display card, we got a steady and clear color display. These tests are not exhaustive, but they show that the 5000 MC bus and the IBM MCA bus are compatible.

We also looked at the performance of the 5000 MC. Once again, we used version 1.1 of the BYTE Small-C benchmarks. Since we were looking at a preproduction unit, we present only the CPU measurements in table 2. It's obvious that the Tandy 5000 MC is easily one of the fastest 20-MHz 80386-based systems: It outperformed both IBM's 20-MHz Model 80 and Compaq's Deskpro 386/20. We can't help but wonder how the 5000 MC would compare to the Model 70-A21 if Tandy placed a 25-MHz processor card in this system.

Two Computers with Replaceable CPUs

IBM's new Model 70-A21 appears to be powerful, slick, and well designed. But at $11,295, you'd expect nothing less. We especially like its small size, even though this limited the number of expansion slots in the system. If you add a high-resolution video board, a network card, and a modem card to the Model 70-A21, you've used up all your slots. We also think the system is high-priced; you can get *two* 16-MHz Model 70s (which go for $5995) for the price of one 25-MHz Model 70. However, the higher price may be justified if you eventually wind up swapping out the processor card for a higher-performance processor.

The 5000 MC has two things going for it when compared to the Model 70-A21: It has IBM MCA-compatible slots (and two extra at that) and a removable processor card. While the 5000 MC runs at only 20 MHz, it has excellent performance for its class, and there's always the possibility of swapping that processor card. The other thing going for it is price. A Tandy 5000 MC, equipped with an 80-megabyte hard disk drive with an ST-506 controller, costs $6999.

Both IBM and Tandy have shown innovation in tackling the problem of how to supply the spiraling demand for more computing power without having the system become virtually obsolete in a year. It's interesting that both companies came up with the same solution: Make the CPU components and memory just more plug-in peripherals. The fastest CPU components and RAM are seldom cheap, but these components should cost considerably less than replacing the entire machine.

We'll have to wait and see if this open-design strategy pays off. Tandy should be commended for its efforts in duplicating the IBM MCA. Again, we'll just have to wait and see if the MCA itself pays off—for Tandy as well as for IBM. ■

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Meanwhile, in the Same Case . . . The Tandy 3000

Whatever your feelings on the new Tandy 5000 MC, Tandy seems to favor the size and shape of its housing. In fact, the company revamped its midline 80286-based 3000 HL into the new 3000 NL, which uses standard PC AT-compatible expansion slots but now has the same case as the Tandy 5000 MC.

The new 3000 NL uses the same keyboard as the 5000 MC: a new 101-key keyboard with the industry-standard layout. The keyboard has both tactile and audible feedback, but it is not quite as loud as the standard IBM keyboards. The 3000 NL also uses the same memory board as the 5000 MC.

But there the similiarities to the 5000 MC end. The new 3000 NL has a 10-MHz 80286 CPU and seven PC AT-style slots (three 8-bit slots and four 16-bit slots). And at $1699 for a system with a single 1.44-megabyte 3½-inch floppy disk drive, it is considerably less expensive. Indeed, the new 3000 NL could steal some customers away from Tandy's original PC AT clone, the 3000. At 12 MHz, the old 3000 is a little faster, but it costs $300 more.

The Dell System 220. Once again the critics stole the words right out of our mouth.

"The Dell System 220 runs most PC Labs system benchmark tests at speeds that would make you think you're running a 386."

—PC MAGAZINE

"...the Dell machine is renewed evidence that the price of 286-based desktop equipment continues to drop rapidly, making such machines very attractive for daily work under MS-DOS even as they hold out the promise of running OS/2 in the future."

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—ERIC KNORR, PC WORLD

"The hot item from a technical point of view is the System 220. This machine runs a 286 processor at 20 MHz, which is its major claim to fame."

—WILL FASTIE, PC WEEK

"...the System 220 has more going for it than just speed."

—PC WORLD

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- 1 parallel and 2 serial ports.
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- Real-time clock.
- Three full-sized AT† compatible expansion slots.
- Socket for 80287 coprocessor.

Options:
- External 5.25" 1.2 MB diskette drive.
- 3.5" 1.44 MB diskette drive.
- Intel 80287 coprocessor.
- 1 MB RAM upgrade kit.

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System 220	With Monitor		
	VGA Mono	VGA Color	VGA Color Plus
One Diskette Drive	$2,299	$2,499	$2,599
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100 MB – 29 ms Hard Disk	$3,799	$3,999	$4,099

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- Dual diskette and hard disk drive controller.
- Enhanced 101-key keyboard.
- 1 parallel and 2 serial ports.
- 200 watt power supply.
- Real-time clock.
- 6 expansion slots. (4 available with hard disk drive controller and video adaptor installed).
- Socket for 8 MHz 80287 coprocessor.

Options:
- 512 KB RAM upgrade kit.
- 8 MHz Intel 80287 coprocessor.

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150 MB – 18 ms ESDI	$3,999	$4,299
322 MB – 18 ms ESDI	$5,999	$6,299

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PostScript Printers

BYTE looks at the latest PostScript printers, tops in quality and versatility

Steve Apiki and Stan Diehl

A few years ago, the phrases "made in Japan" and "computer-printed" suffered from the same low-quality image. Today, both phrases stand for a consistent quality that's hard to find anywhere else. The turnaround for computer printouts can be traced to a few important developments.

First, Canon and Hewlett-Packard provided personal computers with the high-quality output of laser printing. Later, Adobe supplied PostScript, which let users take greater advantage of their laser printers. From a beachhead of only one printer just 3 years ago, the PostScript-compatible laser printer has moved into a position as the standard against which other output devices are measured.

The BYTE Lab looked at 10 of the best PostScript printers. These printers are an ideal match for today's sophisticated, graphics-intensive software—especially desktop publishing and CAD packages—and the acute need for professional hardcopy output. We also tested four enhancement boards that bring PostScript compatibility to the Hewlett-Packard LaserJet Series II (including a glimpse of the first PostScript clone).

The Making of a Standard

As is true with most computer innovations, the design philosophy of PostScript is a simple one. The language describes all aspects of the printed page—text, graphics, and sampled images—in the same way. PostScript graphics operators manipulate text as graphical shapes, therefore ensuring smooth integration of text and graphics on the page.

PostScript's imaging model, the heart of any page-description language (PDL), ensures versatility and total integration. PostScript does not view a page as a conglomeration of separate entities; it handles the page as a single unit. PostScript paints the page by filling in specified areas in color, black and white, or shades of gray.

The wide variety of possible graphics poses special problems for a PDL. PostScript defines operators according to the immediate application by dynamically combining graphics primitives as special needs arise. PostScript's control structure gives it great flexibility in combining graphics operators, thanks to the richness of the programming language.

Scalable fonts exemplify PostScript's versatility. Earlier PDLs called upon a set of physical fonts stored in memory. A PDL from this period could use only the typefaces and point sizes that were available to it. PostScript fonts, on the other hand, are mere geometric descriptions of a typeface's outline. Because the fonts are graphical descriptions rather than a rigid set of typefaces, they can be scaled to any size or rotated to any orientation while retaining their design integrity.

Ironically, the very features that make PostScript such an attractive PDL also conspire against it. The richness of the language makes for a complicated structure. Few programmers would tackle a PostScript program from scratch, and even editing the code can be confusing and tedious. Fortunately, an application program, like a desktop publishing system or a drawing program, usually generates the page description. Though this minimizes the problem of cumbersome code, it also inevitably limits the language's power: Most applications stay within a set of basic commands, leaving many sophisticated features dormant.

The language structure also contributes to the most onerous PostScript problem: It is slow, painfully slow. PostScript code describes every aspect of the page with printable ASCII characters. The processor must interpret each piece of information—one piece at a time. Since PostScript works with high-level graphics primitives, a bottleneck occurs when converting high-level commands to actual printed graphics.

PostScript's most laudable feature, scalable fonts, also accounts for slow speed. It takes much more time to scale an outline font and generate the corresponding bit map than it would to simply load a typeface from font storage.

The Brains Behind the Beauty

Microcomputer users are about as familiar with bottlenecks as glassblowers are. We're used to twiddling our thumbs waiting for files to be read from disks or for a few pages of text to make their way out of a dot-matrix printer. With PostScript printers, however, the bottleneck comes not from some clunky mechanical subsystem, but from the speed of instruction processing itself. Forget that your print engine is rated at 8 pages per minute (ppm); send a complex graphics document through the PostScript printer controller, and you'll be lucky if you get throughput of 8 minutes per page.

In a typical controller, the CPU is the only piece of intelligent hardware on the board. The CPU parses the commands and generates a bit-mapped page image of whatever was sent. If this includes graphics, all graphics manipulations (e.g., fills and rotations) must be conducted through the software that resides on the controller's EPROMs. A bit-mapped image requires the CPU to process the page pixel by pixel, and at 300 dots per inch—90,000 pixels per square

continued

Come of Age

Apple LaserWriter IINT

Apple LaserWriter IINTX

Dataproducts LZR 2665

Dataproducts LZR 1260

General Computer Business Laser Printer

IBM 4216 Personal Pageprinter

PC Publisher Kit

ITT Qume ScripTen

QMS Color Script 100

Laser Connection/QMS JetScript

Laser Connection/QMS PS 800 II

QMS PS 810

Texas Instruments OmniLaser 2115

Varityper VT600

Varityper VT600

QMS JetScript

QMS PS 810

Apple LaserWriter IINTX

Pictured at right are four printers selected as best in quality or price.

Table 1: *The Varityper VT600 finished well in front in text quality, with the Apple LaserWriter IINTX coming in a surprising first in graphics quality. (Time measurements are in seconds; quality is rated on a scale of 1 [worst] to 5 [best].)*

Printer	IBM PC AT Large text file	IBM PC AT Small text file	IBM PC AT PostScript graphics file	Apple Macintosh Large text file	Apple Macintosh Small text file	Apple Macintosh PostScript graphics file	Graphics quality score	Text quality score	Warm-up time
Apple LaserWriter IINT	N/A	N/A	N/A	484	131	203	3.000	3.238	78
Apple LaserWriter IINTX	N/A	N/A	N/A	328	80	87	3.722	3.476	78
Dataproducts LZR 1260	230	57	92	318	77	54	3.389	2.905	69
Dataproducts LZR 2665	412	45	187	397	58	183	3.167	3.190	144
GCC Business Laser Printer	343	102	153	473	108	153	1.106	1.067	89
IBM 4216 Personal Pageprinter	368	82	149	N/A	N/A	N/A	2.833	2.714	32
QMS JetScript (with LaserJet)	258	65	121	N/A	N/A	N/A	3.111	3.238	141
PC Publisher Kit (with LaserJet)	965	71	124	N/A	N/A	N/A	3.167	3.619	25
QMS Color Script 100	1582	362	297	1561	323	108	3.467	3.000	148
QMS PS 800 II	307	64	105	310	144	140	3.056	3.095	66
QMS PS 810	304	85	101	372	95	139	3.667	3.619	66
ITT Qume ScripTen	228	90	168	523	143	112	2.889	3.095	72
TI OmniLaser 2115	334	54	109	439	93	108	3.389	3.429	111
Varityper VT600	268	73	152	336	142	156	3.667	4.200	251

Table 2: *A comparison of features shows similarities in interfaces and capabilities, and large differences in price, downloadable fonts, and storage.*

Printer	CPU/Speed (MHz)	RAM (meg.)	ROM	PostScript version	Hard disk drive	Interfaces	Resident fonts	Emulation
Apple LaserWriter IINT	68000/11.5	2	1M	47.0	No	a, s, d	35	No
Apple LaserWriter IINTX	68020/16.7	2-12	1M	47.0	Port	a, s, d	35	No
Dataproducts LZR 1260	68020/16.7	4	1M	47.0	No	a, s, p	35	HP Plus, D630,
Dataproducts LZR 2665	68000/10	3	512K	46.2	Option	a, s, p	13	D630,
GCC Business Laser Printer	68000/12.5	2-3	1M	49.2	Port	a, s, p	39	No
IBM 4216 Personal Pageprinter	68000/10	2.5	No	47.0	No	AT, PS/2 card	13	IBM 4202
QMS JetScript	68000/16	3	No	47.2	No	PC, PS/2 card	35	No
PC Publisher Kit	68000/10	2	No	N/A	No	PC card	22	D630, IBM, NEC, HP, Qume, Epson
QMS Color Script 100	68020/16.7	8	1M	49.4	20M	a, s, p	35	No
QMS PS 800 II	68000/16	2-3	1M	47.0A	No	a, s, p	35	D630, HP Plus, HPGL
QMS PS 810	68000/16	2-3	1M	47.0A	No	a, s, p	35	D630, HP Plus, HPGL
ITT Qume ScripTen	68000/12	3	1M	47.0	No	a, s, p	35	HP Plus
TI OmniLaser 2115	68000/10	3	576K	47.0	No	a, s, p	13	D630, HP Plus, HPGL, TI 855
Varityper VT600	68020/16	6	628K	48.0.4	20M	a, s, p	13	No

For interfaces, a is AppleTalk, s is serial, p is Centronix parallel, and d is ADB.
[1] Adapter cards were tested on a Hewlett-Packard LaserJet Series II, rated at 8 ppm.
[2] Size and weight include both engine and controller unit.
[3] Price for minimum operating configuration.

inch—that's a hefty amount of information. Compare this to screen graphics, which can limit the speed of an application, where screen resolution is a mere 74 dpi on the Macintosh.

Unfortunately, the slowdown is unavoidable using current technology and architecture. The manufacturers of all these controllers have put real processing horsepower into their systems. All but four of these controllers feature a 68000 CPU: The Apple LaserWriter IINTX, the Dataproducts LZR 1260, the QMS Color Script 100, and the Varityper VT600 are built around a 68020. One would expect these four systems, with the advantage of a 32-bit data bus, to come out on top in our print timings. The IINTX and the LZR 1260 demonstrated excellent throughput on our PostScript graphics benchmark, the best single measure of controller speed. For the complete benchmark results, see table 1.

The VT600 and the Color Script 100 can be considered specialty PostScript printers, and they cannot be fairly compared with the rest of the field in terms of raw printing speed. The VT600, with its 600-dpi resolution (see figure 1), must process 4 times as much information as the 300-dpi printer in generating its bit map. The Color Script 100, which turned in a very good time on the graphics test, has a four-color thermal print engine that is much slower than the typical Canon engine and slows every page sent through it (see figure 2).

The most telling demonstration of the difference a processor can make is seen when comparing the two Apple personality boards, which use the same printer and whose primary difference is in the CPU. The IINT, which has an 11.5-MHz 68000, is less than half as fast as the 16.7-MHz 68020-based IINTX on the critical graphics test.

Most manufacturers have chosen to live with the performance decrease in exchange for the considerable cost savings afforded by the 68000. If the ultimate in speed is not one of your requirements, you can choose from a wealth of quality PostScript printers built around the less powerful CPU. Within this group, Texas Instruments' OmniLaser 2115, the QMS JetScript controller card, and the two QMS 800 series printers have the best processing speeds. QMS arms every one of its controllers with a 16-MHz 68000, rather than the typical 12-MHz version, and the performance difference is obvious.

Next to the CPU, the most important features of a controller are the interfaces it supports and how well it supports them. With the notable exception of the IBM 4216 Personal Pageprinter, all the printers we reviewed can communicate through an RS-232C serial port or on an AppleTalk network; all but the Apple printers support Centronix parallel. The Personal Pageprinter and the LaserJet add-on cards (JetScript and PC Publisher Kit) have their own connections between the printer and the adapter and require an IBM PC AT slot. A Personal Pageprinter controller for Micro Channel–based machines is available. A list of the interfaces that each printer supports, as well as other features, is found in table 2.

Interfaces extend beyond the physical cable connection, and they play an important role in both compatibility and performance. While our Macintosh and DOS benchmark results are not directly comparable, they do point up significant

continued

Engine	Life (pages)	Duty cycle (pg./mo.)	PPM	DPI	Size	Weight	Software	Documentation pages	Suggested price
Canon LBP-SX	300k	Not rated	8	300	8.5 x 20 x 18	45	No	152	$4599
Canon LBP-SX	300k	Not rated	8	300	8.5 x 20 x 18	45	No	152	$6599
Toshiba A-739	600k	10k	12	300	18.1 x 19.8 x 19.5[2]	107[2]	No	280	$7995
Toshiba A-740	3M	80k	26	300	16.1 x 23.4 x 26.7	176	No	44	$18,700
Ricoh 1060	180k	3k	6	300	16.1 x 16.5 x 9	38	Mac fonts Mac drivers	172	$4199
Undisclosed	Not rated	4k	6	300	17.7 x 16.5 x 8.4	38	Adapter w/ fonts	250	$4999[3]
N/A	N/A	N/A	N/A[1]	300	N/A	N/A	Adapter w/ fonts	83	$2495
N/A	N/A	N/A	N/A[1]	300	N/A	N/A	Adapter w/ fonts, DDL software	221	$1995
Mitsubishi G650	Not rated	4k	1	300	13.8 x 20.9 x 22.2[2]	114[2]	No	206	$24,995
Canon CX-D	300k	10k	8	300	18.7 x 18.1 x 19.5	99	PostScript utilities	130 + 2 PS Manuals	$6495
Canon LBP-SX	300k	5k	8	300	18 x 9.1 x 25	44	No	206	$5495
Hitachi	300k	5k	10	300	20 x 17.25 x 15	90	No	179	$5695
Ricoh 4150	1.5M	25k	15	300	21.5 x 28.5 x 17.5	88	No	349	$7995
Undisclosed	360k	3k	10	600	18.5 x 23 x 21.1	161	No	146	$15,995

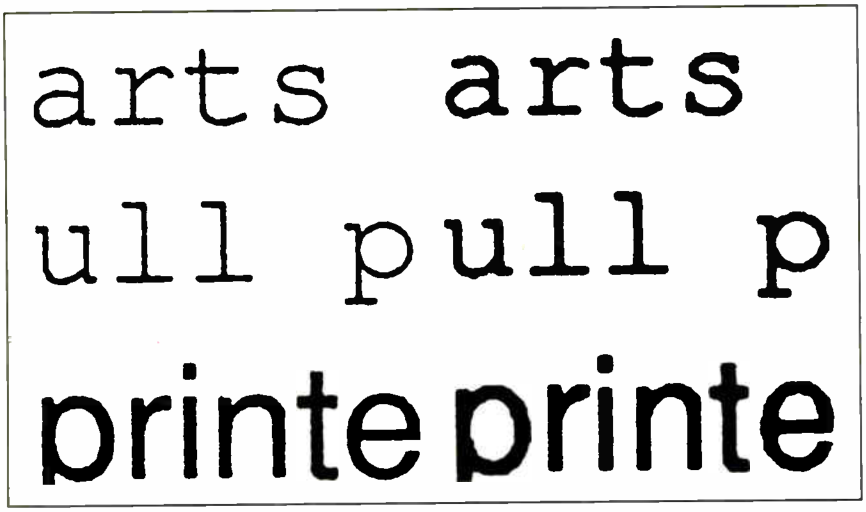

Figure 1: *Finer characters are in the sample at left, from the 600-dpi Varityper VT600. The sample at right, from a QMS PS 810, shows 300-dpi resolution.*

differences in how the interfaces and controllers work together. The ITT Qume ScripTen, for example, printed our graphics file from the Macintosh significantly faster than it printed basically the same file from the IBM PC AT. This is in sharp contrast to the performance of the QMS printers, which did much better on the DOS side. Better AppleTalk compatibility from ITT Qume accounts for this difference.

General Computer's Business Laser Printer follows Apple's lead in making the AppleTalk connection of the DIN-8 variety, rather than the DB-9 favored by all the other AppleTalk printers. The other printers use the DB-9 connection as an additional RS-422 serial port when they are not in AppleTalk mode. These differing connectors can present a problem—though trivial—when connecting different printers to the network.

We chose the parallel interface when testing throughput from the IBM PC AT because we thought it was the least complicated way to connect a DOS machine to a printer. One printer that we ran into some trouble with using this approach was the QMS Color Script 100, which refused to receive instructions through the parallel port. QMS acknowledged the problem and suggested that we use a 30-foot parallel cable to correct it. Since only a 12-foot cable was available, we were forced to use the RS-232C port to get around the buggy parallel interface.

Though PostScript was developed for serial communications and Interactive PostScript depends on it, using a communications program to talk to a printer from an IBM PC AT is a trying experience. Even after the initial headache of matching the protocols, stripping linefeeds, and making sure the software was not expanding any tabs or sending any extraneous control characters, we continued to run into problems where the only solution was to turn the printer on and off. If you have a choice in interfacing from an IBM PC AT, choose the parallel port.

Memories and Storage

PostScript printers owe their ability to create quality, high-resolution output to more than just sheer processing power. Effective use of memory and mass storage capability is vital to the performance of the system. Every controller has at least 2 megabytes of RAM, most have some ROM, and some even have a hard disk drive or that capability. What sets a controller apart is the way it uses available memory to conduct the functions required by PostScript.

Most of the printers use ROM exclusively for retaining resident fonts. Obviously, the greater ROM storage a controller has, the more fonts it can keep readily available. The Texas Instruments OmniLaser 2115 stores most of its font information in ROM cartridges, and it has only a small amount of on-board ROM.

The IBM 4216 Personal Pageprinter and the LaserJet add-on cards opt for no ROM at all; their "resident" typefaces are stored on the system's hard disk drive and are downloaded to controller RAM when the system is initialized. This configuration lets you change your resident font set through software, so whichever typefaces you use most frequently are automatically downloaded. While this gives added versatility, especially to those who commonly use unusual fonts, it does add a significant delay to the initialization process.

Nonresident fonts can be downloaded to RAM from either the controlling microcomputer or a hard disk drive. Only Varityper's VT600 and QMS's Color Script 100 controller come with hard disk drives installed, but Apple's IINTX and General Computer's Business Laser Printer have small-computer-system-interface (SCSI) ports for making optional hard disk drive connections.

Two types of font information are kept in controller memory: the fonts themselves, and a PostScript standardized font cache. The font cache consists of characters that have already been processed and for which a bit-map outline has already been generated. Needless to say, fonts fetched from the font cache are utilized much more rapidly than those that must be taken from regular font memory and completely processed. It's in storing the font cache that a large amount of fast RAM can really make its presence felt.

Controller RAM stores downloaded fonts, the PostScript page description, the page bit map, and whatever header files an application may require. The controller uses any additional space for the font cache. The Color Script 100 comes standard with 8 megabytes of RAM to lead the field, but the IINTX's standard 2 megabytes can be upgraded to 12 megabytes. The VT600 comes with 6 megabytes installed, and the LZR 1260 comes with 4 megabytes; all the other controllers come with 2 or 3 megabytes standard.

Once again, the VT600 and the Color Script 100 are in a class by themselves.

continued

How the Tests Were Done

We tested the printers on the two factors that users care most about: speed and print quality. For speed, we give objective numbers; for print quality, we provide numbers that are subjective but not arbitrary.

We printed three files, each designed to emulate a typical user file, in our speed test. First, we printed a 125K-byte, 16-page file that contained seven fonts, to emulate a large (and somewhat poorly designed) report. Next, we printed a 25K-byte, 6-page file that used only three fonts but also incorporated some small graphical elements. This file was typical of a small newsletter or flier. Finally, we printed a 34K-byte, single-page file of graphics and highly manipulated text. This page made extensive use of PostScript's facilities for text manipulation (e.g., rotation, scaling, and distortion), line rendering, and shading.

On the IBM PC AT, we created a separate PostScipt file for each test, and we used the DOS PRINT command to send the file to the printer. Each printer except the QMS Color Script 100 was connected to the AT via the parallel port.

On the Macintosh SE, we connected to the printer through AppleTalk and printed each file from its creating application. The file sizes for the Macintosh tests were 118K bytes, 21K bytes, and 20K bytes, respectively, for the large text, small text, and graphics tests. We used MacWrite 5.0 for the text files and Adobe Illustrator 1.0 for the graphics file. Since the two computers required different means for sending the files to the printers, you should not try to draw conclusions concerning the IBM PC AT versus the Macintosh as platforms for driving a printer.

For the print quality tests, we took one page of mixed-font text and a graphics page from each printer, taped them to a wall, and had 20 members of our editorial and art departments rate them on quality of text and graphics, using a scale of 1 (worst) to 5 (best). The result in table 1 is the mean of the scores.

One test we did not run was for noise level. We took readings on all printers and found that none added significantly to the noise level of the testing room.

Both of them have more than the standard amount of RAM, and both have a hard disk drive. The hard disk drive, in addition to storing downloaded fonts, is used as additional nonvolatile caching space. Less frequently used fonts in the cache are sent to disk as the RAM cache becomes full, enabling the cache to grow to 10 megabytes. Of course, retrieving fonts from the disk cache takes far longer than getting them from the RAM cache, but it is still faster than regenerating an entire character set.

All the printers except the VT600 provide Times, Helvetica, and Courier fonts among their standard resident fonts. See table 2 for the number of resident fonts each printer provides.

Doing the Dirty Work

Although PostScript gets the headlines, the print engine does all the dirty work. In fact, the engine, more so than the PDL, determines the overall quality of type. The engine affects the main attributes by which a printer is measured: resolution, print quality, durability, and—to some extent—speed.

We often credit PostScript for sparking the laser-printer revolution. In fact, it was Canon who, by unveiling the LBP-CX print engine in 1983, enabled low-cost laser printers to enter the market. When Hewlett-Packard introduced the Canon-based LaserJet in 1984, laser printers became a viable alternative for the office.

The print engine performs the printer's electromechanical functions. In a laser printer, the print engine contains the laser itself, which generates an electrical charge on a photosensitive drum. The charged area corresponds to desired markings on the page. Depending on the type of engine, the laser exposes either the black area of the image (write-black) or the white area of the image (write-white). The rotating drum attracts the toner to the charged areas and transfers it to a piece of paper. A final burst of heat melts the toner, thus fixing it to the page.

This process can affect print quality. Write-black engines produce darker blacks; write-white engines handle finer text. The resolution offered by the engine will, of course, affect print quality the most. Only the Varityper VT600 deviates from the 300-dpi standard, offering a fourfold increase in density at 600 dpi.

Because of the PostScript bottleneck, a manufacturer's rated engine speed means very little. The printer will spit out sheets only as fast as PostScript can compose them. The Dataproducts LZR 2665 advertises a print speed of 26 ppm, but our benchmarks show little speed enhancement over engines with slower ratings. Only if you're churning out multiple copies of the same text file will the engine realize its advertised print speed.

If you intend to use your printer as a shared resource, consider the rated engine life. The original Canon CX has a rated engine life of only 100,000 pages. The Canon SX—the engine driving the newer Apple LaserWriters, the QMS PS 810, and others—claims an engine life of 300,000 pages. The Texas Instruments OmniLaser 2115, equipped with a Ricoh 4150 engine, boasts a life cycle of 1½ million pages. The most durable engines, like the Toshiba A-740 or the Agfa engine, will pump out over 3 million copies before giving out. None of the printers reviewed use the Agfa engine.

The print engine will have a significant effect on the printer's price. The LZR 2665 carries a hefty price tag, mainly because of its top-of-the-line Toshiba A-740 engine. Printers stocked with the Ricoh 1060 engine fall in a lower price range.

Putting It All Together

The 14 printers and boards we reviewed were more than the sums of their controller, memory, and print-engine capabilities. They all are quiet and will fit nicely into an office environment, but each has special features and idiosyncrasies that you should consider when deciding on a PostScript printer. For a description of how we evaluated each printer, see the text box "How the Tests Were Done."

Apple LaserWriter IINT: Apple's replacement for its original LaserWriter PostScript board is a good controller designed for an excellent printer. Although it turned in a mediocre performance on most of our throughput benchmarks, the times were very good for the engine-intensive 36-page text test.

The IINT, which sells for $4599, has a 68000 controller and limited memory, but it is easy to install and use and produces high-quality output.

Apple LaserWriter IINTX: This is a confession: Ever since we got this printer for evaluation back in February, we've used it for creating nearly all our hard copy in the lab. The print quality is excellent, and the printer is fast, versatile, and trouble-free.

Its combination of a 68020 controller and expandable memory gives it the un-

continued

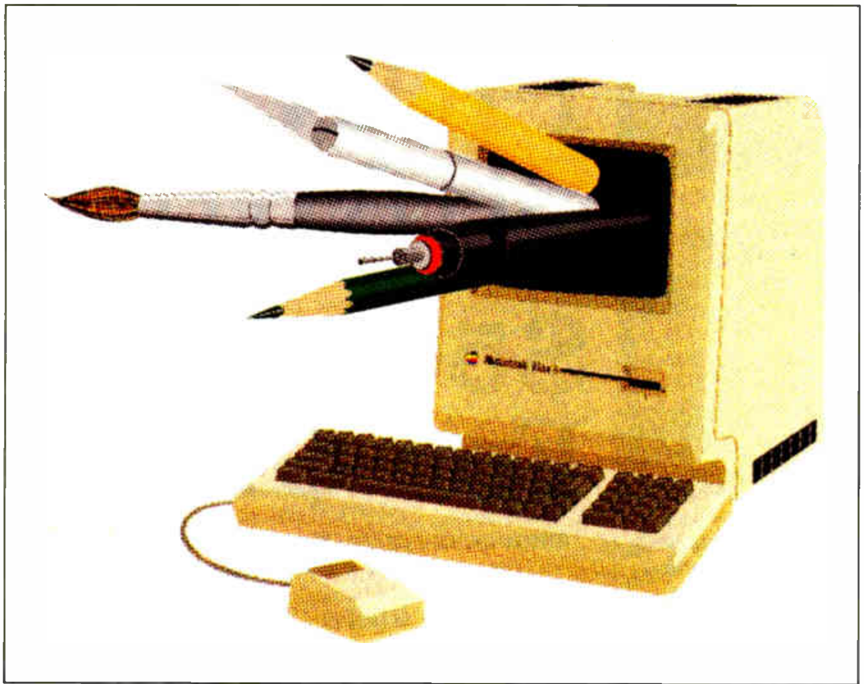

Figure 2: *This drawing, done with Aldus FreeHand, is typical of output from the QMS Color Script 100. To date, this is the only PostScript-compatible color printer.*

The printer produced output of poor quality, and its speed performance was mediocre when connected to the IBM PC AT. The SolutionPac (including a PS/2 Model 80) may be a good turnkey system, but as a stand-alone printer, the 4216 is woefully average.

PC Publisher Kit: The first of the PostScript clones has finally arrived. Imagen's UltraScript language emulates the Adobe standard, bringing PostScript compatibility to the Hewlett-Packard LaserJet Series II. In addition to PostScript, the PC Publisher Kit can print DDL, PCL, and Hewlett-Packard Graphics Language (HPGL) files. The kit features the 68000 processor with 2 megabytes of memory and 22 typefaces.

The $1995 PC Publisher Kit sells for $500 less than JetScript, a true PostScript controller. Lower prices should be a major selling point of the coming clones, since they will be immune from Adobe royalties. The kit comes with two boards, one for the IBM PC AT and one for the printer. Installation of both software and hardware is quick and painless. If you need help, the two manuals should prove adequate.

Much has been made of Adobe's proprietary font-scaling algorithm. We were anxious to see how well PC Publisher Kit would handle our large text file, a benchmark designed to wring out the font cache and test font-scaling capability. Imagen uses its own algorithm to scale fonts. Also, though it does not license Adobe fonts, it does license from original foundries. Adobe's font-scaling claims do gain some credence here, as PC Publisher Kit ran the large text benchmark significantly slower than the JetScript controller. Unfortunately, the kit stores fonts on the host's hard disk drive, so slow disk access time will affect throughput.

For the most part, though, Imagen has created a sufficient clone. PC Publisher Kit posted adequate times on the other benchmarks, it was able to print all the PostScript test files, and it displayed print quality comparable to JetScript's. If you have long documents with multiple font changes, you can't ignore the kit's speed deficiency; but if you're on a tight budget, you can get PC Publisher Kit for 25 percent less than JetScript. Yet another trade-off.

The emergence of clones must be a mixed blessing for Adobe. Competitive prices will cut into its monopolized market. On the other hand, a sudden plethora of imitators is the surest sign that PostScript has attained the status of an industry standard.

ITT Qume ScripTen: This printer deserves high marks for exterior design. It is pleasing to the eye. The output, on the other hand, fails to meet that same aesthetic. The write-white Hitachi engine puts out some deep blacks, but it does not print high-quality text. It scored near the bottom on our print quality tests and average on throughput. The engine has a rated speed of 10 ppm, a duty cycle of 5000 pages per month, and a life expectancy of 300,000 pages.

The ScripTen employs the 68000 processor and holds 1 megabyte of ROM and 3 megabytes of RAM. The $5695 printer is extremely easy to set up and just as easy to use. Indicator lights are accessible and self-explanatory. Documentation includes a guide to operations and a PostScript supplement. The supplement covers basic PostScript commands—the ones you are most likely to use—and explains how to issue these commands from interactive mode. The ScripTen scored high on our IBM PC AT benchmarks, especially on the large text throughput. However, it did not handle the AppleTalk small and large text tests very well. In any case, given the poor print quality, those benchmarks don't mean much.

QMS Color Script 100: If you think 300-dpi graphics look good in black and white, wait till you see them in color. The Color Script 100 lets you take that step by being the first color PostScript printer. The results are spectacular.

QMS has put together a high-powered print controller featuring a 68020 CPU, 8 megabytes of memory, a 20-megabyte hard disk drive, and a four-color thermal print engine to create the Color Script 100, a high-performance printer capable of some truly beautiful graphics. The system lists at an eye-popping $24,995, and at over 3 times the price of most 300-dpi printers, it's reserved for customers who need high-resolution color.

The print engine is slow, especially when processing large files like our large text benchmark file. Printing in color takes far longer, as the printer needs to make four passes on the page: one each for cyan, magenta, yellow, and black. The high-speed controller enabled the printer to perform admirably on our single-page graphics benchmark.

High speed is not, of course, what sells this printer. It's the pages it outputs—with high-quality text or graphics in both black and white and color—that really grab you. The system can also make an excellent proof printer, as it can do color separations for three or four colors.

There are, unfortunately, two serious limitations to the otherwise excellent Color Script 100: the lack of a reliable parallel interface, as discussed earlier,

continued

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QNX vs. OS/2 UNIX

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ARCHITECTURE If the micro world were not so varied, QNX would not be so successful. After all, it is the operating system which enhances or limits the potential capabilities of applications. QNX owes its success (over 60,000 systems sold since 1982) to the tremendous power and flexibility provided by its modular architecture.

Based on message-passing, QNX is radically more innovative than UNIX or OS/2. Written by a small team of dedicated designers, it provides a fully integrated multi-user, multi-tasking, networked operating system in a lean 148K. By comparison, both OS/2 and UNIX, written by many hands, are huge and cumbersome. Both are examples of a monolithic operating system design fashionable over 20 years ago.

MULTI-USER OS/2 is multi-tasking but NOT multi-user. For OS/2, this inherent deficiency is a serious handicap for terminal and remote access. QNX is both multi-tasking AND multi-user, allowing up to 32 terminals and modems to connect to any computer.

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and a limited imageable area. In order to keep the margins required for tight tolerance on color alignment, the thermal print engine accesses only an 8.11- by 8.91-inch region on a standard 8.5- by 11-inch page. This is significantly less than the average 8.1- by 10.5-inch imageable region afforded by most of the laser printers, and it can actually lead to some clipping. You can avoid the problem by simply designing pages with this limitation in mind.

Laser Connection/QMS JetScript: The JetScript controller provides PostScript compatibility to the Hewlett-Packard LaserJet Series II. Two cards, a manual, four floppy disks, and a parallel cable come in the package. You must first install the software. This copies the PostScript code onto the host computer's hard disk drive. The prompts are clear and easy to follow, and the directions cover everything, including jumper settings on the board.

Hardware installation is just as easy: Slide one card into the IBM PC AT, pop the other into the rear slot of the LaserJet, plug in the cable, and boot up. An AUTOEXEC file will load PostScript code onto the controller board's RAM. Unlike the PostScript printers, the code is not ROM-resident. Though this configuration causes some inefficiencies, it also means you won't have to swap ROM chips with each upgrade.

JetScript's ASAP (Advanced System Architecture for PostScript) technology, extended font cache, and 16-MHz 68000 MPU combine for exceptionally fast throughput. JetScript cranked out the large text file in only 4 minutes and 18 seconds. The $2495 controller supports the 35 standard Adobe typefaces. Installing the card will not void the printer warranty.

If you have a LaserJet Series II and need PostScript compatibility, JetScript offers a ready solution. In fact, the smooth operation and impressive speed of this controller almost justify purchasing the LaserJet just to put the JetScript card in it.

Laser Connection/QMS PS 800 II: QMS has a reputation for producing quality printers at a reasonable price, and the printers in the PS 800 series are no exception. Though marketed by The Laser Connection, this printer is QMS through and through. The PS 800 II, with an attractive price of $6495, is a 300-dpi printer with a fast 68000 controller, 2 megabytes of RAM, and an engine rated at 8 ppm. The combination affords good overall performance in both text and graphics printing.

Text and graphics quality rank the PS 800 II in the middle of the field. Highest performance was achieved in the printing of our graphics-intensive benchmark, where the controller's speed could really shine.

Top this printing performance off with provisions for the three common interface connections, a 10,000-page-per-month duty cycle, a double print tray combination, and emulation support for the Hewlett-Packard LaserJet Plus, HPGL, and the Diablo 630, and you have a full-featured printer capable of handling network print jobs with style.

POSTSCRIPT®

Adobe's new logo sets apart true PostScript products from clones.

QMS PS 810: The PS 810 is a compact, comparatively light-duty version of the PS 800 II, with the same controller configuration driving an electrophotographic recording engine. Though the engine is rated for the same 8-ppm speed, the system is much smaller than the PS 800 II, which uses the raster-scan print method. The printer weighs in at 44 pounds, approximately half the bulk of its larger cousin, but it also has only half the recommended duty cycle at 5000 pages per month. It costs $5495.

Print quality was excellent for this machine, consistently on top in our quality benchmarks. Beyond this, the PS 810 and PS 800 II are remarkably similar, sharing the same interfaces and emulations. The PS 810 does not have the dual input trays of the more network-oriented PS 800 II, but the two machines' only critical design difference is in print capacity. If you're looking for a printer to handle less than a whole office's output, you might do well to consider the lighter and even less expensive PS 810.

Texas Instruments OmniLaser 2115: The Ricoh 4150 engine gives the OmniLaser 2115 some impressive specs. With a 25,000-page-per-month duty cycle and a life expectancy of 1½ million pages, the 2115 looks great on paper. If only its output looked better on paper. The write-white engine produces deep blacks, but the text lacks crispness. Still, the 2115 scored average on our print quality tests and above average on throughput.

The $7995 unit has a compact structure, with all switches, trays, and cartridges readily accessible. It is easy to set up and use. Two manuals provide all the information you'll need in a clear, well-organized format. Chances are good, though, that you won't have to refer to them often.

If you're looking for a printer to add to a network, you can't ignore this one. It has all the features you look for in a shared resource: durable duty cycle, long life expectancy, exceptional speed, and ease of use.

Varityper VT600: If you're ready to plunk down a good-size chunk of capital and graduate from the ranks of the 300-dpi laser-printer owners, you're ready for a Varityper VT600. At $15,995, the VT600 is definitely not for the casual user, nor even for the serious individual user. This is a machine meant for organizations with a real need for very high-quality printing but not yet ready to go into the publishing business full-time with the purchase of a Linotype.

The VT600 is the first PostScript printer to achieve 600-dpi resolution. The 600-dpi print engine is fast—rated at 10 ppm—and able to give the printer good throughput ratings when printing large files. Processing power is vital when dealing with the vast amounts of information manipulated at this resolution. The controller is built around a 68020 CPU and 6 megabytes of RAM, 4 megabytes of which are necessary for the page buffer alone. A 20-megabyte hard disk drive provides additional storage space.

The system comes with surprisingly few fonts installed, but you can purchase almost any imaginable font from Varityper's library of 53 typeface families. Text printed with these installed fonts is distinctively good. The printer topped our text quality test.

Graphics, especially those with gradations from dark to light, are beautiful at 600 dpi. Black areas are black, and edges are clearly defined. The VT600 was not, however, the most highly rated graphics printer according to our test, which favored the 300-dpi Apple IINTX.

The Pick of the Lasers

In selecting the best of these printers, our single most important criterion was print quality, an elusive and often subjective

continued

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performance rating. After all, PostScript is not built for speed or economy, but for the look of the printed page.

Varityper's VT600 is the best overall printer we reviewed. Its 600-dpi print engine produces excellent graphics and text, and its powerful controller delivers the output rapidly. The system is fully featured, and, coupled with the optional fonts, it is indeed a "typesetter" as Varityper calls it, not just another laser printer.

Comparing a 600-dpi printer to those with 300-dpi resolution and then choosing the one with the best print quality may seem a little unfair. Our print quality benchmarks point out an important fact, however: Resolution is in the eye of the beholder. If your main objective is output that simply looks good and you don't need the additional resolution for camera-ready proofs, you may want to consider a high-quality 300-dpi printer.

Take Apple's IINTX, which actually beat the VT600 in our graphics benchmark. Though the higher rating is only slightly better, it does demonstrate that the IINTX is in the VT600's league. Its throughput performance was outstanding, its text rating was nearly as high as its graphics rating, and this was on a system that did not have all the options installed. The IINTX, a growing standard by which others are compared, is still tops in the high-quality 300-dpi field.

With top-of-the-line PostScript printers selling for more than most American cars, saving money by sacrificing a little printing speed is a popular alternative. If you're looking for a high-class printer for around $6000, take a look at the QMS PS 810, our pick in the price versus performance category.

The PS 810 combines excellent print quality with good speed and enough features to keep all but the most demanding user completely satisfied. Its one weak area is the print engine's relatively low duty-cycle rating, but the rating is comparable to other printers built for smaller user groups.

As a final alternative, you may choose to upgrade your current printer investment using a PostScript controller card. The two controller cards we reviewed are both relatively inexpensive and both produce output of adequate quality. Of the two, we recommend the JetScript. Although it costs $500 more than PC Publisher Kit, its performance is worth it. But though either board makes sense as an add-on board, you should consider a dedicated PostScript printer if you are starting from scratch. ■

Steve Apiki and Stan Diehl are testing editors for the BYTE Lab. They can be reached at One Phoenix Mill Lane, Peterborough, NH 03458, or on BIX as "apiki" and "sdiehl."

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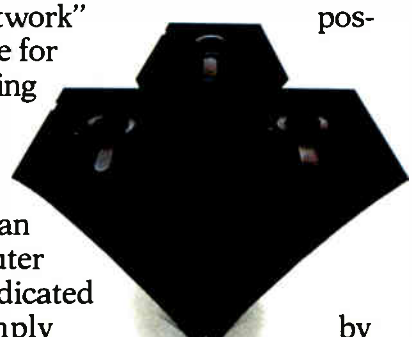

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Two for the Road

GRiDCase 1530 (left) and Toshiba T5100 (right).

Sleek and powerful 80386-based portables: the Toshiba T5100 and the GRiDCase 1530

Mark L. Van Name

When IBM PC-compatible portable computers first appeared, you needed arms like a gorilla to carry them. You were limited to an 8088 CPU, 640K bytes of RAM, 320K-byte floppy disk drives, and a small monochrome screen, if you were lucky. Portable computers have come a long way since then.

Toshiba and GRiD are now offering two of the first 80386-based true portables. GRiD's GRiDCase 1530 runs off battery power, and the Toshiba T5100 requires 115 volts AC. Other than that difference, the two systems I reviewed are very similar. Both are sleek units weighing 15 pounds or less that, when closed, are about a foot wide, a little over a foot deep, and a couple of inches high. You open both of them from the front, where the screen swings up to reveal the keyboard.

Both computers use the 80386 CPU, but the T5100's runs at 16 MHz, while the GRiDCase 1530 uses a slower 12.5-MHz speed to help conserve power. Both have 2 megabytes of memory, a 40-megabyte internal hard disk drive, a jack for an external keyboard, one DB-9 serial port, one DB-25 parallel port, and one RGB connector for an external monitor. Each also has a gas-plasma display, but the T5100's is EGA-compatible, while the GRiDCase 1530 offers only CGA graphics, with an optional expansion cartridge that supports an external VGA monitor. The T5100 also includes an internal 1.44-megabyte 3½-inch floppy disk drive, while the GRiDCase 1530 came with its optional 1.44-megabyte 3½-inch external floppy disk drive. Both systems run versions of MS-DOS.

The GRiDCase 1530 includes an external peripheral port to which you can connect devices such as the external floppy disk drive. To connect an external drive to the T5100, you use the parallel port and a switch on the front left side of the system. The switch lets you make that port act as the connection to drive A or drive B, or as a normal parallel port.

The T5100 I reviewed, which included MS-DOS, is the standard T5100 unit. It has a retail price of $7499.

The GRiDCase 1530 also came with an optional internal 2400-bit-per-second Hayes-compatible modem, a 20-watt-hour internal battery, and both a 35-W and a 70-W battery charger/AC power supply.

The standard model of the GRiDCase 1530, with a list price of $4695, initially appears much cheaper than the T5100. However, the standard GRiDCase 1530 has only 1 megabyte of RAM, two internal 3½-inch floppy disk drives, and a 10-inch diagonal backlit liquid crystal display (LCD); it runs only on AC power, and it has no hard disk drive. It also does not include any software. To make it comparable to the T5100, you

continued

GRiDCase 1530

Company
GRiD Systems Corp.
47211 Lakeview Blvd.
Fremont, CA 94538
(415) 656-4700

Components
Processor: 16-MHz 80386 running at 12.5 MHz, with compatibility speed of 6 MHz; socket for 16-MHz 80387 coprocessor running at 12.5 MHz
Memory: 2 megabytes of 32-bit 120-ns DRAM on motherboard, expandable to 8 megabytes; 128K bytes of BIOS ROM
Mass storage: 1.44-megabyte external 3½-inch floppy disk drive; 40-megabyte internal hard disk drive
Display: Gas-plasma; orange letters on a black background; CGA-compatible; seven shades of orange
Keyboard: 72-key IBM PC keyboard layout; 10 function keys
I/O interfaces: One DB-9 RS-232C serial port; one DB-25 parallel port; DB-9 RGB monitor port; external peripheral DB-25 port; DIN external keyboard connector; two 256K-byte ROM sockets

Size
11½ × 15 × 2⅓ inches; 13¼ pounds

Software
None

Options
10-inch diagonal 640- by 400-pixel plasma display: $995
2-megabyte memory upgrade: $595
16-MHz 80387 coprocessor: $1195
20-megabyte hard disk drive and 1.44-megabyte 3½-inch floppy disk drive: $1175
40-megabyte hard disk drive: $1675
External 1.44-megabyte 3½-inch floppy disk drive: $350
External 360K-byte 5¼-inch floppy disk drive: $395
MS-DOS 3.21 (on disk): $150
MS-DOS 3.21 (in ROM): $200
Rechargeable battery pack: $70
Battery charger: $90
AC power pack: $195
Internal 1200-bps Hayes-compatible modem: $395
Internal 2400-bps Hayes-compatible modem: $595
Expansion chassis and expansion bus interface cartridge: $1295
VGA cartridge: $695

Documentation
GRiDCase 1500 Series Owners Guide

Price
Model 1530: $4695
System as reviewed: $9375

Inquiry 896.

Toshiba T5100

Company
Toshiba America, Inc.
Information Systems Division
9740 Irvine Blvd.
Irvine, CA 92718
(714) 583-3000

Components
Processor: 16-MHz 80386, with compatibility speed of 8 MHz; socket for 16-MHz 80387 coprocessor
Memory: 2 megabytes of 32-bit 80-ns DRAM on motherboard, expandable on a memory card to 4 megabytes; 128K bytes of BIOS ROM
Mass storage: 1.44-megabyte 3½-inch floppy disk drive; 40-megabyte internal hard disk drive
Display: Gas-plasma; bright orange letters on a darker orange background; EGA-compatible; four shades of orange
Keyboard: 82-key IBM PC keyboard layout (101-key compatible); 10 function keys; indicator lights for Caps, Num, and Scroll Lock; cursor and page control keys; numeric keypad available by using a special function key
I/O interfaces: One DB-9 RS-232C serial port; one DB-25 parallel/floppy disk drive port; DB-9 RGB monitor port; DIN external keyboard connector; expansion slot designed for proprietary Toshiba cards

Size
12⅕ × 14⅕ × 3½ inches; 15 pounds

Software
Toshiba's MS-DOS 3.30 (includes TEST3, a diagnostic and setup program, and XCHAD, a program for controlling the mapping of colors to the T5100's four gray shades); Microsoft Windows/386

Options
2-megabyte memory-expansion card: $1299
External 360K-byte 5¼-inch floppy disk drive: $499
Internal 1200-bps Hayes-compatible modem: $399
Carrying case: $99
PC Floppy Link: $199
Expansion chassis: $999
Expansion chassis interface card: $199
GWBASIC 3.0: $75

Documentation
The First Time; T5100 Reference Manual; T5100 Portable Companion; MS-DOS 3.30 Operating System; MS-DOS 3.30 Operating System Quick Reference

Price
Standard T5100 system (as reviewed): $7499

Inquiry 895.

have to add an additional megabyte of RAM, a 40-megabyte hard disk drive (in place of one floppy disk drive), an external floppy disk drive, a gas-plasma display, and MS-DOS. These options bring the GRiDCase 1530's price up to $8780—or $1281 more than a comparable T5100.

Working on the Road

While an AC power supply is standard equipment on both units, the GRiDCase 1530 can also run on a rechargeable internal 20-watt-hour nickel-cadmium battery. The battery is fairly large (5¼ by 2¾ by 1½ inches) and fits into a slot in the rear left of the machine. It goes in easily, and you are supposed to be able to pop it out by pushing on a tab underneath it. However, I could get it out only by hitting the tab with a blunt instrument.

The GRiDCase 1530's manual includes a section and table that discuss battery life. The table lists each major possible system component (such as the LCD or plasma screen or the optional 80387 coprocessor) and the amount of power it draws. The internal battery pack is supposed to supply 20 watt-hours of power, and from that figure and the table, you can calculate how long the battery should last on your system.

I tested the system several times with a fully charged battery, and it lasted an average of about 31 minutes. The system was admittedly fairly power-hungry because of its hard disk drive and plasma display. Any system that uses an 80386, however, almost certainly needs a hard disk drive, and the plasma display is much easier on the eyes than the LCD screen. GRiD also has an optional 54-watt-hour external battery pack that can more than double your time in the field.

The GRiDCase 1530 has a red battery-low light that warns you, well in advance, that the machine is about to run out of power. Further, if you install a special GRiD device driver, the computer will beep at you approximately every 30 seconds, starting about 10 minutes before the failure.

Looking and Typing

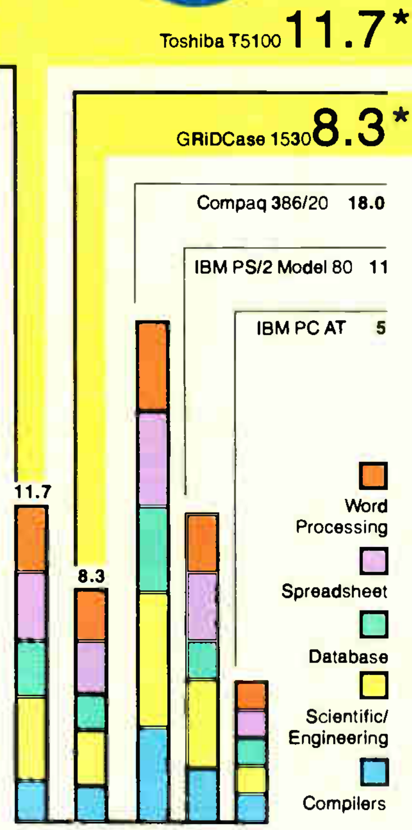
Aside from the type of power it requires, perhaps the most important other aspects of any portable computer concern how it feels in use. Screen and keyboard quality are crucial.

The T5100 has a 9¼-inch diagonal gas-plasma monitor that displays bright orange characters on a darker orange background. There are contrast and brightness knobs on the swivel arm that

continued

Toshiba T5100 GRiDCase1530

APPLICATION-LEVEL PERFORMANCE



*Cumulative applications index. Graphs are based on indexes at left and show relative performance.

WORD PROCESSING	Toshiba	GRID
XyWrite III+ 3.52	**Med./Lrg.**	**Med./Lrg.**
Load (large)	:14	:19
Word count	:03/:24	:04/:32
Search/replace	:06/:35	:09/:34
End of document	:02/:19	:02/:21
Block moves	:11/:11	:15/:15
Spelling check	:10/1:14	:14/1:40
Microsoft Word 4.0		
Forward delete	:15	:22
Aldus PageMaker 1.0a		
Load document	:04	
Change/Bold	:30	
Align right	:23	
Cut 10 pages	:21	
Place graphic	:06	
Print to file	2:27	
Index:	**2.39**	**1.75**

SPREADSHEET	Toshiba	GRID
Lotus 1-2-3 2.01		
Block copy	:04	:05
Recalc	:01	:02
Load Monte Carlo	:19	:20
Recalc Monte Carlo	:04	:08
Load rlarge3	:05	:05
Recalc rlarge3	:01	:01
Recalc Goal-seek	:04	:07
Microsoft Excel 2.0		
Fill right	:06	:07
Undo fill	2:11	2:23
Recalc	:02	:02
Load rlarge3	:29	:35
Recalc rlarge3	:01	:02
Index:	**2.47**	**1.91**

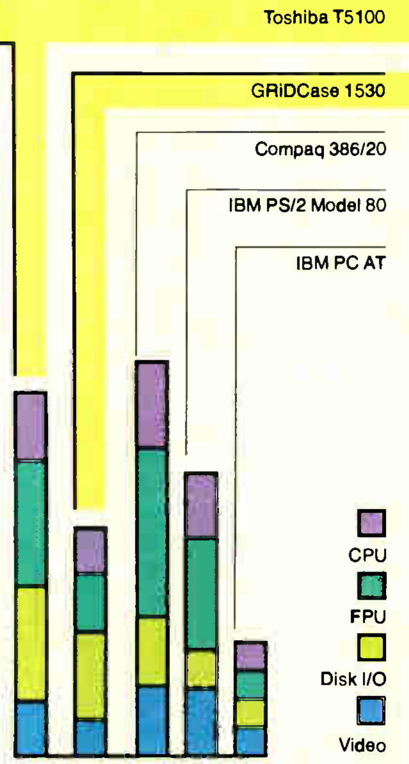
DATABASE	Toshiba	GRID
dBASE III+ 1.1		
Copy	:46	1:24
Index	:12	:21
List	1:23	1:52
Append	1:21	2:21
Delete	:01	:02
Pack	1:02	1:41
Count	:10	:18
Sort	:51	1:31
Index:	**2.23**	**1.29**

SCIENTIFIC/ENGINEERING	Toshiba	GRID
AutoCAD 2.52		
Load SoftWest	1:02	1:21
Regen SoftWest	:54	1:02
Load StPauls	:12	:17
Regen StPauls	:07	:11
Hide/redraw	13:37	20:54
STATA 1.5		
Graphics	:27	:42
ANOVA	:15	:26
MathCAD 2.0		
IFS 800 pts.	:17	:28
FFT/IFFT 1024 pts.	:17	:29
Index:	**3.05**	**2.03**

COMPILERS	Toshiba	GRID
Microsoft C 5.0		
XLisp compile	5:51	7:35
Turbo Pascal		
Pascal S compile	:08	:08
Index:	**1.51**	**1.36**

All times are in minutes:seconds. Indexes show relative performance; for all indexes, an 8-MHz IBM PC AT=1.

LOW-LEVEL PERFORMANCE[1]



CPU	Toshiba	GRID
Matrix	4.67	6.35
String Move		
Byte-wide	40.83	52.87
Word-wide:		
Odd-bnd.	40.57	52.69
Even-bnd.	20.43	27.66
Sieve	28.78	38.34
Sort	22.36	44.12
Index:	**2.39**	**1.68**

FLOATING POINT[2]	Toshiba	GRID
Math	9.54	23.54
Error[3]	0.00E+00	0.00E+00
Sine(x)	4.36	8.67
Error	2.00E-09	2.00E-09
e^x	4.15	8.64
Error	1.77E-02	1.77E-02
Index:	**4.53**	**2.09**

DISK I/O	Toshiba	GRID
Hard Seek[4]		
Outer track	3.34	3.32
Inner track	3.31	3.32
Half platter	8.77	8.30
Full platter	11.06	11.50
Average	6.62	6.61
DOS Seek		
1-sector	9.50	9.82
32-sector	22.93	33.17
File I/O[5]		
Seek	0.16	0.30
Read	0.02	0.02
Write	0.02	0.02
1-megabyte		
Write	6.77	11.62
Read	7.16	12.58
Index:	**4.06**	**3.12**

VIDEO	Toshiba	GRID
Text		
Mode 0	5.00	12.49
Mode 1	5.00	12.47
Mode 2	4.78	13.05
Mode 3	4.80	13.04
Mode 7	N/A	N/A
Graphics		
CGA:		
Mode 4	2.19	2.89
Mode 5	2.22	2.91
Mode 6	2.31	3.02
EGA:		
Mode 13	4.21	N/A
Mode 14	4.55	N/A
Mode 16	4.56	N/A
Index:	**1.90**	**1.25**

CONVENTIONAL BENCHMARKS	Toshiba	GRID
LINPACK	236.88	448.30
Livermore Loops[6] (MFLOPS)	0.11	0.06
Dhrystone (MS C 5.0) (Dhry/sec)	4118.00	2944.00

N/A=Not supported by graphics adapter.

[1] All times are in seconds. All figures were generated using the 8088/8086 version (1.1) of Small-C (16-bit integers). Figures for 80386 machines do not use 80386-specific instructions.

[2] The floating-point benchmarks use 8087-compatible instructions only.

[3] The errors for the floating-point benchmarks indicate the difference between expected and actual values, correct to 10 digits or rounded to 2 digits.

[4] Times reported by the Hard Seek and DOS Seek are for multiple seek operations (number of seeks performed currently set to 100).

[5] Read and write times for the File I/O benchmarks are in seconds per 64K byte.

[6] For the Livermore Loops and Dhrystone tests only, higher numbers mean faster performance.

For a full description of all the benchmarks, see "Introducing the New BYTE Benchmarks," June BYTE.

supports the screen.

The monitor is EGA-compatible. The T5100 maps each of the 16 possible EGA colors to one of its four gray shades, or levels of intensity (off, ⅓, ⅔, and full). Toshiba and Paradise did the EGA BIOS jointly, while the EGA chip is Paradise's PEGA-2. If you install a special device driver, the T5100 will copy the EGA ROM BIOS into the faster system RAM.

You can sometimes get into trouble with the default color-to-gray-scale mappings. For example, the calculator in Borland's SideKick displays numbers that are by default the same shade as the background. Fortunately, Toshiba provides a nice utility, XCHAD (Enhanced Change Display), that addresses this problem. If you load XCHAD as a terminate-and-stay-resident (TSR) program, you only have to enter Alt-SysReq, and it will clean up the screen so that you can see everything on it. It does so by reading the screen and then mapping the colors to gray scales that provide the greatest amount of contrast between adjacent pixels of different colors.

The screen in the GRiDCase 1530 is a 10-inch-diagonal CGA-compatible gas-plasma display. It displays orange letters on a black background. There is a sliding brightness control on the bottom right of the screen, but I could never see any difference in the screen regardless of the control's position. A Yamaha video chip provides the CGA emulation.

Like the T5100, the GRiDCase 1530 maps colors to gray scales. It offers seven levels of intensity: ¼, ⅓, ½, ⅔, ¾, full intensity, and off. Some of these levels are very close, however; only three or four are easily visible. The 1530 comes with six predefined color mappings. A GRiD spokesperson said that these mappings were enough to support nearly all MS-DOS applications. You can cycle through them with a key sequence or choose one with one of GRiD's extensions to the MS-DOS MODE command.

Both the T5100 and the GRiDCase 1530 let you connect an external monitor (EGA for the T5100 and CGA for the 1530). Both let you alternate between the internal and external displays by using a special key sequence. However, neither system lets you display the same image on both screens simultaneously.

The GRiDCase 1530's black background is much more soothing to the eyes than the bright orange background of the T5100's display. However, the finer standard font on the T5100 and its EGA capabilities make it more pleasant for prolonged text work.

Just as these machines have similar displays, so, too, do they follow similar approaches in their keyboard layouts. Both keyboards are small and are attached, integral parts of the system. Both have fewer than the 101 keys of the IBM Enhanced keyboards. They get around this deficiency by using a special function key, Fn, in multikey sequences to simulate "missing" keys, such as those normally on the numeric keypad. Both also provide a DIN jack to which you can connect any external AT-compatible keyboard.

The T5100's keyboard has a pleasant feel, with strong tactile feedback and an audible keyclick. There are Caps, Num, and Scroll Lock indicators on the screen swivel arm. The 82 keys are arranged much like an IBM PC's, but with the 10 function keys across the top. The left side of the keyboard follows that same stan-

continued

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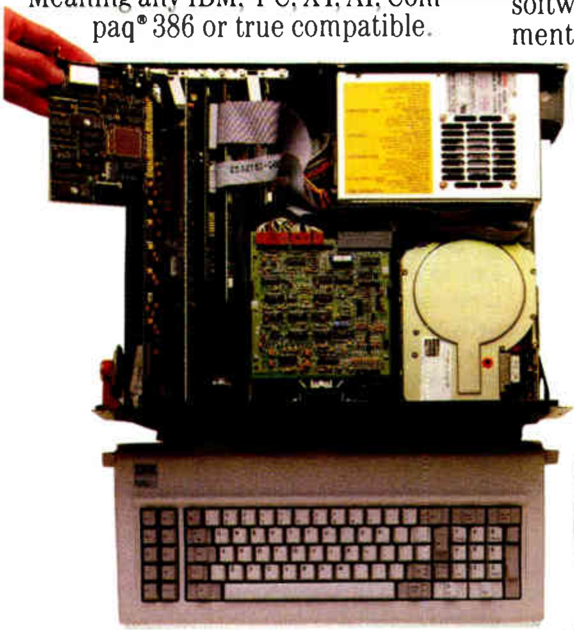

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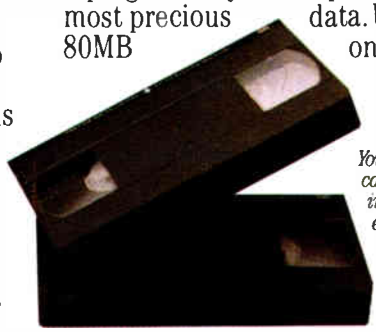

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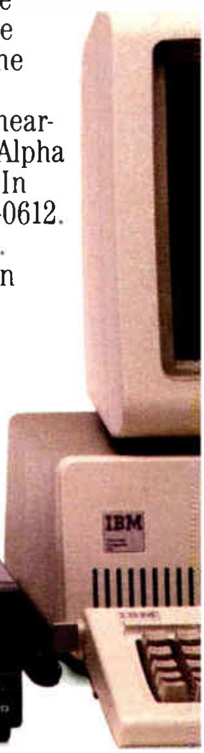

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dard, but on the right it diverges. There it has special arrow, Home, PageUp, PageDown, End, Insert, and Delete keys. You get the numeric keypad numbers, +, −, and decimal point, as well as F11 and F12, by using Fn and another key. To make it easy for you to find these other characters, alternate key functions appear in blue on the front of the keys. By using the Fn key, you can get this keyboard to generate all the key sequences of the IBM Enhanced keyboard.

The keyboard on the GRiDCase 1530 has only 72 keys—10 fewer than the T5100's—but it follows the same approach to provide other keys, such as those on the numeric keypad. Its action feels mushy at first, but the keys spring back quickly. It also has a much softer keyclick than the T5100. There are no indicator lights, not even for Caps or Num Lock—a tiny omission that I found annoying.

It also has the 10 function keys across the top, but it unfortunately also has Backspace up there, well beyond its usual position. There are four arrow keys on the right side, but you can get the other numeric keypad keys only by using the Fn key. Alternate key functions appear in different colors on the keys. There are also a few printable characters, including square brackets, curly brackets, and the tilde character, that you get only by using the Fn key. Programmers (especially C programmers) may find this bothersome.

Performance and Compatibility

As you can see in the performance charts, the T5100 is about the same speed as the 16-MHz IBM PS/2 Model 80. This performance puts it right in the middle of the zippy 16-MHz 80386 pack but still leaves it behind the 20-MHz and 25-MHz speedsters.

The GRiDCase 1530 is roughly 30 percent slower than the T5100. Most of this difference must come from its 28 percent slower 12.5-MHz clock. The 1530 actually uses a 16-MHz chip, but it runs with a slower clock to save power.

There are a few performance anomalies worth noting. While both units use the same basic hard disk drive, the T5100 actually beats the GRiDCase 1530 on the File I/O Seek test. The T5100 has its typical 30 percent edge on the 1-megabyte file Write and Read tests, and takes the Disk I/O tests overall.

The T5100 also has an unusually large edge on both the floating-point tests and tests involving applications that do a lot of floating-point math (e.g., the Engineering/Scientific application tests). Both machines have a socket for an 80387; the T5100's runs at 16 MHz, and the GRiDCase 1530's runs at 12.5 MHz.

One reason these systems don't break out of the 16-MHz pack is that they do nothing special to help speed memory access. For example, neither system uses a hardware cache. The T5100 uses 80-nanosecond dynamic RAM (DRAM), which leaves it with one wait state. The GRiDCase 1530 also has one wait state, although its slower clock speed lets it get away with 120-ns DRAM chips.

On the compatibility front, there is some obvious hardware bad news and lots of mostly good software news.

The hardware bad news is that neither of these systems can handle even one standard IBM PC expansion card. Both let you expand system memory by adding memory within the main unit—with single in-line packages (SIPs) in the 1530, and with a memory-expansion card in the T5100.

You can expand the T5100 in two other basic ways. There is one expansion slot in the right rear of the machine. It is a proprietary slot that works only with cards designed for the T5100 and, usually, the T3100, T1200, and T1100 Plus. (A card will work in all these units as long as it does not play with memory addressing in any unusual ways.) You typically would use this slot to hold an internal modem. However, you can also use it for the other major expansion option: a card that lets you attach Toshiba's external expansion chassis, which can handle full-length cards.

The GRiDCase 1530 also offers an optional interface card and expansion chassis for full-length cards, but it does not have an explicit expansion slot. Instead, you use a GRiD-proprietary expansion cartridge that fits into the battery slot. You can also buy other expansion cartridges from GRiD, including one that supports VGA graphics on external VGA-compatible monitors. The 1530 offers one other odd expansion option: It has sockets on the main face of the unit, above the keyboard and before the screen, for two ROM chips. GRiD offers its MS-DOS, as well as several other software packages, on such ROM chips.

These machines run nearly all PC-compatible software. I ran them both through a test suite that included a copy-protected Lotus 1-2-3 version 2.0; DESQview 2.0 and its accompanying Quarterdeck Expanded Memory Manager 386 version 1.0; Kermit 2.30; Norton Utilities 3.0; Microsoft's Windows/386 2.03, Word 4.0, and PC Paintbrush 2.0; WordStar 3.3 and 4.0; Q&A 1.1;

Digitalk's Smalltalk/V 1.2; and Borland's Quattro 1.0, Turbo C 1.5, Turbo Basic 1.1, Turbo Pascal 4.0, Reflex 1.14, SideKick 1.56A, and SuperKey 1.16A.

The T5100 has one software compatibility problem: It will not run Windows/386. When I tried, I got the message: `Error: Unsupported DOS version.` A Toshiba technical-support person said that Toshiba is aware of this problem and that it should go away when Toshiba releases MS-DOS 3.3 for the T5100.

The 1530 also seemed to have a compatibility problem, but there was a way around it. The Quarterdeck Expanded Memory Manager 386 version 1.0 would not work, and instead reported: `No room for Page Frame. Cannot load because there is not enough memory.` GRiD's own expanded memory manager (GRiD-386) worked like a champ, however. A GRiD support person led me to try putting the page frame at memory locations C000x and D000x hexadecimal, both of which worked. He said that the error was due to my old version of the Quarterdeck software, and that it would not occur with a newer version.

If necessary, both machines can operate at a slower compatibility speed. The T5100 offers 8-MHz operation; the 1530 can run at 6 MHz. However, they each ran Lotus 1-2-3 version 2.0 without making me slow them to their compatibility speeds.

Digging Inside

Getting inside most personal computers is a fairly simple matter; not so with these tightly packed portables. I don't recommend that you take one of these apart unless you are willing to move very slowly and carefully.

The bottom of the T5100 curves slightly, so when its rear tilt stand is up, the keyboard sits flat. To accommodate this bend, the motherboard, which runs along the bottom of the machine, is in two pieces: There's a small piece under the keyboard, and a larger one under the rest of the machine.

The section under the keyboard is attached to the main section by several wide ribbon cables and is easily accessible. It contains the ROM chips, the keyboard controller, the memory, and some support chips. It also contains an expansion connection for the memory-expansion board, which goes to its right. This board can increase the system memory to 4 megabytes of 32-bit memory. You can make the T5100 copy the ROM BIOS (from Award and Toshiba) into the faster RAM by choosing the fast ROM option in the T5100's Setup program.

The T5100's memory chips are 1-megabit chips mounted on single in-line memory modules. The SIMMs are soldered, not socketed. There is also a small daughtercard, seated above the main part of the motherboard, that holds the EGA chips, 256K bytes of EGA memory, and some other support chips.

The main piece of the motherboard contains the 80387 socket, the 80386, and a number of Toshiba chips; many of the chips are surface-mounted. Not counting the memory chips, the three motherboard components contain a total of only about 70 chips. The boards are clearly manufactured by Toshiba and use many Toshiba parts.

The GRiDCase 1530 has a flat bottom, so it has a single main motherboard. It also has a daughtercard above part of the motherboard. GRiD manufactures both boards. The daughtercard contains the Yamaha CGA chip and the sockets for the two ROM-expansion chips that you can install.

The main motherboard contains 109 chips, not counting DRAM chips, but very few are surface-mounted. Its 2 megabytes of DRAM are mounted in eight 256K-byte SIPs. You can replace some or all of these SIPs with 1-megabyte versions to get either 4 or 8 megabytes of RAM. The motherboard contains the 80386, the 80387 socket, the ROM BIOS chips, and four large Faraday chips, among many other chips. The four Faraday chips do much of the standard AT work, while most of the others provide the discrete logic that handles the 80386 and its 32-bit memory bus. The 1530's ROM BIOS is Phoenix's 80386 ROM BIOS version 3.06, dated 3/17/88.

Both machines use the same Conner 40-megabyte hard disk drive. This drive has a formatted capacity of 40.8 megabytes and an average access time of 29 milliseconds.

Toshiba made a modification to its setup and MS-DOS that lets you avoid the usual 32-megabyte partition limit and have a single 40-megabyte partition. The T5100 uses 1024-byte sectors to support this larger partition.

The floppy disk drives of the two machines are standard 1.44-megabyte 3½-inch models. The T5100 uses a Toshiba drive; the GRiDCase 1530's external drive is from Epson.

The Rest of the Package

The T5100 comes with Toshiba's MS-DOS 3.30, and you can buy GWBASIC 3.0 as an option. Toshiba's MS-DOS in-

continued

cludes setup options that let you allocate memory above 640K bytes to expanded and/or extended memory. A Toshiba spokesperson said that the company would be offering Unix and OS/2 in the future. With the T5100, Toshiba is also bundling Lotus's Metro, a desktop manager with 12 accessories and a macro generator.

The T5100 also comes with a boxed set of five manuals. This set includes an MS-DOS 3.30 reference manual, an MS-DOS quick reference guide, a manual for new users, a T5100 reference manual, and a thin "Portable Companion" manual that summarizes most of the information in the T5100 reference manual. The reference manual is particularly useful, with thorough explanations of nearly all the system's features.

The standard GRiDCase 1530 does not include any software. You can buy GRiD's MS-DOS 3.21; its MS-DOS extensions include many new MODE options that let you control hardware options, a GRiDScan program that gives system configuration information, and the GRiD386 expanded memory manager.

A GRiD spokesperson said that the 1530 will run both the Santa Cruz Operation's (SCO) Xenix System V and Interactive Systems' 386/ix Unix; GRiD sells only the SCO Xenix, however. The spokesperson said that GRiD was experimenting with OS/2 and would offer it when enough customers requested it.

The GRiDCase 1530 comes with an owner's guide and short reference manuals for each of the hardware options. You also get an MS-DOS manual if you buy that option. The owner's guide is short but useful, with a fairly thorough discussion of the system's options, including much useful information on its battery usage and power requirements.

The telephone-support people at both companies were among the best with whom I've had the pleasure to talk. They were able to answer nearly all my questions, including very technical ones, quickly and correctly. Those few that they could not answer, they researched and answered later. There does not seem to be any limit on the telephone support that either company offers, and you can reach both support services through toll-free numbers.

The T5100 comes with Toshiba's one-year "Exceptional Care" limited warranty. You can buy an additional two years of support, but it is expensive: $979 for the basic unit alone, and more for each option.

The GRiDCase 1530 includes a 90-day limited warranty.

Juggling Options

Given the short life of my GRiDCase 1530's battery, battery operation seems to be for occasional use only. If you need that capability and can do without EGA graphics, it is a good machine. It also provides a cheaper entry-level model than the T5100.

The T5100 has a higher price for an entry-level machine, but if you want a faster CPU and EGA graphics at a less expensive price (for comparably equipped machines), and if you do not have the need to run from a battery, go with the T5100.

Both machines are signs of the times and of things to come: ever more power in ever-smaller, sleeker packages. ■

Mark L. Van Name is a freelance writer and computer consultant living in Durham, North Carolina. He can be reached on BIX as "editors."

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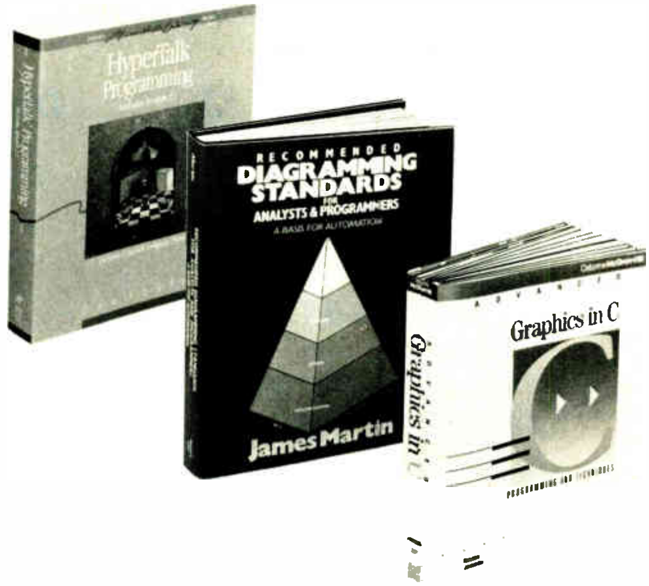

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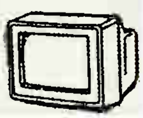

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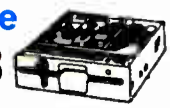

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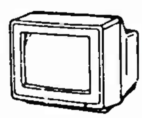

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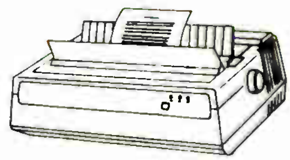

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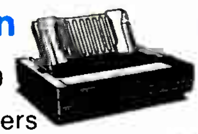

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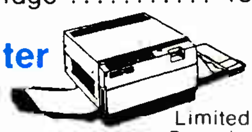

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An 80386 with a Twist

Competitive pricing and an intelligent bus distinguish the AST Premium/386 from its peers

Jeff Holtzman

In an increasingly crowded field of 20-MHz 80386-based AT compatibles, AST Research's Premium/386 is a unique entry. Like IBM's PS/2 series, it includes several peripheral controllers on the motherboard. But what separates the Premium/386 from the rest of the 80386 pack is its intelligent bus design, which lets devices on the motherboard other than the CPU take control of the bus to gain fast access to system memory and peripherals. And unlike the PS/2's Micro Channel architecture (MCA) bus, the Premium/386's bus is fully compatible with IBM PC XT and AT buses.

The Premium/386 comes in five configurations. The basic unit is the Model 300 ($5195), which includes a 20-MHz 80386, sockets for both an 8-MHz 80287 and a 20-MHz 80387, 1 megabyte of 32-bit 80-nanosecond static-column RAM, one parallel and two serial ports, and seven expansion slots. One expansion slot is dedicated to AST's proprietary 32-bit memory card; two are standard 8-bit (XT-style) slots; one is a standard 16-bit (AT-style) slot; and three are SmartSlots. The latter closely resemble a standard AT expansion slot, except that the lower connector carries several new signals that allow a "master" device on a specially built card to take control of the bus from the CPU (see the text box "AST's SmartSlot Architecture" on page 196).

The base unit also comes with a battery-backed clock/calendar, a 101-key enhanced-style keyboard, and a floppy disk drive controller that controls a maximum of four devices in all 5¼-inch and 3½-inch formats. The Premium/386 can accommodate three externally accessible half-height drives; another unexposed bay accepts either one full-height or two half-height devices.

Unlike many high-performance 80386-based microcomputers, the Premium/386 has no hardware cache, nor does it support the Weitek 1167 math coprocessor. The base system does not come with a graphics card, a monitor, or a hard disk drive.

Standard software includes MS-DOS 3.30, GWBASIC 3.22, a ROM- and RAM-based setup program, and utility software (an expanded/extended memory manager, RAM disk, disk cache, and print spooler). AST's version of OS/2 1.0 is available for an extra $325.

I reviewed the Model 390, which includes an additional megabyte of memory and a 90-megabyte 18-millisecond enhanced-small-device-interface (ESDI) hard disk drive. The hard disk drive automatically parks the read/write heads in the last cylinder when powered down. The review system came with a 20-MHz

continued

AST Premium/386

Company
AST Research, Inc.
2121 Alton Ave.
Irvine, CA 92714
(714) 863-1333

Components
Processor: 20-MHz Intel 80386; sockets for 20-MHz 80387 and 8-MHz 80287
Memory: 2 megabytes of 80-ns static-column DRAM, expandable to 15 megabytes with 13-megabyte expansion card
Mass storage: 1.2-megabyte 5¼-inch floppy disk drive; 90-megabyte 18-ms ESDI hard disk drive
Display: Optional EGA monitor and 3G Plus II EGA card
Keyboard: 101-key enhanced keyboard
I/O interfaces: Two RS-232C serial ports (25-pin); one parallel port (25-pin); one 32-bit memory-expansion slot; two 8-bit and one 16-bit expansion slots; three 16-bit AT-compatible SmartSlots

Size
19¼ x 6¼ x 16½ inches; 40 pounds

Software
MS-DOS 3.30, GWBASIC 3.22, ROM- and RAM-based setup, diagnostics, RAM disk, disk cache, print spooler, expanded/extended memory manager

Options
OS/2 1.0: $325
1 megabyte of SIMM memory: $1095
4 megabytes of SIMM memory: $7995
3G Plus II EGA card: $395
VGA card: $445
VGA Plus card: $599
Monochrome monitor: $195
EGA or VGA monitor: $695
1.2-megabyte floppy disk drive: $235
360K-byte floppy disk drive: $215
1.4-megabyte floppy disk drive: $695
40-megabyte tape backup: $695

Documentation
AST Premium/386 User's Manual; AST Premium Utility Software User's Manual; AST Operating System 3.30

Price
Model 300: $5195
Model 340 (with 40-megabyte hard disk drive): $6295
Model 390 (with 90-megabyte hard disk drive): $8495
Model 3150E (with 150-megabyte hard disk drive): $9795
Model 3320 (with 320-megabyte hard disk drive): $10,795
System as reviewed: $9585

Inquiry 894.

With an AST EGA card, you can load the FASTEGA.SYS driver via your CONFIG.SYS file; this copies the EGA BIOS to Shadow RAM. Typing a 32K-byte ASCII file to the screen took about 38 seconds without using FASTEGA.SYS, but only about 11 seconds with it installed. Unfortunately, FASTEGA.SYS won't let you copy third-party EGA (or VGA) BIOSes to Shadow RAM.

Of the remaining 256K bytes of reserved memory, you can use 64K bytes (or 60K bytes in a 1-megabyte system) to load AST's expanded memory manager, ASTEMM.SYS, leaving 192K bytes (196K bytes in a 1-megabyte system) for use as Expanded Memory Specification (EMS) 4.0 memory. Like similar drivers from other vendors, ASTEMM.SYS also uses the 80386 processor's hardware memory-paging capability to emulate EMS 4.0 using standard 32-bit and 16-bit extended memory. 386MAX also knows how to add the Premium/386's reserved memory to its pool of EMS memory.

My only complaint with this allocation scheme is that 64K bytes of the 128K bytes of Shadow RAM (the segment beginning at E000:0000h) is wasted if you don't run an AST video adapter. That segment is unavailable to other adapters (e.g., a network card) or programs that might otherwise be able to use it. 386MAX, for example, could have used it for program loading. You can regain the use of the segment by disabling Shadow RAM, but then you lose the speed advantage of running the BIOS from RAM.

Up and Running

Getting the machine running is simple, thanks to AST's well-written and well-illustrated directions. To run the ROM-based setup program, you press and hold any key during the boot process. When the machine displays an error message, you press Ctrl-Alt-Esc to enter the setup program. AST also supplies a RAM-based version of the setup program.

The setup information occupies two screens. If you've ever used an AT clone with a BIOS written by Award Software, AST's setup program will be familiar to you. With auto-slowdown enabled and the system operating at its fastest speed, processing slows to the XT-compatible speed (4.77 MHz) whenever the system accesses the floppy disk.

During operation, you can change speed at any time by pressing Ctrl-Alt-Up to increase speed or Ctrl-Alt-Down to decrease speed. You can also execute SPEED.EXE to switch among high (20-MHz), medium (8-MHz), low (4.77-MHz), or default speed, or to enable and disable auto-slowdown. With all these speeds, though, the actual clock speed doesn't change.

Booting is fast because the system performs only a limited memory check. You can run more extensive diagnostics with a supplied set of routines that check various subsystems (e.g., memory, keyboard, disk, and video) and that also include a low-level disk-format routine.

Benchmark Standings

The Premium/386 offers performance that lies between that of the 16-MHz IBM PS/2 Model 80 and that of the 20-MHz Compaq Deskpro 386/20. In the low-level memory-access tests, the Premium/386 performed the Sieve and Sort benchmarks nearly as fast the Compaq, but in the String Move and Matrix operations, it dipped to the level of the Model 80. Here the Premium/386's static-column architecture had a negative effect.

On the floating-point benchmarks, the Premium/386 fell between the Model 80 and the Deskpro in all three tests. It was a consistent 26 percent faster than the Model 80, and it ranged from 10 percent to 20 percent slower than the Deskpro 386/20.

The Disk I/O tests show that the performance of AST's Control Data hard disk drive with Western Digital's controller is nearly identical to that of the Compaq's drive. The two exceptions are the DOS Seek 1-sector test, where the Premium/386 was some 30 percent faster, and the 1-megabyte Write test, where the Premium/386 performed about 20 percent faster than the Compaq.

The Premium/386's performance in the Video benchmarks was disappointing. The Compaq was consistently faster in both text and graphics tests. The Model 80 performed better than the Premium/386 in the text benchmarks, and the Premium/386 barely edged out the IBM in graphics modes.

The applications benchmarks generally correspond to the low-level benchmark results. In most tasks, the Premium/386 lagged behind the Compaq and was 10 percent to 50 percent faster than the Model 80. Overall, a user running disk-intensive applications wouldn't notice much difference between the Premium/386 and the Compaq. Applications relying more heavily on computation and graphics output would find the Compaq somewhat faster.

What Runs

The Premium/386 had no trouble running the following software: DESQview

continued

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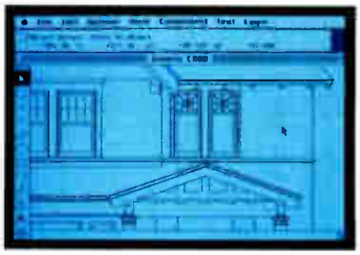

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S O F T W A R E

2.01 (with QEMM), 386MAX, Windows/386, Windows 2.0, AST's version of OS/2, Concurrent DOS 386, WordStar 4.0, a beta release of WordStar 5.0, Turbo Pascal 4.0, T-DebugPLUS 4.0, Procomm 2.4.2, Microsoft BASIC 6.0, Lotus 1-2-3 version 2.01, VP-Planner 1.0, Professional CED 1.01a, Brooklyn Bridge 1.30, DeskLink 1.06/2.16, AutoCAD 9.0, AutoSketch enhanced version 1.01, Excel 2.0, and PageMaker 1.0.

AST's optional OS/2 software lets you boot either DOS or OS/2 from the hard disk. In addition, AST's OS/2 leaves your hard disk better organized than does IBM's. It stores only a dozen or so files in the root directory, versus three or four dozen with IBM's version. The rest it stores in the OS2 directory and in other subdirectories below it.

As for hardware, I had no problems installing and using a Microsoft Serial Mouse, a Quadram JT Fax board, a BocaRAM/AT extended memory board, or a Paradise AutoSwitch monochrome EGA card. However, I did have problems installing Orchid's Designer VGA and Paradise's VGA Plus boards on my review machine. With either card installed, the machine became extremely unstable, sometimes refusing to boot and at other times crashing unexpectedly, especially when I changed speeds using the keyboard commands. Also, the Orchid board simply wouldn't fit into the machine unless I removed the mounting bracket.

AST said it had not tested the Orchid board, but it claimed that the Paradise board was compatible. The company sent a second machine, and this time the boards worked flawlessly. Both machines were using BIOS version 1.2.

Supporting Details

The Premium/386 has a 220-watt power supply and carries an FCC Class B certification, which means it's approved for home use. The motherboard, measuring about 10 by 13 inches, is divided into three areas. At the rear left are seven expansion slots. At the rear right are the peripheral interfaces (serial and parallel ports and the disk controller). The front half of the board holds most of the system logic, including the CPU, math coprocessor, BIOS EPROMs, keyboard controller, and I/O decoding. Instead of mounting memory on the motherboard, however, AST put it on a 32-bit card. The overall workmanship of the motherboard is excellent; there are only three jumper wires on the back of the board.

The Premium/386's keyboard is the same unit that ships with the Premium/286. Its mushy feel is disappointing, given the overall quality of the system.

Finally, my EGA monitor had a tilt-and-swivel stand, but I couldn't tilt the monitor forward from the upright position. Counterbalancing that fault, however, are the front-mounted power switch and brightness and contrast controls.

Technical support is available for the price of a phone call. The technician I talked to was knowledgeable about simple setup and operational questions but weak in knowledge about wait states, reserved memory, and similar topics. A local dealer fared somewhat better, however.

The machine carries a 12-month parts and labor warranty (after shipping from an authorized AST reseller, or 14 months from AST, whichever comes first).

The Cost Effect

If performance is paramount and money is no object, there are faster machines (Compaq's Deskpro 386/20 and ALR's FlexCache 20386, for example). However, you can buy a Premium/386 Model 390 with VGA adapter and monitor for $9585, whereas a comparably equipped Compaq costs about $11,400. In other words, the Premium/386 costs 85 percent of the Compaq price, but it provides more than 85 percent of the performance overall.

Also, the performance of AST's new 16-bit VGA card (released too late for this review) may equal or exceed the video performance of the Compaq and other machines, for just a few hundred dollars over the Premium/386's current price.

On the other hand, the motherboard has no on-board video adapter, regular memory, or cache memory. But because graphics standards are evolving so rapidly, the lack of a built-in video adapter is an advantage—you can upgrade that portion of the system as your needs require.

AST's SmartSlot architecture is a potential advantage for the Premium/386, if vendors design products that take advantage of its features. AST has published SmartSlot's specifications and has instituted a liberal licensing policy. But even if SmartSlot doesn't take off, the Premium/386 still provides good performance for a good price. ■

Jeff Holtzman owns Publishing Concepts, a firm that specializes in evaluation, verification, and documentation of high-technology products. He lives in Ann Arbor, Michigan, and can be reached on BIX as "editors."

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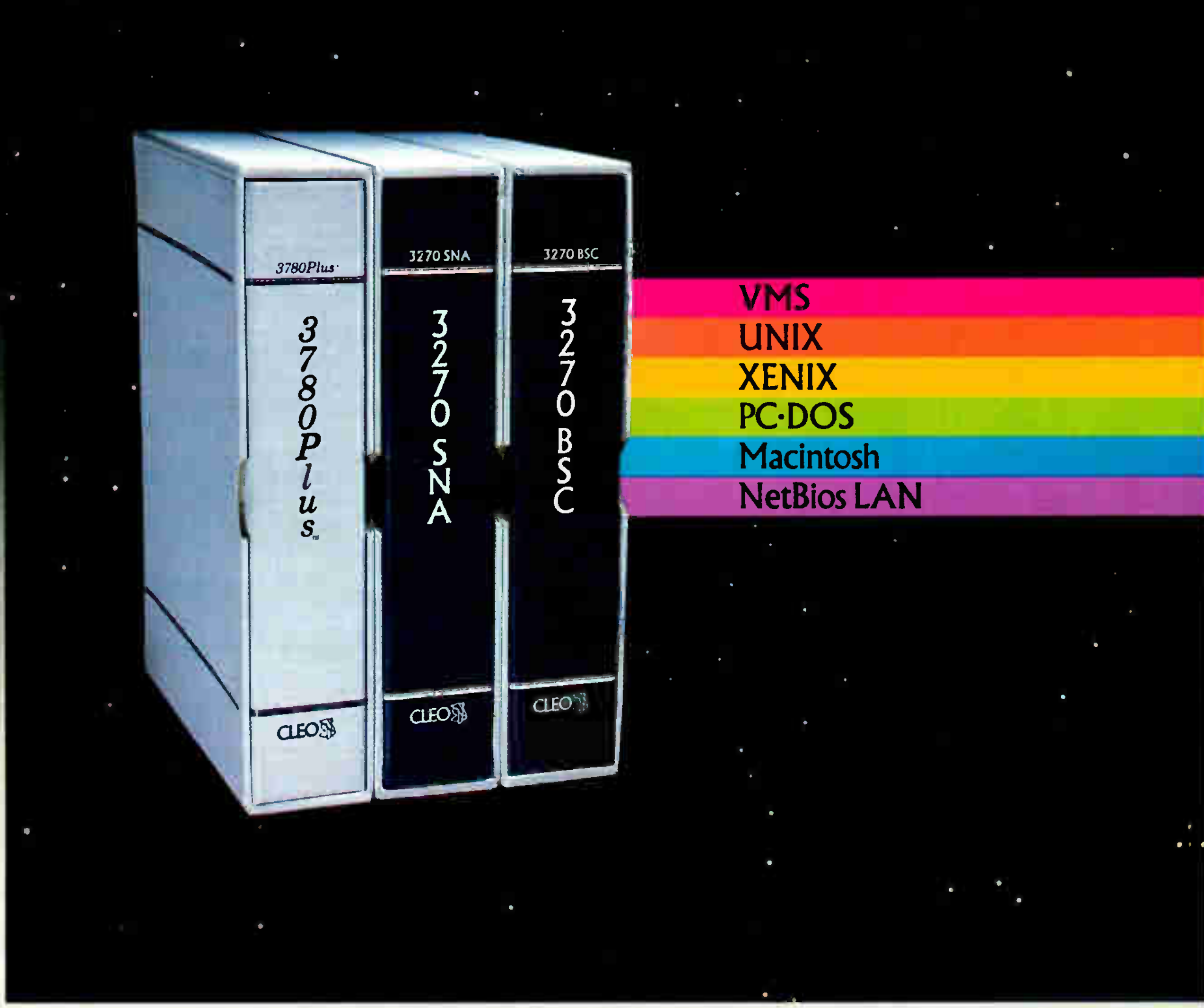

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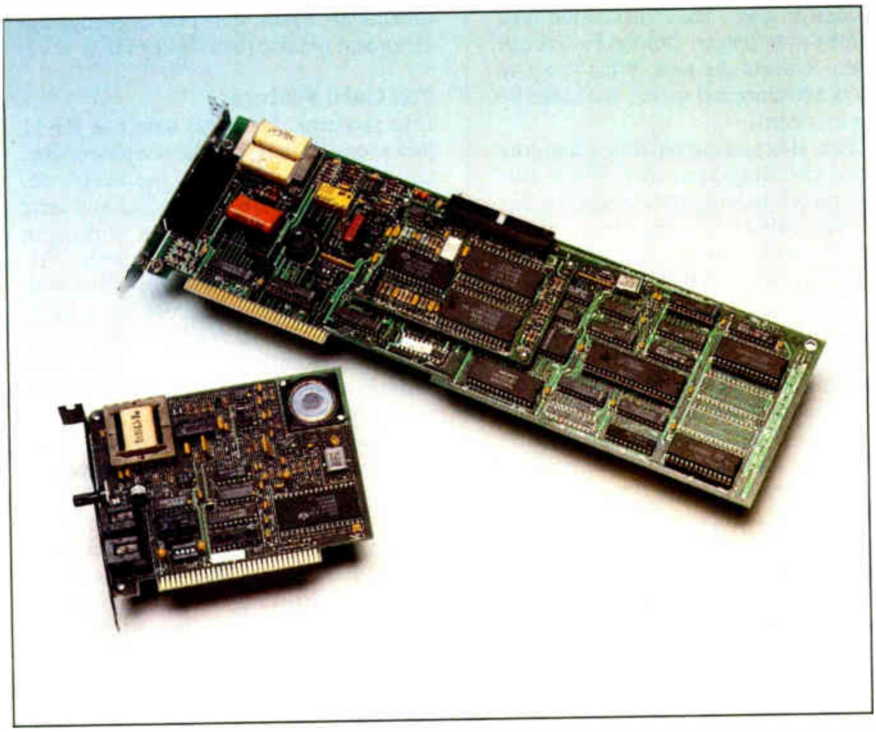

Datacopy's Microfax (top) boasts a Hayes-compatible modem and support for AutoCAD files; Quadram's JT Fax 4800 (bottom) offers basic fax capabilities for under $400.

Facsimile boards offer high-speed text and graphics file transfers from the desktop

Brock N. Meeks

The latest high-tech catchphrase is the trendy-sounding "image communications." This entails sending bit-mapped text and graphics information across a city, or across continents, simply by inserting a document into a facsimile machine and pressing a button. In 30 seconds or less, an exact duplicate crawls out of the remote machine. It's a heady process, and it's easier to comprehend than the telephone. Now implementations of this technology on microcomputers are gaining popularity.

If the last fax machine you were acquainted with was that hulking monster in the corner of the mail room, look again. The newest fax machines are smaller, cheaper, and easier to use than some multibutton telephones. Microcomputer fax cards share much of the same simplicity while offering better image quality and the ability to store image files to disk. Regular RJ-11 connectors tie them into your telephone line, giving you the option of voice or fax transmission.

What, Me Fax?

The appeal of fax technology isn't so much due to its trendy high-tech status as to its down-to-earth practicality. Fax can marry graphics images with pages of text and send those documents from Toledo to Tibet in a matter of seconds—something that anyone who has tap-danced on a tight deadline or winced at the price of sending documents by overnight courier can appreciate. And since fax is virtually instantaneous, it can salvage a deadline for the price of a phone call.

Fax cards fit into a standard slot in your microcomputer and support the 9600-bit-per-second CCITT Group III fax standard. (See the text box "How Fax Works" on page 204.) The cards also include software for converting ASCII text and graphics files to bit-mapped fax image files. Once you've converted a file, you can store it, fax it to another machine, or print it out.

Fax cards aren't intended to replace the traditional fax machine, but to turn the desktop into a communications center with full graphics capabilities. Still, fax cards do have some distinct advantages over their stand-alone cousins.

One advantage is better image quality. A traditional fax machine is convenient; you simply insert a document, dial the remote machine, and press a button. But what stand-alone fax gives you in convenience, you give up in quality. Chunky, jagged fonts printed on flimsy thermal-transfer paper are the trademark of stand-alone fax machines. These look bad, in part, because they're third-generation copies. The document usually starts out as a file, which you then print. Next, you feed the document into the fax machine, which scans it and sends it to

continued

How Fax Works

Although current fax technology zips along at 9600 bps, the road to these high-speed image transfers was a long one.

The ability to transmit bit-mapped images isn't new; the technology to transmit signals over a wire and onto paper has been around since Alexander Bain patented such a device in 1842, and newspapers have used the wire services to transmit photographs for decades. So what took so long? In a word: standards. There were none.

Fax machines became popular only after the mid-1960s, when the CCITT (International Telephone and Telegraph Consultative Committee) hammered out the world's first set of fax transmission standards, called Group I. Since then, the CCITT has developed three other sets of standards (Groups II through IV). Each successive standard has provided fax technology with a quantum leap both in image quality and transmission speed.

The Group I and Group II standards are based on analog technology. Early Group I fax machines operated much like a 300-bps modem and took 6 minutes to send a single page. Group II machines, introduced in the mid-1970s, improved resolution and cut transmission time to 3 minutes per page. These are the fax machines most people probably remember dealing with in the mailroom. They were unwieldy and were prone to jamming and telephone line noise. A fair number of Group II machines are still around.

The big break in fax technology came in 1980 when the CCITT approved the 9600-bps Group III standard; most fax machines and fax cards today conform to it. Group III broke away from the analog world by implementing digital image scanning and data compression methods.

Many Group III products use the Rockwell V.29 chip set, which uses the CCITT V.29 half-duplex 9600-bps file transmission standard and the Modified Huffman compression scheme. Fax machines use this scheme to compress much of the white space in a document. The fax image file is compressed en route to the remote machine; on arrival, it is decompressed (decoded) for storing to disk or printing.

The top-end resolution for Group III fax machines is 200 dpi. A typical transmitted page in normal resolution (actually 203 dpi horizontal by 98 lines per inch) takes from 15 to 20 seconds on a "clean" phone line. However, many documents, especially those with lots of graphics, are transmitted in fine mode, which increases the vertical resolution to 196 lines per inch and doubles the transmission time. If your fax card happens to have gray-scaling capability (the ability to read and transmit subtle shades of gray), the transmission time can be even longer. But the results can make it worth the wait. What you give up in economy and speed, you make up for in quality.

Fax transmissions don't use any error-checking protocols. While this optimizes throughput, it makes fax transmissions susceptible to "data hits," which result in tiny holes in an image. However, data hits aren't as critical for images as they are for other types of data, such as program code.

Another nice feature of Group III fax transmissions is that they have automatic fallback protocols. If a Group III machine is transmitting to a Group II machine, for example, it automatically falls back to the slower Group II transfer rate. In addition, if it can't establish a connection at 9600 bps due to poor line quality, it will try to connect at 7200 bps, and then at 4800 bps.

The Group IV standard, approved last January, is a bit ahead of its time. To use a Group IV–compatible fax, you must have a leased telephone line or connect to an Integrated Services Digital Network (ISDN), which has yet to become widely available. Group IV–compatible machines, at about $10,000, are high-priced, but you do get a dramatic increase in performance: 30 pages per minute at 400 dpi. Federal Express based its ill-fated Zap Mail service on Group IV fax.

While the fax industry looks to the day when ISDN becomes a reality, at least one promising advance awaits implementation in the Group III arena. Last September, Rockwell announced a compact, CMOS low-power, full-duplex V.32 9600-bps modem board, called the R9696DP. Essentially a modem on a chip, this board promises to change the complexion of the fax card market by allowing such cards to support full-duplex fax or modem transmissions at 9600 bps.

---

the remote fax, which prints it again. This process of converting and printing the document file lowers image quality significantly.

By contrast, documents created on a personal computer and sent from a fax card require no intermediate conversions, so they produce first-generation documents. If you happen to be sending an image file to another fax card, it's possible to store the image to disk or output it to a laser printer. Anyone familiar with the less-than-stellar thermal-print quality of a fax document is in for a pleasant surprise: Laser-printed fax documents are crisp, and line drawings are clean and precise (see figure 1).

Fax Card Features

Like modems, fax cards have two RJ-11 jacks; one connects to the telephone line, and the other attaches to the telephone. The first input lets the fax dial and send and receive documents, often working in background or unattended mode. Although your telephone shares a line with the fax card, telephone use isn't hampered. In fact, most fax cards let you initiate a voice call, send a fax during the call by pressing a function key, and then resume your conversation.

Software is the key to differentiating between fax cards. Some of the products reviewed here are "bare bones" units that offer conversion of ASCII files to bit-mapped fax image files, but not much else. Others are packed with an array of bells and whistles. If your fax needs don't go beyond transmitting text documents and an occasional graph or two, then a fax card without all the fancy features should serve you well. However, if you're looking for a full-function card, you'll want to check into some of the more advanced features.

Two key features included with most fax cards are unattended (automatic) polling, and broadcasting. With automatic polling, you configure your fax to call a designated group of other fax numbers at a specified time to see if they have anything to deliver. To broadcast a document, you specify a list of telephone numbers you want a document faxed to at a specific time; transmission then occurs automatically. Some fax cards limit the number of locations you can put into a list; others let you string together multiple lists to broadcast to a virtually unlimited number of machines. Broadcast capability makes it easy to schedule transmissions in the early morning hours, when telephone rates are lowest. And when your fax card isn't sending those documents, it can receive fax transmissions or poll other machines.

Another consideration is whether you can view files on-screen before printing or faxing them. Most fax cards support this capability. Seeing how a file will look before faxing it helps ensure that the receiver will get the correct image. Another handy feature is background-mode operation, which lets you work on a spreadsheet or word-processing file while sending a fax.

You may want a fax card that accepts optical scanner input. Some cards include special optical-character-recognition (OCR) software for this purpose. Others may also include a port to connect the scanner directly to the fax card. A related feature is the ability to accept and transmit gray-scale images—a crucial feature for transmitting multicolor drawings or photographs. Fax cards with gray-scale capability pick up and transmit subtle shades.

Not all fax cards are compatible with every graphics format. Be sure that the conversion software supports TIFF (Tag Image File Format) if you're using PageMaker, .PCX files for PC Paintbrush, .PLT files for AutoCAD, and so on.

Most cards keep some kind of "activity log" that stores information about the fax transfer process. This lets you monitor fax transmissions and determine if any transmission failures have occurred. Some cards also include a modem, making maximum use of the computer's slot. Finally, you should make sure that the fax card supports your printer.

Trials and Tribulations

I tested 10 fax cards on an IBM XT compatible with a 20-megabyte hard disk drive, a Hercules graphics card, and 640K bytes of RAM. All tests were run at 8 MHz. See the table on page 206 for a listing of the products and their features.

Before reviewing the results, a few caveats are in order. First, converting files from ASCII to fax with a system running any slower than 8 MHz is unbearably slow. Second, converted fax images gobble disk space, so leave plenty of room on your hard disk. A typical page of text requires about 60K bytes of storage as a fax image file; a detailed, multi-gray-scale picture can eat up as much as 500,000K bytes.

Also, if you're a fan of RAM-resident programs, break your habit, at least when you're using fax software to convert files to fax images. More than once, after I waited minutes for a fax image conversion to finish, the entire system locked up because I didn't have enough RAM overhead.

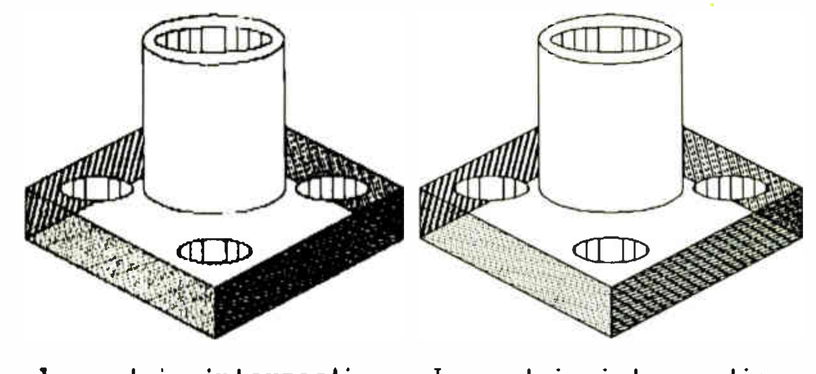

Figure 1: *The image at left is an AutoCAD file that was printed on a LaserJet II and transmitted between standard fax machines. The image at right is the same file, sent between PC fax cards and output to the same printer.*

I also experienced problems when exiting from some fax card programs. Not all software packages would issue error reports; some locked my machine up and I had to reboot. Here again, you have to watch what programs you have in RAM. It's a trial-and-error process, unfortunately, as none of the manuals give specifics on which RAM-resident programs may cause problems.

That said, here are the highlights of my experience with 10 fax cards.

Fax-Mail 96

Brooktrout Technology's Fax-Mail card comes in three versions: the $599 9600-bps fax card reviewed here, a 2400-bps model ($399), and a 4800-bps model ($499). For the difference in price, I can't imagine why anyone would opt for the slow speed of the 2400-bps fax card.

The Fax-Mail 96 includes the ability to merge text files with letterhead. Getting the letterhead encoded as a bit-mapped fax image file requires a scanner, however. You could input a printed copy of the letterhead from a stand-alone fax machine, but the image quality would leave much to be desired.

Brooktrout's Chop feature separates a received fax image into different files. For example, you can cut both the letterhead and the signature from an original fax so you can merge them into other fax documents. You can also use PC Paintbrush to clean up the letterhead or other images.

Other features include Supershow, which lets you scale down a multipage fax image so you can view multiple pages on your screen, and a printer capture option that can create a fax image file from word-processing files sent to the printer port in Epson FX-80 format. The latter converts text and attributes (such as boldfacing and italics) to fax image files. Fax-Mail also supports several word-processor file formats, including Microsoft Word and WordPerfect.

Conversion software transforms ASCII and PC Paintbrush files to fax image files, and it also can convert fax image files back to PC Paintbrush.

JT Fax 4800

If any fax card marches to the beat of a different drummer, Quadram's JT Fax is it. Although this is the least expensive of the cards reviewed, it offers several heavyweight features that make it ideal for small business or personal use.

One standout feature of this card is the way it converts files to fax images. With most fax cards, you must run all files through a conversion process before transmitting them. The large size of fax image files quickly depletes hard disk real estate, however. In contrast, the JT Fax does file conversion on the fly. It determines what type of file it's going to send, and after making a connection with a remote machine, it converts the file as it's transmitted.

This approach has one small drawback: It limits the board's speed to 4800 bps. The slower speed shouldn't be a problem for the occasional fax user, however, and the board's low price and the fact that your disk drive isn't cluttered with several 50K-byte-plus files is adequate compensation.

The JT Fax accepts input from an external scanner and lets you send documents to another fax or to your printer as they're scanned, without first storing

continued

Product and company	Price	Speed (bps)	RAM required (bytes)	Board size	Hayes-compatible modem	Scanner port
Fax-Mail 96 Brooktrout Technology, Inc.	$599	9600	512K	Full	No	Yes
JT Fax 4800 Quadram Corp.	$395	4800	256K	Half	No	No
The Complete Fax The Complete PC	$499	4800	512K	3/4	No	No
MFAX96P Microtek Lab, Inc.	$995	9600	256K	Full	No	Yes
Facsimile Pac Dest Corp.	$995	9600	640K	Full	Optional 1200-bps ($129)	Yes
pc-Fax EIT, Inc.	$1095	9600	640K	Full	No	No
GammaFax GammaLink	$995	9600	256K	3/4	Optional 1200-bps ($200)	Yes
Microfax Datacopy Corp.	$1195	9600	384K	Full	1200-bps	No
Faxcard/Fax Partner SpectraFAX Corp./Panasonic Industrial Co.	$999	9600	640K	3/4	No	No
SmartFax American Data Technology, Inc.	$949	9600	640K	2/3	No	Yes

them to disk. The unit does not operate in background mode, however.

Another feature is support for gray-scale images, and there is another utility that automatically merges text with an image file containing your letterhead and signature. Again, the process occurs on the fly.

The Complete Fax

The Complete Fax is a low-cost, multi-featured fax card from The Complete PC that operates at 4800 bps. The Complete PC doesn't make grandiose claims; it simply promises solid fax transmission capabilities. It delivers.

You can create fax documents from PC Paintbrush, Windows Paint, and Dr. HALO formatted files, and you can store these converted documents in either standard or fine mode. (Fine mode is 203 by 196 dots per inch, which eats disk space at four times the rate of the standard 203- by 98-dpi mode.) The file conversion process is one of the quickest I tested.

The Complete Fax's Facsimile Directory function lets you overlay any fax image with another. This merging function gives you crude, but effective, graphics manipulation capability. However, it's easier to just convert the files to .PCX or another graphics format, massage them with a paint program, and turn them back into fax files again. If your word processor includes an Epson MX printer driver, you can also send text files with all attributes.

An option, The Complete Hand Scanner ($249), works in tandem with The Complete Fax. The scanner is a glitzy, mouse-type device that scans images up to 2½ inches wide by 10 inches long. You can store the images in any file format compatible with The Complete Fax. The scanner is great for scanning logos, line art, and letterheads. It also includes custom software, called Soft Stationery, that lets you create any kind of letterhead you can scan into your computer.

Another card, the CFAX/9600 ($599), was introduced too late to include in this review. This 9600-bps fax card features a scanner interface port, an optional 2400-bps modem, a mail-merge function, and Epson FX print-capture capability.

MFAX96P

The MFAX96P fax card is an appendage of Microtek Lab's scanner line. Six months ago this board was a bad deal. Today, it's an adequate implementation of fax technology.

Version 1.11 of MFAX's software left much to be desired, including the glaring omission of an ability to view a fax image file on your monitor before transmitting it. The beta copy of version 2.0 that I reviewed has solved that problem.

Background mode	Polling	Maximum broadcast	Printers supported	Software features	Standard files converted
Send/receive	Yes	Unlimited	Epson, IBM, HP LaserJet, others	Text/graphics editor	ASCII, PC Paintbrush, formatted Epson FX-80 word-processing files
No	No	Unlimited	Epson, IBM, Toshiba, HP LaserJet, others	Automatic file conversion, help	ASCII, PC Paintbrush
Send/receive	Yes	25	Epson FX, Toshiba, IBM Graphics, NEC, HP LaserJet, others	Help, cover-page generation, graphics editor	ASCII, Dr. HALO, PC Paintbrush, Microsoft Windows Paint, Epson MX-formatted word-processing files
Send/receive	Yes	Unlimited	Epson FX, LQ; Canon, HP laser; others	None	ASCII, TIFF
Send/receive, print	No	Unlimited	Epson FX, IBM Graphics, Toshiba, IBM Matrix, HP LaserJet, others	Mail-merge fax, image file encryption	ASCII, Dr. HALO, PC Paintbrush
No	Yes	Unlimited	Epson, HP LaserJet, others	Help, text and image merging	ASCII, PC Paint
Send/receive	Yes	Unlimited	Epson, IBM, Fujitsu, NEC, Toshiba; Canon, HP laser; others	Help, windows, LAN support	ASCII, AutoCAD, Dr. HALO, PC Paintbrush, TIFF, Hewlett-Packard HPGL plotter files
Send/receive	Yes	160	Epson FX, Toshiba, IBM Graphics, NEC, HP LaserJet, others	Help, text editor, direct printing of incoming fax, automatic file conversion	ASCII, PC Paintbrush, TIFF
Send/receive	Yes	100	Epson, NEC, Toshiba, Panasonic, HP LaserJet, others	Graphics editor	ASCII, PC Paintbrush, many word-processing files
Receive	No	999	Epson FX, LQ; IBM Graphics; Canon, HP laser; others	Help, graphics editor, area-code lookup, blank page creation	ASCII, TIFF, Dr. HALO, PC Paintbrush, WordStar

High points of the new software include the ability to print documents at either 204 by 196 dpi or 300 by 300 dpi. This lets you expand a fax image to 300 dpi when printing to a laser printer, which is handy if you've received a fax that's formatted on a desktop publishing program.

You can also send a text file without running it through the conversion program. This solves the MFAX's earlier problem of having to break multipage documents into separate files before converting them. When you choose an ASCII file for faxing, the software automatically converts it to a fax image, as long as the file has a .TXT extension.

The program's built-in editor lets you create memos without exiting to your word processor. This is handy when you need to fax quick notes, but for extensive text processing, you'll still want to use your word processor.

The Easy Send feature lets you send hard-copy documents through a scanner to the MFAX card and on to another fax machine with the press of a key. This feature is so simple that even the most paranoid technophobe can handle sending a fax from the computer. Also, the MFAX96P has a built-in scanner port, so you can add a scanner without giving up an extra slot in your computer.

I have two gripes about this unit. First, the board requires you to set more hardware switches than does any other fax card, and the process isn't well documented. Other fax cards operate on a "plug and go" principle; I don't know why Microtek chose to make the user do all the work.

Also, while the MFAX supports TIFF files, there is no facility to convert files from any paint programs; you have to either scan pictures into the system or forget about sending graphics. EyeStar Plus software, included with Microtek scanners, converts PC Paintbrush and Windows Paint files to fax image files, but for this you have to purchase a scanner, which ranges from $995 to $3995.

Facsimile Pac

Dest's Facsimile Pac has two noteworthy options. The first is a 1200-bps Hayes-compatible modem ($129). The second is a plug-in chip ($195) on the fax card that provides full Department of Defense Data Encryption Standard (DES) encryption capability.

The DES chip is a serious-minded (and handy) capability, although the documentation, which reads like backyard mystery theater, takes itself perhaps too seriously. One passage reads: "Use this option to send and receive confidential documents in *secret code*" (italics added).

continued

For security at both ends, the DES chip establishes a public key (key A) between the two machines. This is common to the encrypted message. However, a second, private key (key B) is known only to the receiver. If both keys don't match, the message remains scrambled.

Like the MFAX, the Facsimile Pac card includes a scanner port, saving a card slot if you decide to add a scanner.

Facsimile Pac supports file conversion, printing, and sending and receiving files in background mode. The software operates as a terminate-and-stay-resident (TSR) program that you can invoke within other applications to send files. It also lets you set up a rather sophisticated telemarketing blitz using fax machines: By inserting "tags" into your text, you can create a mail-merge application that sends mass mailings via fax.

Dest has provided a fax card with an impressive array of features. If you need the security of DES encryption (when transmitting confidential contracts, for example), you should think seriously about the Facsimile Pac. You certainly don't lose any capability; in fact, the card is of intelligent design, and the software is more than adequate. For those who want sophisticated scanner support and multiple fax options, this is the product.

pc-Fax

EIT's pc-Fax provides the usual host of features, including polling, laser-printer support, and a funky background mode for receiving image files.

Contrary to what the name implies, "background" mode is only in the background until called on to receive a fax. When pc-Fax picks up a carrier tone, it automatically halts everything—your computer locks up and becomes hostage to the fax transfer. Although this acts as an "insurance policy" for the reliability of the fax transfer, it's annoying to have your work flow suddenly and unexpectedly grind to a halt for a incoming fax. EIT says it is working on true background-mode capability.

The card also has a built-in binary transfer capability that runs on the IBM PC AT and compatibles at the blazing rate of 9600 bps, as long as each end runs a pc-Fax board. With vanilla PCs, the transfer rate slows to 4800 bps. (Other fax cards with binary transfer capability performed similarly.) The software uses pull-down menus and provides mouse support.

The pc-FAX's OCR capability recognizes four fonts and converts them to ASCII format. In addition, you can "teach" the software to recognize other fonts. The pc-Fax card is perhaps the most versatile of the bunch at turning hard copy into a machine-readable format.

GammaFax

GammaLink was one of the earliest players in the fax card market, and that experience shows in the number of features its GammaFax card offers. The latest version of the software (4.0D) is a vast improvement over an earlier version I received, which didn't function properly when sending a fax during a voice-initiated call.

Features include the ability to write batch files to, for example, send a text file from one microcomputer to another microcomputer's GammaFax card via a local-area network. Also, a cut-and-paste function lets you cut out sections of a fax image, such as a logo or a signature, and put them into separate files.

Like the pc-Fax board, GammaFax can also perform binary file transfers between PCs or ATs and compatibles using GammaFax boards at 4800 and 9600 bps, respectively. You can also purchase a version of the GammaFax card that includes a 1200-bps Hayes-compatible modem for an extra $200.

GammaFax's software converts ASCII, Dr. HALO, PC Paintbrush, AutoCAD, TIFF, and Hewlett-Packard Graphics Language (HPGL) plotter files. If you haven't converted your file before it's queued to send, the software will automatically convert it to a fax image.

GammaLink technical support helped solve a problem I had with converting from ASCII to fax image files—this was the previously mentioned RAM overhead problem caused by TSR programs. Finally, the documentation is well written and includes numerous tips sections, set apart from the main text by italics.

Microfax

Datacopy's Microfax is the standard against which to measure other PC fax cards. Microfax's documentation is straightforward, and Datacopy seems to have a clear idea of the proper role of a fax card.

After crawling through thousands of pages of documentation for other cards that was either poorly printed or "typeset" on the first available letter-quality printer, the documentation supplied with Microfax was a sight for sore eyes. Ample use of white space and crisp typefaces gave me the impression that the company cared about its product. That impression wasn't misleading.

Easy-to-use menu screens and simple file-conversion procedures make the Microfax's software stand out. The Microfax can convert TIFF and PC Paintbrush files, and AutoCAD converts files to the Microfax's proprietary `.IMG` image format. The unit also includes a 1200-bps Hayes-compatible modem that worked flawlessly. If you're sending a file to a remote PC with a Microfax card, you can also take advantage of the card's 9600-bps binary file-transfer capability.

Datacopy is known for its scanners, so it's no surprise that Microfax is compatible with a host of units. Microfax stores scanned files to disk as an image file before letting you send them to another fax machine. Optional OCR software ($695) converts between fax images and a variety of word-processing formats. The scanner software recognizes 19 fonts, and you can program it to recognize others.

Faxcard/Fax Partner

Ease of use and attention to detail are the hallmarks of SpectraFAX's Faxcard. Panasonic also licenses this board as the Fax Partner, which is identical in every respect to the Faxcard. SpectraFAX has gone out of its way to make things easy, including building the fax card around the 8081 microprocessor and stuffing the 3/4-length board with 256K bytes of RAM, which isn't cheap these days.

The 8081 gives the fax card a certain independence not found in other products. This is handy if you plan to send and receive fax documents in background mode. Most fax cards will slow the application you're currently working on when the fax card goes into action. But because the 8081 processes the fax transmission, even a system running at 4.77 MHz isn't affected.

This card gets a special nod for the way it converts files. You don't have to agonize through the tedious conversion process. Instead, sending a file entails nothing more than selecting it with a highlight bar. The software then takes care of all conversion before transmitting it to the remote fax.

The Faxcard/Fax Partner automatically converts images it receives to a proprietary `.PCX`-type format. You can only manipulate the graphics format files through a built-in graphics editor, however. This feature relieves you from fumbling with several file formats, but it limits you to working with PC Paintbrush files. As extensive as the graphics editor is (the 320-plus-page manual contains 134 pages of instruction on how to

continued

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use it), it's only adequate, at best, for most advanced graphics needs. The fax card seems more useful for transferring text documents.

Transmitting any kind of ASCII file with this card is easy. However, you can broadcast to a maximum of only 10 machines per list, although you can string together up to 10 lists to broadcast to up to 100 machines per session. The software converts files from a variety of word-processing formats, including WordStar, Microsoft Word, and WordPerfect.

SmartFax

SmartFax from American Data Technology comes in a slick, fire-engine-red box. The documentation manuals are also slick, fire-engine-red. Unfortunately, that's as slick as it gets. Once you've slogged your way through a tedious setup procedure, you're ready to decipher a manual "typeset" on someone's letter-quality printer.

A special software module handles file conversion. The manual makes a point of telling you that you don't need to convert files beforehand, thus wasting disk space, because SmartFax can handle such a feat when the transmission sequence begins. But just a few paragraphs later, the manual warns against transmitting documents on the fly. The reason: If you're converting a big document, it could take a long, long time—and chew up disk space in 100K-byte chunks, to boot.

SmartFax supports Dr. HALO, TIFF, PC Paintbrush, and WordStar files. It also includes a small graphics editor that is woefully lacking. It can rotate an image and cut and paste, but not much else. Yet the manual spends an inordinate number of pages teaching how to use it.

When you get ready to transmit a document, you can choose to display the world's time zones on your screen with the hours (+ and −) as they relate to Greenwich mean time. In addition, SmartFax includes a built-in database of worldwide area codes.

A new version of the SmartFax software, and a new board, the SmartFax Plus, were introduced too late for this review. The software is now RAM-resident and offers an FX-80 print-capture ability. The new card includes an onboard 8188 with 512K bytes of RAM and a 1200-bps modem option.

Fax Me the Envelope, Please

Getting the most out of microcomputer-based fax requires a supporting cast of hardware, such as an image scanner and a laser printer. Scanners are probably the most prevalent option, but they still are considered expensive extras. In addition, they may take up a precious slot in your computer, and their supporting software eats disk space. And if you don't already have one, you might not be prepared to buy a laser printer just so your fax card can generate high-quality printouts. What you save by buying a fax card (for around $1000, compared to $2000 to $3000 for stand-alone machines), you can end up spending many times over on supporting hardware. On the other hand, the convenience of being able to send a fax directly from your computer and the ability to use fax to transmit graphics image files between machines are distinct advantages.

The bottom line on fax cards, and on fax technology in general, is that they give you easy access to a fairly complex technology. A stand-alone fax machine is essentially a telephone into which you can insert a piece of paper. With a fax card, you can eliminate the paper at both ends.

Which fax card is the best? That depends on your application. The JT Fax 4800 has all the features most people need for the least amount of money. For a full-featured fax card, Datacopy's Microfax is the best bet. This card handles a variety of file formats, includes an onboard modem, and is compatible with Datacopy scanners. Although other fax cards offer similar features, Microfax's implementation makes things easier for the user. The documentation is good, file conversion is uncomplicated, and the software's menus are easy to use. ■

Brock N. Meeks is a San Diego-based freelance writer specializing in high technology. He also writes BYTE's monthly column on microcomputer communications. He can be reached on BIX as "brock."

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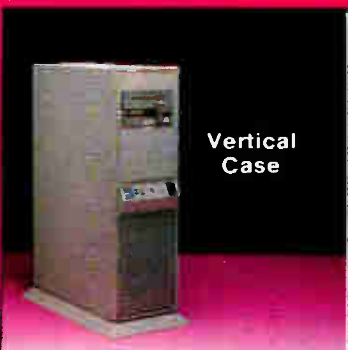

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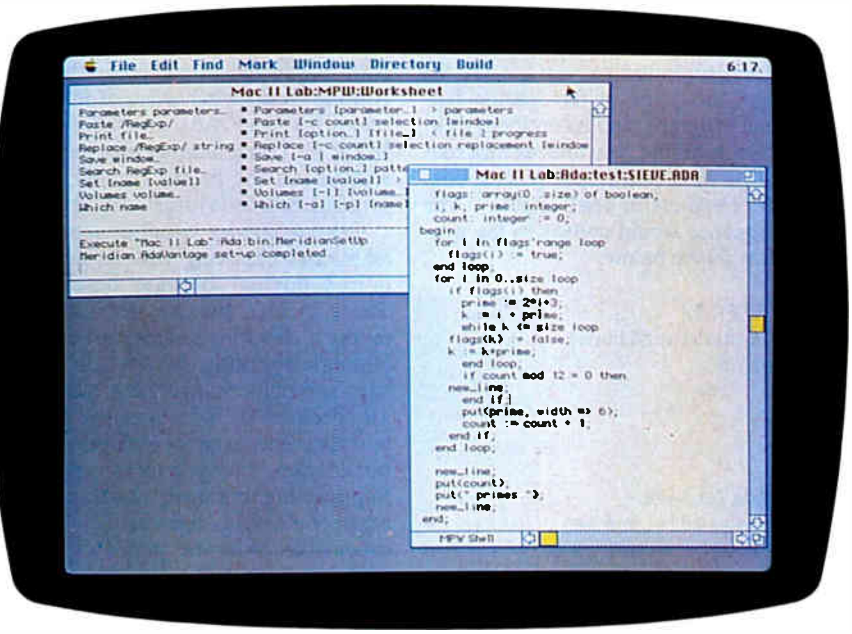
Ada Comes to the Mac



Does the Mac make a reasonable Ada development system?

Namir Clement Shammas

The Meridian AdaVantage compiler has come to the Apple Macintosh world from the same company that implemented Ada compilers for the IBM PC and the Zilog System 8000 computers. The Mac version reviewed here, which sells for $1195, is an Ada compiler that works under the Mac Programmer's Workshop (MPW) shell and its C compiler (see "MPW C for the Mac" by Mike Wilson on page 156 of the February BYTE). This is because the Ada compiler first translates Ada source code into MPW C source code, then invokes the MPW C compiler transparently.

Like its Ada compilers for the PC-DOS and MS-DOS computers and Unix systems, Meridian's Mac 2.2 has been officially validated. Meridian offers additional libraries and other utilities (e.g., a math library package and a debugger) to complement the basic compiler package. (The debugger was not available for this review.)

Crank It Up

The Meridian AdaVantage compiler is easy to install. I first installed the MPW shell, which is included with the package, and the MPW C compiler (not included) on my hard disk drive. Although this was my first time using the MPW shell, installation was smooth. Next, I installed the Meridian Ada compiler, using the manual's clear instructions. While the manual does discuss installation troubleshooting, I didn't have to worry about that section; the compiler ran on the first try. Also, the setup command adds a menu for operating the computer.

The Ada compiler supports integer and floating-point data types. A short integer occupies 2 bytes, while an integer requires 4 bytes of memory. A floating-point type needs 8 bytes, compared to 4 and 2 bytes required by the long and short fixed-point types, respectively. Fixed-point types have a great appeal for programmers working in "no round-off" situations.

The version I reviewed (2.2) does not support the MC68881 12-byte representation of floating-point numbers. The manual mentions that the compiler implements the two fixed-point types using integers with imaginary decimals. Regarding advanced data types, Meridian's compiler supports discriminant records (i.e., they are declared with arguments that allow client routines to define the record's actual size) and arrays. (Discriminant arrays have bounds that are defined as arguments, so the array size is not determined until you actually declare a variable of the array type.)

While AdaVantage supports the complete `text_io` package (i.e., the predefined library unit containing routines for text I/O), Meridian includes three simpler I/O libraries: `iio`, `fio`, and `ada_io`. The `iio` package is an instantiation of `text_io.integer_io` using the following simple Ada statements:

```
with text_io; use text_io;
package iio is new
  text_io.integer_io(integer);
```

Similarly, the `fio` package is an instantiation of the `text_io.float_io` for the float-data type. The `ada_io` package is a library that contains simple console I/O routines for characters, strings, integers, and float-type data. While `iio`, `fio`, and `ada_io` are not part of the standard

continued

AdaVantage 2.2

Type
Language compiler
for the Apple Macintosh

Company
Meridian Software Systems, Inc.
23141 Verdugo Dr., Suite 105
Laguna Hills, CA 92653
(714) 380-9800

Format
Two 3½-inch double-sided double-density (800K-byte) floppy disks

Language
MPW C

Hardware Needed
Mac with at least 1 megabyte of memory and a hard disk drive with 1.6 megabytes of free space

Software Needed
Mac Programmer's Workshop C 2.0 or higher, System 4.1, and Finder 5.5 or higher

Documentation
227-page three-ring manual

Price
$1195

Inquiry 906.

packages, their inclusion offers uniformity among your programs when you inevitably create these libraries.

Files

AdaVantage can access files either as arrays of bytes (using direct_io) or as byte streams (using either sequential_io or text_io). You can have up to 30 files opened at one time. However, your available memory can place limitations on the actual number of open files.

You use the Mac Hierarchical File System naming convention for referencing both filenames and directories (i.e., folder names). Obviously, this can create compatibility problems when porting Ada source code from one operating system to another; you may need to edit string constants that represent filenames in programs. Under the MPW shell, your programs can use piping and I/O redirection. For example, the MPW command Ada_lister|sort pipes the output of a program lister (written in Ada) into a sort application. The MPW shell predefines several special devices, such as the console, a null output device, the standard output stream, the standard input stream, and the diagnostic output stream.

Inside

The AdaVantage compiler supports generics implemented as macros. The tradeoff is between the speed gain and the increase in size of the instantiated generic code. Meridian recommends that, in order to conserve memory, you not excessively use instantiation of generic code. To use the generic feature, place the generic code body and its specification in the same compilation file.

AdaVantage permits your Ada source code to interface with assembly and C language. Using the pragma (i.e., compiler directive) interface, you specify the language, the name of the foreign language subprogram, and its optional linkname. For example, you may write a routine in MPW C that implements a one-line editor and call it oneLineEdit. The code sequence would appear in the general form shown below:

```
/* MPW C */
void oneLineEdit(s)
char* s
{
  ....
}

-- AdaVantage
package editLine is
  procedure oneLineEdit(s :
   string);
    pragma interface(c,
     oneLineEdit)
end editLine;

with editLine;
procedure get_line(s : string)
 is
begin
  editLine.oneLineEdit(s);
end get_line;
```

The reviewed Ada implementation supports a somewhat limited form of tasking. AdaVantage does not use true preemptive time-slicing to perform task switching. Instead, the processor switches from one task to another at activation points, entry calls, completions, and wait states. So you have to be careful when coding long-lived looping routines that do not include processor-switching constructs previously mentioned; such routines can block other tasks from being scheduled. The manual suggests you insert into indefinite loops a delay 0.0, which will reschedule the current task.

The priority pragma assigns the task's priority at compile time. While no default task priorities are defined by the Ada standard, the AdaVantage compiler assigns the lowest priority as the default value. Each task is assigned its own 2K-byte stack space, a value that you can alter in the source code.

Invoking Ada

The Meridian Ada compiler is invoked to compile source code files. These can be stand-alone programs, package specification, package body, or separate subunits. Each type of compiled file requires a distinct file extension name separated from the main filename by a dot. Meridian provides a number of versatile compiler switches that determine both major and minor compiling steps. Among these switches is one that simply compiles your Ada source code into MPW C. Using another switch, you can supplement the output C code with the original Ada code inserted as comments.

Other compiler switches suppress the additional checking that is usually required during software development. These include switches for suppressing numeric checking and overall checking. Numeric checking monitors division-by-zero and numeric overflow, while overall checking includes numeric checking as well as checking for violations of array boundaries, string lengths, and so on. Suppressing numeric checking or all types of checking reduces the size of the executable code and increases the program's execution speed.

Another category of compiler switches relates to the support of debugging. The -fD switch prepares a compiled file for use with the Meridian AdaVantage Debugger, available as a separate product. The -g switch enables you to use the MacsBug machine-level debugger (this option is actually passed on to the MPW C compiler and causes the compiler to insert each procedure's name into the generated object code).

Meridian has integrated an optimizer with its compiler. Using compiler and linker switches, you can optimize for speed or for code size. If you optimize for code size, the compiler trims the unused portion of code imported from libraries from the resultant program. You can gain additional speed if you turn off checking and, in case you are using a Mac II with its standard MC68020 processor, you can instruct the AdaVantage compiler to emit 68020 instructions.

Meridian provides adaff, a special version of the Ada compiler that is more suited for working with error-riddled source code. You can use the adaff com-

continued

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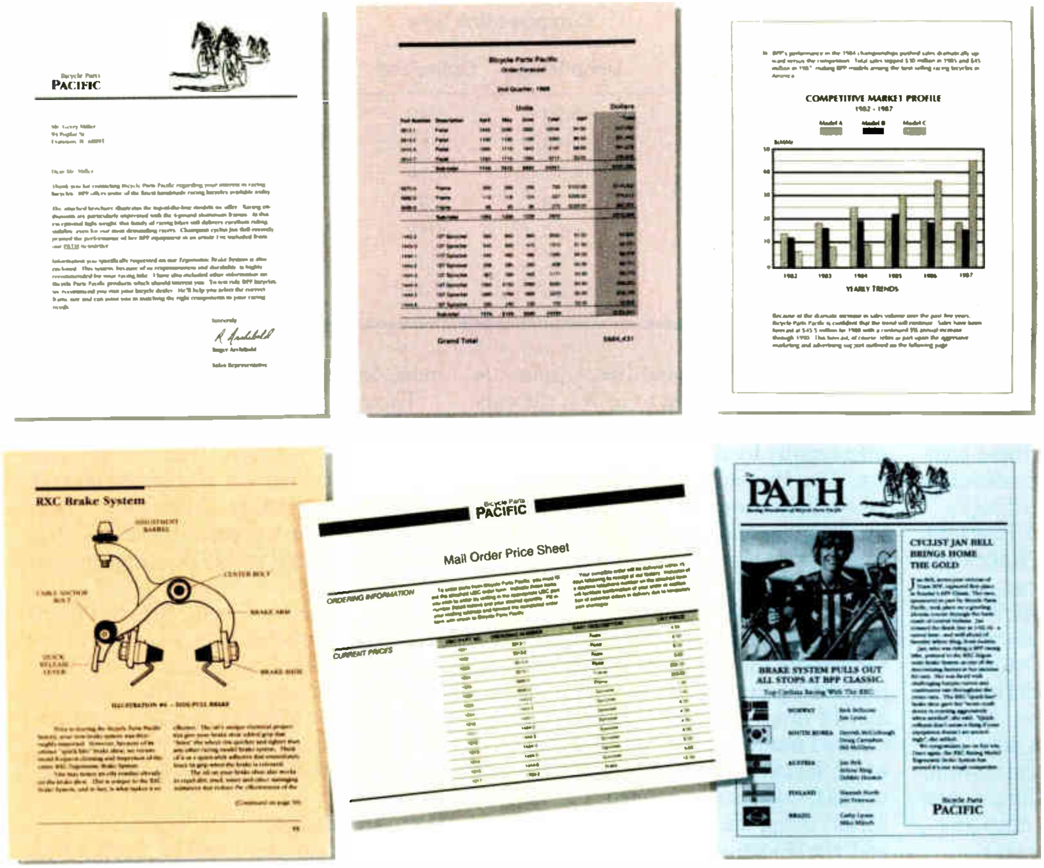

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Table 1: *Benchmark results for optimized and unoptimized runs. (All times are in min:sec.)*

Test	File Size (K bytes)			Compile + link time		Run time	
	Source	Unoptimized	Optimized	Unoptimized	Optimized	Unoptimized	Optimized
Sieve	1	22	21	3:39	3:43	0:34	0:08
Sort	3	26	24	4:13	4:12	2:36	0:18
Float	1	30	28	4:17	4:14	1:08	1:08
Invert Matrix	2	31	29	4:28	4:23	0:39	0:27
Recursion	2	23	21	4:04	4:12	0:44	0:11
Disk Write	1	28	27	3:32	3:30	0:19	0:19
Disk Read	1	27	26	3:26	3:28	0:13	0:13

piler to pipe compilation error messages through the ff utility, where the messages are converted to executable editor commands. You can then use these commands to locate and edit the offending source-code lines in the proper file.

The BAMP (Build Ada Main Program) command invokes the MPW linker and creates programs that you can launch from the Mac Finder or the MPW shell. The default action of BAMP is to create an MPW tool, a program that runs only under the MPW shell. You can fine-tune BAMP with options that let you override the default 32K-byte segment size, perform global and local optimization, select an alternate run-time library, and request the output of a link map (i.e., symbol names and where they are).

The intricate relationship between the various libraries and compiled units dictates the use of library database files. These files permit the compiler to maintain the integrity and version consistency of the compiled code. The Meridian package contains a number of utilities that create, maintain, modify, and remove library databases. When a file is compiled, the information related to that file is added to the library database.

The AdaVantage pull-down menu uses the Mac user interface for invoking the AdaVantage compiler, BAMP, other library management commands, and a HyperCard-based on-line help. The user interface provided through the pull-down menu is attractive. The screen contains option buttons, command switches, an internally generated command-line window, and a help window.

The option buttons enable you to select the operational switches, program names, library names, and so forth. Using the mouse, you click at the command switch boxes to turn the commands on or off. If you click the mouse and hold the button down, the help window displays a short description for that switch. As you select options, program files, and libraries, the command-line window is automatically updated to reflect the current choices. You can execute the command easily by clicking on a special button. The HyperCard help stack contains an on-line reference for components of the compiler and their commands.

Stack It Up

I ran the various Ada compilers through a suite of benchmarks. The programs I developed for the compiler test are based on popular operations, such as sorting and matrix inversion. The first three benchmarks I used were the Sieve test; integer-array Sort test, in which an ordered array of 1000 integers is created and reverse sorted using the Shell-Metzner method; and the Floating-Point operations test, which uses the standard BYTE benchmark that performs the four basic operations 5000 times.

I used the Matrix Inversion test to measure the speed of floating-point operations by employing matrix inversion. The program creates a square matrix with 20 rows and 20 columns, and assigns 2's to diagonal elements and 1's elsewhere. The program then inverts the matrix and measures the execution time.

The last three tests I used were the Recursion, the Disk Read, and the Disk Write tests. With the recursion test, I used a recursive version of the popular QuickSort algorithm. This is similar to the nonrecursive Sort test, except that recursion is heavily employed. The Disk Read and Disk Write tests are standard BYTE benchmarks that measure times for reading and writing a file to a newly formatted double-sided double-density 3½-inch floppy disk in the Mac's internal drive.

I ran the benchmarks on an unmodified Mac Plus with a 20-megabyte DataFrame hard disk; I launched them from the MPW shell. [Editor's note: *The source code listing for the benchmark programs is available in a variety of formats. See page 3 for further details.*]

Table 1 shows the benchmark results. I ran the benchmarks twice: with and without optimization. The compilation and linking times for all the benchmark programs are rather slow. This is because the Ada compiler translates Ada source code first to MPW C and then to executable code.

In the optimized runs, I also turned off all types of checking (i.e., I used the -q and -fs switches). Dramatic run-time improvements occurred with the Sieve, Integer Sort, Matrix Inversion, and Recursion tests. There was no noticeable change in the run time of the other tests.

Any Advantage?

The Meridian AdaVantage is the first commercial Ada compiler for the Mac. While the execution-code speed ranges from good to satisfactory, the compilation and linking cycle is on the slow side. The price tag suggests that AdaVantage is aimed at professional Mac programmers, rather than those who occasionally program in Ada. I find the general price-performance ratio works slightly against the implementation examined, especially when you have to add the cost to purchase MPW C. The stiff competition for the AdaVantage for the Mac comes from validated Ada compilers for the IBM PC, including a fine implementation by Meridian itself that sells for less than $1000. I believe that serious Ada programmers should go with the IBM PC implementations and obtain a better buy for the dollar. However, the company says it will release a new version for the Mac early in 1989 that will produce native code without MPW C. That could tip the scales in favor of the Mac version. ■

Namir Clement Shammas is a columnist for several computer magazines and a freelance writer living in Glen Allen, Virginia. He can be reached on BIX as "nshammas."

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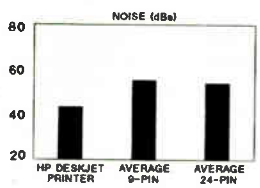

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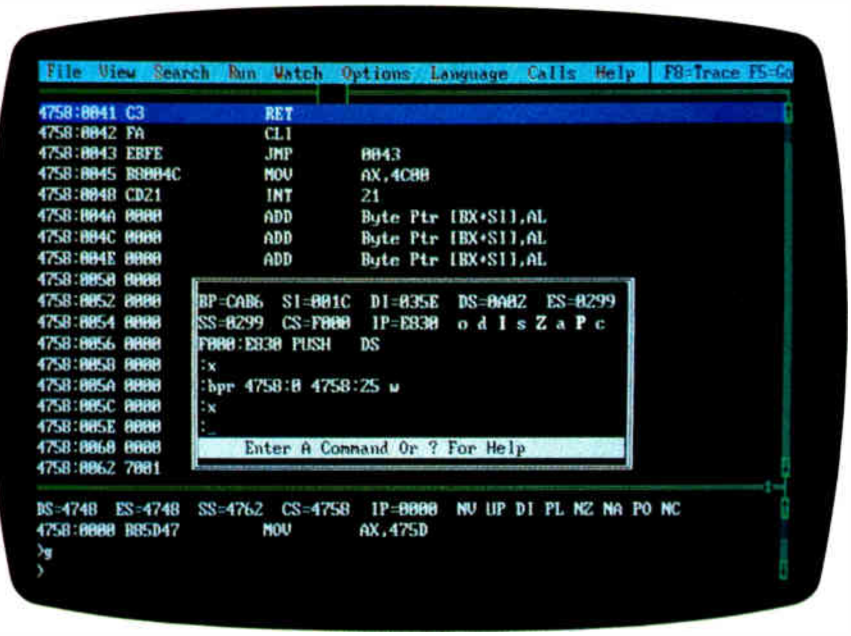
Software for Hardware-Style Debugging



Soft-ICE runs CodeView and 8086-based programs on 80386 systems

Namir Clement Shammas

Programs that improperly access code or data haunt their creators. OS/2 promises relief, but MS-DOS programmers continue to suffer. There is an intermediate solution: Soft-ICE, from Nu-Mega Technologies, a debugger that adds break-on-memory-access and break-on-interrupt features to existing debuggers, such as DEBUG, SYMDEB, and CodeView. Soft-ICE can provide these capabilities—normally associated with hardware-based debuggers—only if your debugger and target program restrict themselves to the 8086 (i.e., the real address mode) instruction set, and if you run Soft-ICE, your debugger, and your target program on an 80386 machine. Given this configuration, Soft-ICE runs your 8086-based program and debugger on a virtual DOS machine that it creates on the 80386.

You can instruct Soft-ICE to watch for events that your debugger can't see, like a hardware interrupt or a write to a region within your program's code segment. When it traps such an event, it deposits a breakpoint instruction (INT3 for DEBUG or SYMDEB, NMI for CodeView) in the code, thereby activating your debugger so you can use it to investigate. Soft-ICE can also go where other debuggers can't: into device-driver code that loads when DOS boots. Here Soft-ICE works as a stand-alone debugger.

Most 80386-based microcomputers work with Soft-ICE, including the IBM PS/2 Model 80, 80386 AT compatibles, and AT-style machines with 80386 coprocessors. The program is compatible with monochrome, CGA, EGA, VGA, and Hercules graphics adapters. I tested it on an IBM PC AT equipped with an 80386 card, and I used it along with DEBUG, CodeView, and T-DebugPlus 4.0, the Turbo Pascal debugger from TurboPower Software.

Nu-Mega recommends that you use Soft-ICE in conjunction with extended memory. In the absence of extended memory, the program loads as high as possible within 640K bytes, then adjusts the high-memory mark so as to hide itself from DOS programs. Because the program alters the amount of memory DOS can see, you should load it before you load any terminate-and-stay-resident (TSR) program. When extended memory is present, Soft-ICE loads at the top of it, so you must arrange to name its extended-memory driver in `CONFIG.SYS` before you name any other installable device drivers. One minor annoyance is that you can't load programs, drivers, or utilities (other than Soft-ICE itself) that use 80286 or 80386 protected-mode instructions, since the program supports only real-address-mode software. I had to create a special boot disk to avoid loading device drivers that use 80386 protected modes.

Soft-ICE loads from the DOS command line and takes arguments to override its defaults. For example, you can replace its default hot key, Ctrl-D,

continued

Soft-ICE

Type
Debugger

Company
Nu-Mega Technologies
P.O. Box 7607
Nashua, NH 03060
(603) 888-2386

Format
One 5¼-inch double-sided, double-density floppy disk; 3½-inch floppy disk available on request

Language
Assembly

Hardware Needed
80386 PS/2 and compatibles; 80386 AT compatibles; 80386SX; monochrome, CGA, EGA, VGA, or Hercules graphics adapters; extended memory recommended

Software Needed
MS-DOS/PC-DOS 2.0 or higher

Documentation
130-page reference manual, reference card

Price
$386

Inquiry 907.

with Alt-D or SysReq. You can also unload Soft-ICE from the DOS command line.

The program presents itself in a pop-up window that you can move or resize. Screen controls include FLASH, a command that restores the target program's output while Soft-ICE traces or steps its execution, and RS (restore program screen), which displays your program's output until you press a key. If you have a second monitor attached to your system, you can use Alt-SCR to redirect Soft-ICE's output to it.

The window contains a command line; the colon serves as a prompt. A command-line editor provides the usual services (e.g., move cursor left and right, move to the beginning and end of a line, and delete a character), and it can recall command lines. As you type the names of Soft-ICE commands, an EMACS-style completion facility displays choices that match what you've typed. You can use the HELP command to see all the commands, along with short descriptions.

Dueling Debuggers

When you use Soft-ICE with another debugger, first you should set up the protocol that it uses to communicate with your debugger. The ACTION command specifies where control goes when a Soft-ICE breakpoint triggers. ACTION's default is HERE, which means that control passes to Soft-ICE itself; you use this configuration when Soft-ICE operates as a standalone. If you haven't overridden this default, you issue the command ACTION INT3 (DEBUG or SYMDEB) or ACTION NMI (CodeView) to arrange for one of these debuggers to take control.

DEBUG and CodeView both worked well with Soft-ICE. I found Soft-ICE's window-oriented interface more convenient than DEBUG's; while debugging a screen-oriented program, I was able to view its output and separately monitor its progress in the Soft-ICE window. Since Soft-ICE provides all the DEBUG commands (and then some), there's only one reason not to bypass DEBUG entirely—you need to use it to load your target program. Nu-Mega says it plans to endow a future version of Soft-ICE with the ability to load a target program directly.

For CodeView users, Soft-ICE offers two major benefits: enhanced breakpoint capability and protection from DOS or ROM BIOS reentrancy. With ACTION set to NMI, I was able to specify a memory-range breakpoint in Soft-ICE and gain control in CodeView when it triggered. For debugging in situations where you have access to source code, you'll probably prefer CodeView, with its ability to work with source code and symbolic information, to Soft-ICE. But the combination of the two debuggers lets you specify more powerful breakpoints than you can with CodeView alone.

The reentrancy issue requires some explanation. Soft-ICE doesn't use DOS or ROM BIOS, but other debuggers (notably CodeView) do. If you're using Soft-ICE to break on interrupts serviced by DOS or ROM BIOS code and then want to transfer control to your debugger, there may be a conflict: DOS and ROM BIOS routines aren't fully reentrant. Soft-ICE therefore provides a Warn facility; when enabled, it returns control to Soft-ICE first. You can then choose to let your debugger take control, but Nu-Mega recommends that, in this situation, you should use Soft-ICE unless you know that your debugger uses no DOS or ROM BIOS calls. With Warn enabled, I used CodeView to step through a program that contained BIOS calls; control did revert to Soft-ICE when the program entered BIOS code.

Neither ACTION INT3 nor ACTION NMI will work with T-DebugPlus 4.0, because this debugger uses a different trapping mechanism. You can, however, place an INT3 in Pascal source (i.e., Intr(3, Registers);), use Soft-ICE's I3HERE command to capture control, then debug a Turbo Pascal program with Soft-ICE alone. When the INT3 instruction triggers a break, the Soft-ICE window pops up and displays the CPU registers and the next executable machine instruction.

Breakpoints

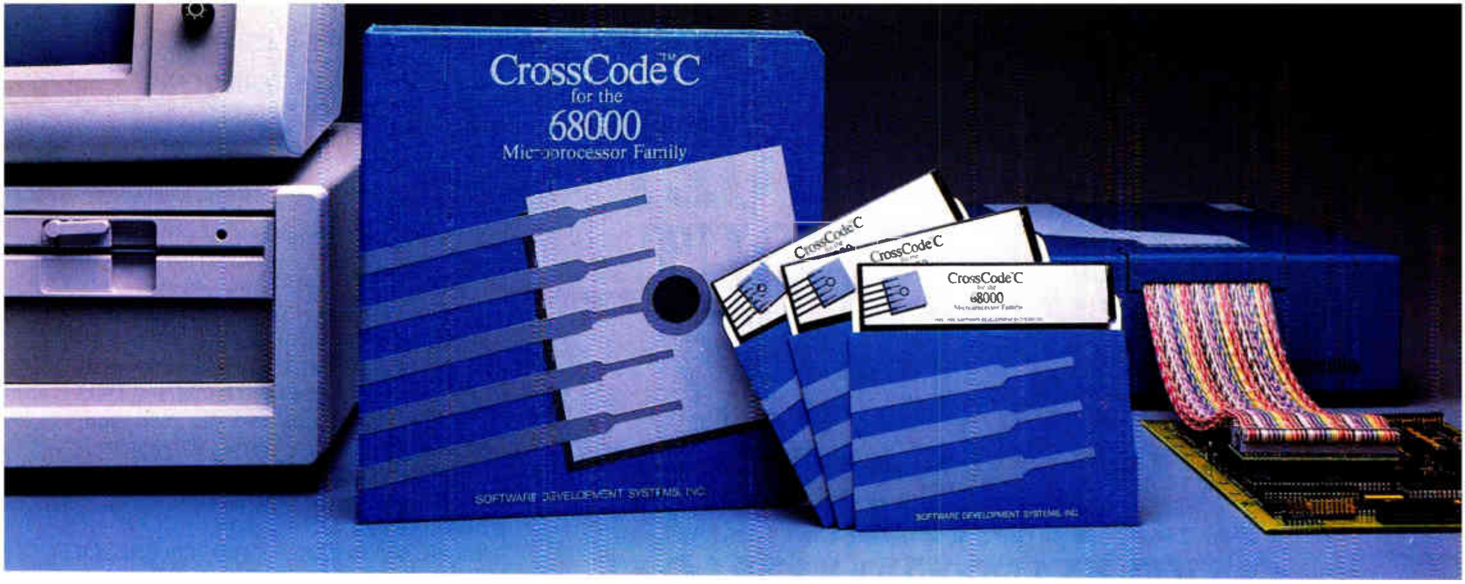
Soft-ICE provides a rich set of breakpoint functions. The BPM (breakpoint-on-memory) command tags a byte-, word-, or double-word-size region of memory beginning at an address you specify. One type of modifier specifies the mode of access that triggers the breakpoint: R (read), W (write), RW (read/write), or X (execute). Another type of modifier, applicable only to read and write breakpoints, makes the breakpoint contingent on the value residing in the specified region: EQ (break when equal) and NE (break when not equal). A third type of modifier, C (count), renders the breakpoint dormant until the Cth access of the region.

The BPR (breakpoint-on-range) command works like BPM but lets you specify an arbitrarily large region of memory. BPR's access-mode qualifiers are restricted to R, W, and RW; you can still break on execution by using R, but you can't differentiate between read and execute modes. BPIO (breakpoint-on-I/O) works with I/O ports. CSIP makes all existing breakpoints contingent on the instruction pointer, which you specify to be within or, with the NOT modifier, outside a range.

Finally, BPINT (breakpoint-on-interrupt) tags hardware or software interrupts. To use it, you need to specify the interrupt's number in hexadecimal format. The modifiers AL, AH, and AX enable you to further qualify the breakpoint. For example, the command BPINT 21 AH=4C selects the terminate-program function from among the many services that interrupt 21h provides.

You can enable and disable breakpoints, and you can edit the description of a breakpoint and use it as a template for the description of a new breakpoint. Soft-ICE supports 16 concurrent breakpoints. Of these, 4 can be of type BPM, and 10 can be of any other type. You can use BPAND (breakpoint-AND) to construct a complex breakpoint that triggers

continued



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only when the conditions of all its component breakpoints are satisfied.

The BREAK facility provides a breakpoint of last resort. When it's enabled (at a slight cost to performance), you can always activate Soft-ICE by means of its hot key, even when the virtualized DOS system's interrupts are disabled and, from the DOS perspective, the system is completely hung.

Stand-Alone Debugging

Soft-ICE's toolkit is well stocked. Of course, when you use Soft-ICE with another debugger, you don't need these tools. Soft-ICE helps you catch events that you couldn't otherwise have caught, then transfers you to your own debugger. But for projects outside the scope of standard debuggers, like debugging loadable device drivers or DOS or ROM BIOS code, Soft-ICE has everything you need. The standard debugger commands—to display and change registers, display and edit memory, unassemble instructions, read from or write to I/O ports, trace, step, and go—resemble their counterparts in DEBUG or CodeView.

Commands unique to Soft-ICE—notably MAP and BOOT—support the tasks for which you deploy Soft-ICE as a stand-alone. MAP displays a memory map of the system, noting the names, locations, and sizes of device drivers, RAM-resident programs, DOS, the debugged program, and any other programs already loaded into memory. BOOT uses interrupt 19h of the ROM BIOS; this restarts DOS but retains Soft-ICE. To debug an installable device driver, you use MAP to locate the driver, then dump its header and decode its entry point, set an execution breakpoint on the entry point, and use BOOT to restart DOS. The breakpoint triggers, and you can use Soft-ICE to debug the driver.

Developers of 8086-based software who use or have access to 80386 machines should find this product very attractive. It implements a debugging environment otherwise available only with hardware-based debuggers that cost at least three times as much. Soft-ICE alone is a powerful tool for debugging device drivers and interrupt service routines. It merges smoothly with other debuggers, such as DEBUG and CodeView, and can extend their breakpoint capabilities as well as protect against reentrancy. ■

Namir Clement Shammas is a columnist for several computer magazines and a freelance writer living in Glen Allen, Virginia. He can be reached on BIX as "nshammas."

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1024 dots × 768 lines Graphics (Non-interlace)
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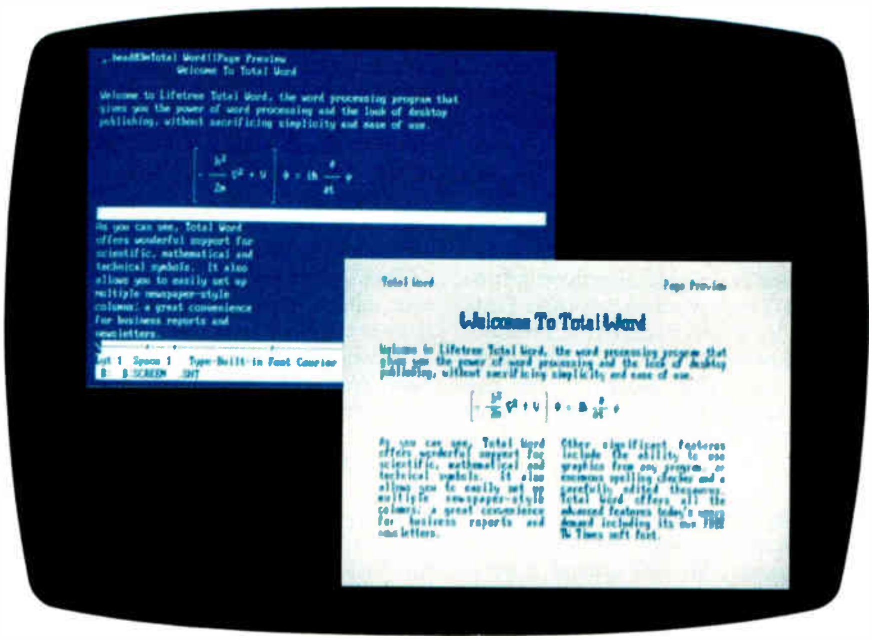
Total Word



Does it offer the total solution for word-processing and desktop publishing?

Lamont Wood

If you're a closet typographer or graphics designer, you want an infinite number of desktop publishing features. But if you're like most people, you just want your printouts to look good—without having to learn the difference between a point and a pica, and without having to take a sabbatical to get your font files, software, and printer configured the way you want.

Total Word 1.012 ($495) from Lifetree Software—the company behind the Volkswriter dynasty of MS-DOS word processors—is for that latter group. It works on the IBM PC and compatibles with 480K bytes of RAM and a CGA, EGA, VGA, or Hercules graphics adapter. The program also requires a hard disk drive, where it occupies about 2.7 megabytes of space (including LaserJet fonts).

Total Word offers you enough functionality to produce handsome documents with all the trademarks of desktop publishing, but it still manages to keep things simple. It includes differing typefaces and sizes with or without proportional spacing, boxes, columns, graphics, and special characters for engineering and scientific formulas, and it takes a stab at WYSIWYG (what you see is what you get). Basically, it's a word processor with limited desktop publishing features for those who are more interested in content than appearance but who still want presentable printouts in a world where typewriter emulation is no longer good enough.

The program achieves its simplicity by, essentially, limiting and prescribing what you can do in terms of graphics layout. But its limitations probably still exceed the ambitions of many users.

Indeed, Total Word is still a word processor. As you type, your text appears on an alphanumeric screen with fixed spacing. It gives you full editing features, plus a dictionary and a thesaurus. In fact, it has all the features you'd expect from a word processor.

Beyond that, things get interesting. You can capture and include graphics images in your word-processing files; you can type math, engineering, and chemical equations straight from the keyboard; and you can change fonts easily.

Almost Desktop Publishing

Call up Total Word and start typing, and there is little to differentiate it from the scores of other MS-DOS word processors—except for the intriguing label in the status line at the bottom of the screen: "`Type: Built-in Font Courier 10 Pitch Medium 12 pt Roman`." This refers to the default font in a Hewlett-Packard LaserJet Plus (I tested it with a Quadram QuadLaser emulating a LaserJet Plus).

As you might expect from a program that carefully labels the font it's using, it also knows other fonts. Pressing Alt-Y brings up the Typestyle menu with a list of other possible fonts (for the LaserJet): standard, bold, italic, small headline, large headline, and small text. These turn out to be rather disingenuous labels for softfonts (i.e., downloadable typefaces for a laser printer) included with Total Word; they are, respectively, Times Roman 12-point medium, bold, and italic; 10-point medium; 16-point medium bold; and 24-point medium bold. (A point is $\frac{1}{72}$ inch.)

Switching to one of these typefaces

continued

Total Word 1.012

Type
Word processor with desktop publishing features

Company
Lifetree Software, Inc.
411 Pacific St.
Monterey, CA 93940
(408) 373-4718
(800) 543-3873

Format
Nine 5¼-inch floppy disks or five 3½-inch floppy disks

Language
Pascal, C, and assembly

Hardware Needed
IBM PC or compatible with 480K bytes of RAM, a hard disk drive, and CGA, EGA, VGA, or Hercules graphics adapter

Software Needed
DOS 2.1 or higher

Documentation
480-page Total Word Manual
48-page Printer Technical Information
16-page Total Word Quick Reference

Price
$495

Inquiry 897.

produces no immediate change on the screen—except that the right margin shifts and there's a new label for the type name. However, once you start typing, it's a new experience. The format line on the bottom of the screen, which has a marker showing the position of the cursor, no longer seems to match the actual cursor position.

Unlike many word processors that offer some sort of proportional spacing, Total Word has a preview-page mode that toggles the screen to graphics mode (if available) and shows the page as it will look when printed.

The preview screen has two modes: full page and half page. In full-page mode, you can see the image of a full page, but the text is illegible except for the headlines. The half-page mode has a high-enough resolution for you to make out the text immediately, although I did not find it comfortably legible.

Mixing different sizes on a line, which often spells trouble in other word processors, didn't bother Total Word. It still managed to figure the spacings as it went along, and the printed margins tracked nicely. What you see with the preview screen matches the printout exactly. However, vertical spacing is based on whatever typeface the line begins with, so tossing a headline typeface into the middle of a line of 12-point type can cause problems.

Total Word controls appearances with precision because it supplies the fonts and oversees the installation of any new Hewlett-Packard or PostScript fonts you purchase from a third party, such as Bitstream (although, realistically, the supplied fonts probably cover the average user's requirements). You can name the font whatever you wish when you install a new one, and it is added to Total Word's list of fonts. The confusing details of width tables and software installation are handled for you.

But with simplicity also comes limitations. Total Word supports hundreds of printers, but only because those printers emulate one of the several printer definitions that Total Word recognizes: PostScript, Hewlett-Packard LaserJet, Epson, IBM Proprinter, NEC Pinwriter, Okidata Laserline, Toshiba, and the Xerox Diablo 630. The software is familiar with the various cartridges available for each.

Scientific Word Processing

The softfonts supplied with Total Word include more than 300 special characters, from the integral sign to the null set to the Hebrew aleph. These special characters are useful in transcribing scientific and engineering formulas.

You call up these formulas by pressing Alt-K. The program then gives you a list of possible keyboards (1 through 10); you invoke one by pressing Alt plus the number of the one you want. A diagram of the key assignment of the keyboard you choose is displayed while you are in the Alt-K mode.

The first keyboard has the standard QWERTY layout, and the second adds bullets, blocks, and business symbols, like the trademark sign and the British pound. The eight remaining keyboards offer the following additional features in their respective order: international characters (i.e., letters with umlauts and accents, and foreign punctuation); math logic and set symbols, such as union, congruent, and such that; square root, delta, sigma, and other special math operators; the Greek alphabet; a collection of arrows; various lines and brackets for box drawings; the standard IBM extended graphics; and various angled slashes used in organic chemistry.

To actually see these symbols as they are supposed to look, you need EGA, VGA, or MCGA circuitry, or a Hercules RAMfont card. Otherwise, you see some other standard characters, unrelated to the ones you want to use, that are either boldfaced, blinking, or both.

If you can put up with those blinking oddments on the screen, you don't really need the correct graphics boards. Total Word comes with printed keyboard charts that let you pick your symbols even without being able to recognize them on the screen.

But keep in mind that, to Total Word, the symbols are just that—symbols. It has no sense that the formulas are as meaningful as words. The integrals and root signs, for instance, do not grow to cover the formula, as some scientific word processors can do. In other words, you're just doing typewriter drawings. Still, it's a lot more functional than most general-purpose word processors.

Total Word will do arithmetic, however, and it adds up rows and columns (and even blocks) of numbers. Unlike some word processors with this capacity, Total Word can even multiply and divide as well as add and subtract.

Graphic Imports

Many of the leading word processors lack any graphics capabilities, but depend on the user to create a print file with some graphics package. The user can then insert a command in the word-processing document to have the file printed on the page at that point, perhaps with some instructions for how it will be placed between the margins.

Total Word elaborates on this theme. The package includes a utility called Snapshot that you have to invoke from DOS. It sits in the background until, one moment when you're using some graphics program, you press Ctrl-Alt-Q. Snapshot then takes over and lets you crop the image on the screen and save it to a file. Control then reverts back to the graphics program.

Later, back in Total Word, you can call up the graphics menu with Ctrl-G, give it the name of the file, and answer some questions about the type of formatting you want, such as the size (100 percent means it will stretch from margin to margin), whether you want a border around it, and how dark you want it. Total Word then inserts a print-file command in your document to invoke graphics printing; you don't have to fool with the syntax at all.

continued

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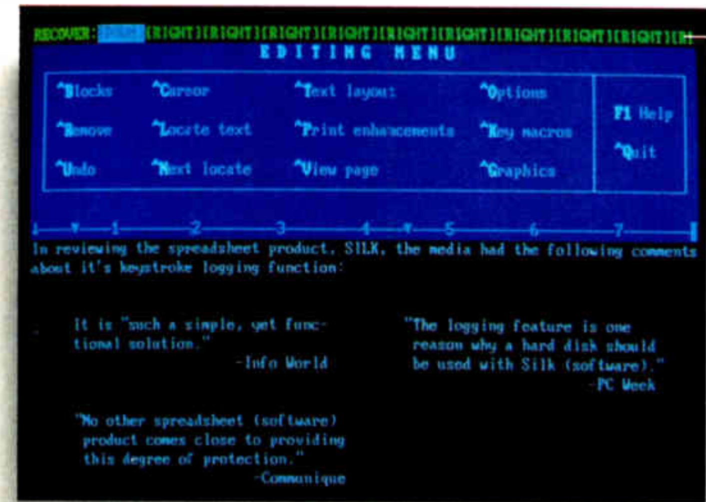

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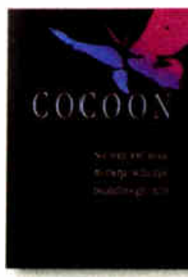

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Table 1: *Total Word did poorly in BYTE's reformat and search-and-replace tests compared to Word 4.0.*

	Keystroke count	Search & replace	Reformat 4K file	Convert ASCII to WP*	Convert WP to ASCII	Print in columns	Scroll test	Load WP file	Save WP file
Total Word 1.012	322	364	94	18	8	170	42	16	9
Microsoft Word 4.0	158	24	<1	1	5	160	35	3	6

*Text format used by word processor.
Note: Results are in seconds, except for keystroke count, which is the total number of keystrokes necessary to edit a standard document.

All you see in word-processing mode is that one-line command, but you can go into page-preview mode (although you have to use the full-page option) to see that miniature rendition of the page with the graphic on it.

When printed, the graphic is a faithful representation of the screen you captured, except for whatever minor distortions crept in when it was resized. However, it is also faithful to the original resolution of the screen from which it was captured, and that resolution can be markedly inferior to your laser printer's resolution.

Total Word also includes several other printer commands, mostly inherited from Volkswriter. These commands, which you embed in the text by preceding them with two periods, are intended for mail-merge projects, chain printing (i.e., one document invoking another), sophisticated printer control, and the generation of an index or table of contents.

Full-Featured Word Processing

Aside from desktop publishing-like features, Total Word remains a word processor with strong roots in Volkswriter, including peculiarities you may not like.

Like Volkswriter, Total Word does not reformat as you go along. If you are inserting text in the middle of a paragraph, it adds blank lines for you to type the new text in, making it look like a mess until you stop and press a cursor-control key or the F8 (reformat) key. This is a rather antiquated approach, and the only apparent advantage is that it will be familiar to Volkswriter users.

The cursor-control keys can also fluster you. While the arrow keys work as expected, both the Home and End keys mean the same thing (i.e., "go all the way") when used with an arrow key. For instance, Home-left arrow means "go to the start of the line." Most word processors simply use Home for this purpose. And since after inserting some text, you first want to move elsewhere with the cursor-control keys, you, of course, press one, but this causes the text to reformat, and you end up going to the wrong place.

Surprising Performance

Total Word is the first word processor I've encountered in a long time that cannot keep up with my typing, especially when I used a proportional typeface (although it also happened in Courier mode); the moment it word-wraps to start a new line, it falls behind and starts to issue warning beeps. After the beeps, it picks up only about half of what I typed.

I used a 4.77-MHz 8088 machine, but I discovered that the problem lessened on a PC AT-class machine (which was at least three times faster). Still, it was a disappointment not to be able to type two lines on a run without trouble.

In fact, Total Word presented a mix of comfortable speed and frustrating sluggishness. File loads and saves were tolerable, print speed and cursor movement were average, reformatting was tedious (because the program scrolls through the text and shows what's being reformatted), and the search-and-replace feature was embarrassingly slow—more than 15 times slower than Microsoft Word (see table 1) and more than 45 times slower than WordPerfect. The keystroke-count benchmark gave poor results, even among mouseless programs.

Speed aside, Total Word has impressive functions, most of them quite easy to use. You can add footnotes, for instance, just by pressing Alt-F. It takes care of placing the reference number in the text and the footnote at the bottom of the page (or on the last page—you get to choose). All you have to do is type Alt-F, then type the footnote text, and go on. A slight annoyance is that the spelling dictionary does not access the footnote text.

Redlining is also available, in which inserted text is shown with a special demarcation, and deleted text is not deleted but given yet another demarcation. Total Word also includes a command that lets you jump through the file from one change to another, and a global command to make all the redline insertions and deletions official.

There's also a feature that lets you define an abbreviation. Once Total Word notices that you have typed a defined abbreviation, it backspaces over it and then types the full text. This feature would be more impressive if it were faster, since I had to stop and wait for the replacement text to type itself, which rather defeated the whole idea.

You can print text in multiple columns, but in text mode you see only one column on the screen. You have to go to page-preview mode to see how the multiple-column page will really look.

The spelling dictionary has 170,000 words—about 50 percent more than average—and it can recognize words that were accidentally repeated, or abbreviations that need a period. There is also a word-count feature. The built-in thesaurus has 30,000 root words.

You can also store document formats in style sheets, create macros, insert commands that will not print, print in background mode (with DOS 3.0 or higher), create and fill out data-entry forms, generate form letters, sort lists, and exit to DOS to run DOS commands.

All in all, Total Word would seem to demonstrate the state of the market rather than the state of the art in word processors. It has every feature you would expect from an old warrior in the checklist word-processing wars—the ongoing competition to cram in every feature that any competitor ever found marketable. Now that desktop publishing has come along, some of its features must also be embraced by serious contenders, and in Total Word, they certainly are.

How few or how many desktop publishing features the market will bear (i.e., how many typographic complications users really want) has yet to be determined. But Total Word is in the forefront of those trying to find out.

Editor's note: *At press time, Lifetree began shipping version 1.1, which it claims is faster than version 1.012.* ■

Lamont Wood is a freelance writer in the computer and electronics fields and lives in San Antonio, Texas. He can be reached on BIX as "editors."

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B U S I N E S S   S E R I E S

Data Entry Goes High-Tech

DataPlex provides data conversion and a universal front end for data entry

Lamont Wood

If the computer world has a hierarchy, data entry is at the bottom. It offers no glamour, and it gets no attention. The rest of the computer world seems to see it as a necessary evil. But someone has to do it. Those ill-paid someones used to be found struggling mainly with card-punch machines, but in this increasingly personal computer-oriented world they're far more likely to be struggling with off-the-shelf software whose data-entry facilities were, at least in many cases, an afterthought.

Those data-entry struggles may be over: Now there's DataPlex, from Tools & Techniques of Austin, Texas. Touted as a "universal front end" for data entry, DataPlex uses a low-level form of artificial intelligence to format incoming data. Its attempt to be universal offers a side effect—data conversion—that may make it noteworthy even to those who could otherwise never work up an interest in data-entry software.

DataPlex runs on an IBM PC or compatible with two floppy disk drives and 512K bytes of RAM, though the company recommends a hard disk drive and 640K bytes of RAM. It works with DOS 2.0 or higher and sells for $195.

The Problem

By "data entry," I mean more than the thankless mechanical task of keying information from paper into a computer. Of course, that keyboard entry has to happen, but the computer ought to be doing data checking and editing. *Range checking* can keep a typist from inadvertently paying someone $3 trillion an hour, or from doing anything on February 31. *Data typing* can ensure that ZIP codes and Social Security numbers aren't confused. The software ought to supply prompts that lead the typist through the task. And the typist ought to have the option of checking and editing data that's been input during that particular session.

Generally, if an organization has any software addressing the task, it's something cooked up by an in-house programmer who reinvented the wheel while doing so. So there are no standards: The data-entry clerks have to relearn every system they encounter. When you consider that one package might use the Tab key to move between fields, the next might use the Return key, and the next might use the space bar, you can see why data entry is considered a high-stress job. The big advantage to DataPlex, therefore, is not that it provides just the data-entry facilities mentioned, but that it eliminates the problem of learning a new system when the data-entry clerk moves to another system.

To be such a universal front end, DataPlex must address all major data-file formats. And it stands to reason that if it can do that, DataPlex can also let you move existing data from one package to another, so that database files can be fed directly to a spreadsheet, and vice versa. And DataPlex does, indeed, do that.

DataPlex Explained

While DataPlex helps you enter data that can be used by off-the-shelf PC software packages—chiefly dBASE II and III, Lotus 1-2-3, Paradox, SuperCalc 4, and their many compatibles—it does not actually use those software packages. Instead, it produces files in the formats they use. If data input (as opposed to data

continued

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manipulation) is all you're interested in, you don't even need to possess those packages.

The list of packages that DataPlex is compatible with is much longer than it seems, because many packages use or at least load files in 1-2-3 or dBASE formats, even if they are not functional clones of those two products. DataPlex can also use ASCII files, which most packages can at least import. DataPlex also supports the mail-merge data list formats used by WordStar, WordPerfect, and Microsoft Word. DataPlex's menu lists 24 formats or packages it can work with (see table 1), and it seems the list could easily be lengthened by adding more clones or packages that can use an intermediate format for input purposes. (The company says it intends to add about one new format a month.)

But you don't need to worry about formatting when you start using DataPlex. All you need is the ability to type and a vague realization that data files should be arranged in records that are themselves divided into fields. The address of BYTE magazine would be a record; the name, street address, city, state, ZIP code, and phone number would be fields.

The screen is divided into three windows. The bottom one has a list of command options that you select by moving a color bar from one to another and then pressing Return, as in Microsoft Word. The middle third of the screen has a box where help messages appear. (Contextual help messages are available at any time by pressing Alt-H.) The top of the screen is where your data is shown.

When you fire up the software and go into data-entry mode, the data-entry area of the screen has, centered in it, an enclosed space marked `FIELD 1`. If you type `BYTE magazine`, the words appear in the field. (For longer entries, the field expands to include the text.) When you press Return, `FIELD 1` is joined on the right by `FIELD 2`. You can go on entering the street address, city, state, ZIP code, and phone number. Each time you hit Return, a new field is added.

At the end of the address, you press Return twice—and the magic begins. The software pauses for about 20 seconds (on my 4.77-MHz system), and the word `Styling` appears in the help box.

Then the data reappears. The name, address, and city fields are, as before, labeled `FIELD 1-4`. But the state field (containing `NH` for New Hampshire, BYTE's home) is labeled `ST` (state). And the phone number field is segmented into three subfields, labeled `Area Code`, `Exchange`, and `Number`.

In other words, DataPlex recognizes data for what it is. On subsequent records, you will not be able to enter anything in the `ST` field except a valid state abbreviation, and the phone field will accept only appropriately formatted numbers.

It's not perfect. BYTE's ZIP code, 03458, comes out as `3458`, DataPlex having seen it as just a five-digit number. But leaving that field highlighted, you can go into command mode (by pressing Escape) and go to the `Format` menu, choose the `Use` command from the menu, and choose `ZIP Code` from the list of possible formats that appears. Suddenly, the ZIP code turns back into `03458`. According to the company, DataPlex's designers were leery of letting the software classify every five-digit numeric field as a ZIP code, so you have to format it manually. The software readily recognizes ZIP+4 codes, however.

There are 44 different data formats it can recognize (actually more, if you count a number coupled with a unit measure as a format), including Social Security numbers, Canadian and European postal codes, 26 formats for calendar dates, and 6 formats for time of day.

These aren't perfect either. The date formats will let you specify February 31—but not February 32. The system knows only that a month should not have more than 31 days, or a year more than 12 months.

You can specify your own formats for a field, too. Numbers can be assigned a range, and an entry outside that range won't be allowed; thus, the computer can't try to pay someone $3 trillion an hour. Or you can assign a list of possible entries. Anything not on the list will not be allowed, and as you type your entry DataPlex will try to match it with the entries on the list, beginning with the first letter. Generally, two or three keystrokes will be enough to produce a correct match. You can also compose your own lookup tables, so that an entry in one field will trigger an entry in another. For instance, an entry of 0 to 59 in a `Semester Average` field of a classroom tracking system could trigger the entry of an `F` in the `Semester Grade` field.

You can also set prompts for a particular field, so the computer can ask the typist to `Enter last name`, for example, instead of displaying a default prompt like `Enter Data for FIELD 1`.

Once you're finished with a session, you then use the `Transfer` command to save the file. DataPlex then saves it in a proprietary format with a `.DP2` file extension.

At this point, you still don't have a database or spreadsheet file. To produce one, you invoke DataPlex's Connect facility and choose from the list of 24 formats, and the system produces a file of the corresponding file format and extension. The original `.DP2` file still exists, so you can render it in multiple formats if you want.

DataPlex has no data-processing facilities of its own, but you can have it filter the data you want to output by using the `Extract` command in the Connect facility. Using simple logical operators tied to specified fields, you can have DataPlex output only those records that have fields meeting the requirements of the logical operators. Using the example address file mentioned above, you could specify the `ST` field, set the logical operator to `=NH`, and output a file containing only records with New Hampshire addresses. In fact, I found DataPlex's Extract function more approachable than the similar function in my database package.

A Data Converter, Too

The data input procedure described above also works with existing data files. When you import a data file in one of the listed formats, DataPlex will attempt to

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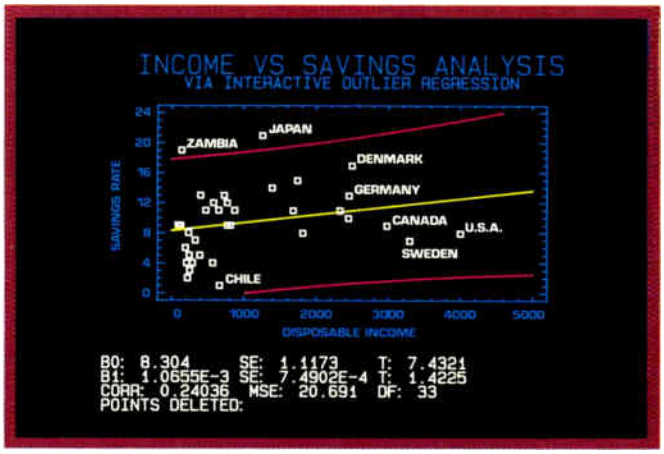

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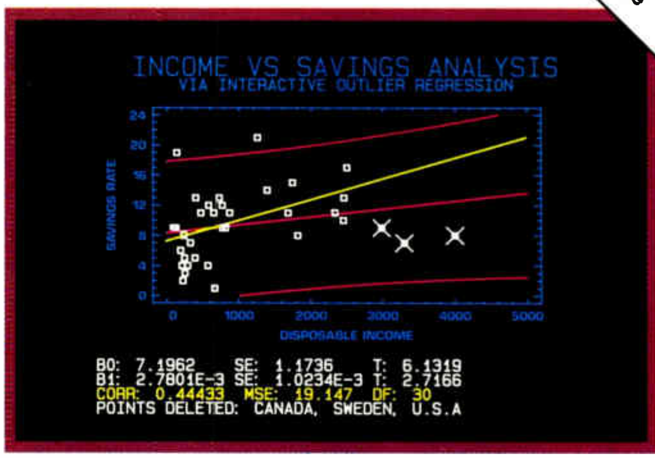

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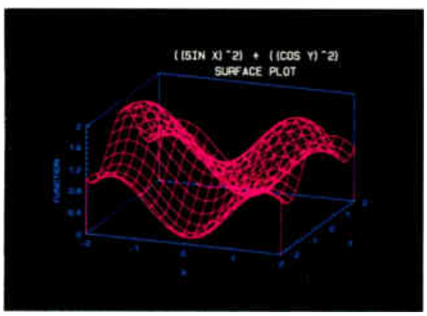

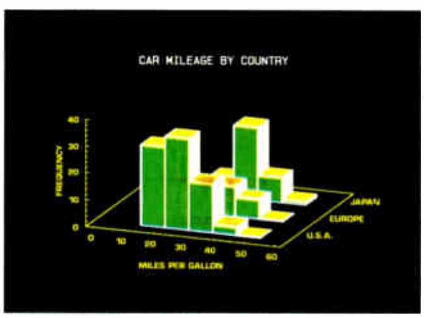

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Table 1: *A list of file formats currently supported by DataPlex.*

- ASCII delimited-field format (delimiters can be specified)
- ASCII fixed-field format
- IBM binary (EBCDIC)
- dBASE II
- dBASE III
- DIF (Data Interchange Format)
- Lotus 1-2-3
- Paradox
- FoxBASE
- FoxBASE Plus
- Microsoft Word (mail-merge list format)
- WordPerfect (mail-merge list format)
- WordStar (mail-merge list format)
- Symphony
- Catamount (nine-track tape interface board)
- Overland (nine-track tape interface board)
- Framework II (database format)
- Framework II (spreadsheet format)
- Multiplan 2.0 (ASCII list format)
- Multiplan 2.0 (spreadsheet format)
- Reflex
- SuperCalc 4
- VP-Info
- VP-Planner

classify the contents of each field in the first record (or the first row in a spreadsheet file) and apply it to the rest of the file. After it's loaded, you can add further data, or you can edit the data and (after saving it as a `.DP2` file) output it in either the same format or a different one.

A new file or a newly converted file can also be appended to an existing data file, although the manual warns against doing this with certain spreadsheets.

Actually, you can use the program as a data converter independent of data entry, and vice versa. DataPlex can be invoked with its `FE` (front end) command, in which case you're immediately in the data-entry facility, or through the regular `DP` (DataPlex) command, which gives you access to both the data-entry and file conversion commands. So it's possible to use DataPlex as purely a data converter without being aware of its data-entry facilities.

DataPlex also handles binary data entry downloaded through a modem. This refers to data in IBM mainframe format, using the EBCDIC alphabet code instead of the ASCII code and representing numbers in packed decimal format. DataPlex can also convert data from nine-track tapes when used with a PC equipped with a Catamount or Overland tape interface board and an optional DataPlex software enhancement that costs $595.

Inside DataPlex, a numeric field can be assigned a unit of measure; the unit will not be listed in the field, but it will appear in the prompt. DataPlex has 31 units of measure, covering distance, weight, and volume. After assigning a unit to a field, you can then change the measure and DataPlex will recalculate the figure. Thus, for instance, you can convert from English to metric and change all your tons to kilograms automatically.

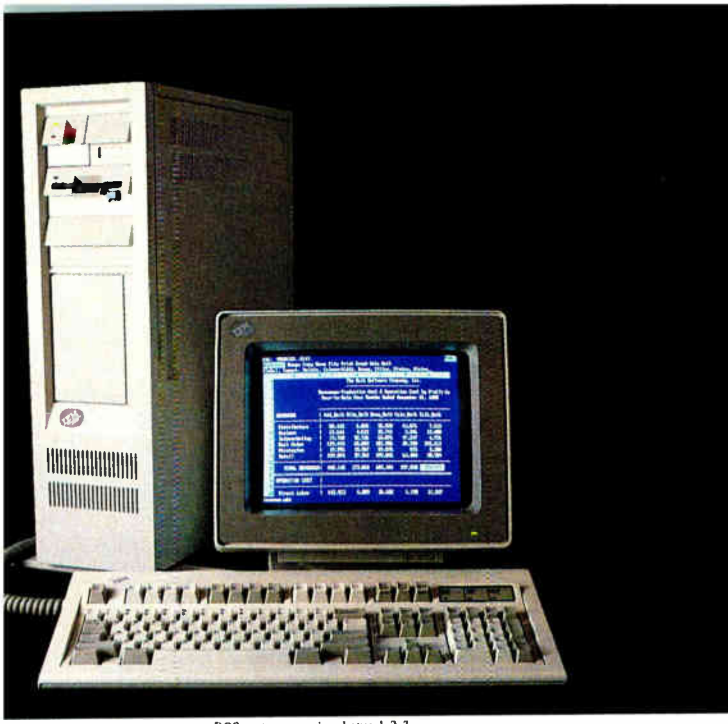
All Things to All People?

The manual is thorough, but it was apparently written by and for programmers, saying things like "connect to an outside application" when it means "output your data in a particular file format." Nor were things clear even after I broke this code: Pertinent information tends to get lost in the forest of options. For instance, it turns out that to output the ZIP code mentioned above correctly to a data file (as 03458 instead of 3458), you also have to format that field with the `Width` command in the Format menu to add leading zeros.

And while DataPlex seeks to be a "universal front end" for data-entry tasks, that means the company is offering its data-entry screen as *the* universal data-entry screen—and a lot of people won't be happy with it. The (usually empty) help box and the command lines consume so much of the screen that you only see the data record you're working on, plus the last three records (which are shown at the top of the screen). There's no way to adjust the size of the data-entry area, so what you see is what you get. In addition, there is no provision for using color to give extra meaning or emphasis to the input screen, although color is all the rage nowadays.

DataPlex is easy enough to use for a data-entry clerk, although the naive user is in danger of getting lost in the formatting options when approaching anything but the most rudimentary task. But it is a powerful tool in the hands of a computer-literate manager. When you have scores of people struggling through the ghastly tedium of inputting data into the typical spreadsheet, even slight improvements in productivity are important, and DataPlex offers major improvements for most folks. And in any office where the professionals each have their own unique and beloved software package, DataPlex is an invaluable integration tool. ■

Lamont Wood is a freelance writer in the computer and electronics fields and lives in San Antonio, Texas. He can be reached on BIX as "editors."



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In the matter of full-duplex data communication at 9600 bps, a number of approaches have been discussed. There's the CCITT-approved V.32. There are even some "pseudo V.32s" around. Some suggest that, because of their somewhat lower cost, non-standard modems may be the answer.

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Review Update

NEC's Newest MultiSyncs

Since the February review of multiscan color monitors, we've been able to test NEC's three new monitors: the MultiSync II, XL, and GS.

The $899 MultiSync II, the successor to NEC's original MultiSync, has a 13-inch screen with a 0.31-millimeter tri-dot pitch. Front-panel controls include brightness, contrast, and power. You can access more switches from beneath a front-panel cover. These include vertical position and size, horizontal position and size, text mode, and text color. When the text-mode switch is on, text appears in the color selected by the text-color switch—white, amber, or green.

Rear controls include a manual switch, a mode switch, and a color-mode switch. When the manual switch is off, the MultiSync II automatically adjusts to the scanning frequency, resolution, and color requirements of the graphics adapter you're using. With the manual switch on, you select the mode (gray-scale or color) and the number of colors (8, 16, or 64) that the graphics adapter requires. The monitor's single D-sub 9-pin adapter accepts digital or analog inputs, and the unit comes with a tilt-swivel base.

The monitor's horizontal scan frequency automatically ranges from 15.5 kHz to 35 kHz, and vertical scan ranges from 50 Hz to 80 Hz. The bandwidth is 30 MHz, and resolution runs 800 dots horizontal by 560 lines vertical. A 21-page manual covers adjustments, connections, basic troubleshooting, pin assignments, and timing charts. The MultiSync II's warranty is limited to 1 year for labor, 2 years for parts.

Our Microvision Superspot 100 tests recorded a 0.534-mm spot size for the MultiSync II. The monitor's spot size bloomed to 0.642 mm at maximum brightness, but this difference is within acceptable limits. Spot size indicates the true fineness of the display, while blooming reveals how resolution is affected by brightness. A small spot size and a small difference between low and high levels are best. In earlier tests, the Electrohome ECM 1910 and the NEC MultiSync Plus registered the best spot sizes—around 0.45 mm. The MultiSync II numbers represent a median range.

Spot sizes usually deteriorate at the corners. Too much difference between a center spot size and a corner spot size reveals poor design. Corner spot size for the MultiSync II measured 0.648 mm at normal brightness and 0.75 mm at maximum brightness. These numbers fall within tolerable bounds. The finest corner spot sizes of the monitors we tested fell between 0.55 mm and 0.60 mm.

The MultiSync II displays pure colors, but it lacks striking sharpness. Our tests noted very little misconvergence, but they did reveal some unacceptable jitter. Swim and drift were not problems. In fact, the MultiSync II monitor posted exceptionally small numbers for horizontal time variance.

In the February review, we presented general specifications for NEC's 19-inch MultiSync XL, but we hadn't received the monitor in time to run our Microvision tests. The XL has a 0.31-mm tri-dot pitch, and our equipment measured a center spot size of 0.562 mm and a corner spot size of 0.585 mm. Both the spot size itself and the difference between best-case (center) and worst-case (corner) measurements were small. However, at high intensity, blooming begins to affect the display. The center spot size increases to 0.809 mm at maximum intensity; the corner spot size rises to 0.919 mm.

Measurements for jitter and swim were average, but the XL's numbers for both vertical drift (0.041 mm) and horizontal drift (0.015 mm) were exceptionally low. The XL also scored very well on our misconvergence tests, registering less than 0.1 mm in red-to-green, blue-to-green, and red-to-blue errors. The tests also revealed very little difference between misconvergence at the center of the screen and at the corner.

The MultiSync XL comes with a 25-page pamphlet that covers adjustments, connections, basic troubleshooting, pin assignments, and timing charts. Like the MultiSync II, the XL's warranty is 1 year for labor and 2 years for parts.

The $279 MultiSync GS (gray scale) monitor has a 14-inch screen with a flattened face to minimize glare. The monitor comes with a tilt-swivel base. The controls are easily, though somewhat inconveniently, accessible atop the monitor. These controls include brightness, contrast, vertical size, vertical position, horizontal position, and power. A TTL/analog switch at the rear of the monitor selects the proper video input mode. The monitor comes with an adapter to interface it to the analog video port of IBM PS/2 systems.

Resolution for the MultiSync GS reaches a maximum of 720 dots horizontal and 480 lines vertical. The horizontal scan frequency automatically adjusts to a maximum of 31.5 kHz; the vertical scan reaches a maximum frequency of 70 Hz. A 17-page manual covers controls, connections, basic troubleshooting, pin assignments, and timing charts.

Spot sizes for the MultiSync GS were fairly high: 0.719 mm at the center and 0.765 mm at the corner. However, spot size did not vary greatly from best-case (center) to worse-case (corner), and intensifying the brightness did not cause excessive blooming. These numbers reveal a well-designed monitor with average fineness.

Our time variance tests for the MultiSync GS registered excessive jitter: vertical jitter measured 0.016 mm, and horizontal jitter measured 0.0089 mm. However, measurements for swim fell within the median range, and drift measurements were very low.

Visually, the GS display is much more appealing than a conventional monochrome screen. Colors are represented by up to 64 shades of gray, providing greater clarity and versatility than the monochrome option offers. For programs that use extensive graphics or color menus, the GS display also enhances functionality.

All three monitors are available from NEC Home Electronics (USA), Inc., 1255 Michael Dr., Wood Dale, IL 60191, (312) 860-9500.

—Stan Diehl

IN DEPTH

Display Technology

What you see isn't just what you get—it's everything. When you're interacting with a computer on a visual level, as many of us spend a great deal of time doing, what you see and how well you see it often makes the difference between health and headaches, efficiency and eyestrain. The quality of that visual interaction can—dare I say it—affect the very quality of our lives, at least the portion that we spend looking at our display screens.

As soon as you start talking about various types of displays, it becomes very clear that there are almost as many opinions about what is best as there are people working at display monitors. One person wants an amber monochrome display while another prefers green. One person likes a display that is garish with bright colors while another wants just a few carefully chosen soft colors. One person wants as sharp a contrast as possible between the characters on the screen and their background, while another finds that combination blinding. And who among us hasn't had to adjust the brightness controls and the viewing angle on nearly every monitor we've used?

This month, BYTE looks at display technology and the various types of monitors popular today. In "Face to Face," Gene Smarte and Nicholas M. Baran look inside the CRT, gas-plasma, liquid crystal display (LCD), and electroluminescent (EL) display and describe what they find there. Gene and Nicholas explain the hows and whys of these technologies, how each one creates the light we see, and what the various problems with each are.

"Behind every successful monitor is a hard-working graphics chip." Well, maybe not every one, but certainly the various graphics chips are heavily involved in "what you see." This month we are excited to present "Taking the Wraps off the 34020" by Ron Peterson, Carrell R. Killebrew Jr., Tom Albers, and Karl Guttag. The 34020 is the new 32-bit graphics microprocessor from Texas Instruments, and these gentlemen have been intimately involved with its design and implementation. It's a fascinating article about a chip sure to have an effect on the marketplace, and we are delighted to be able to give you the inside scoop so soon after its release.

Next, we take a look at a screen type undergoing significant changes—the EL display. In "Lighting the Way," Rolland Von Stroh and Brian Dolinar expose the secrets of electroluminescence, how and why it's so bright, and Planar Systems' recent foray into the world of EL color.

There may never be one monitor or one type of display that pleases all of us all the time, but as the technology improves, choosing the best is becoming more and more difficult. There are literally hundreds to choose from. In fact, there are simply too many to list, so this month rather than listing monitors you might pick, we have included a list of the companies that make microcomputer monitors in "Monitor Makers."

As headaches and sore eyes—at least those caused by poor display quality—become a thing of the past, and display technologies approach each other in quality, prices will have to come down. As a result, the choice between monitors will become just that—a choice, a matter of personal preference. Then, it will be interesting to see which technology comes out on top.

—Jane Morrill Tazelaar
Senior Technical Editor, In Depth

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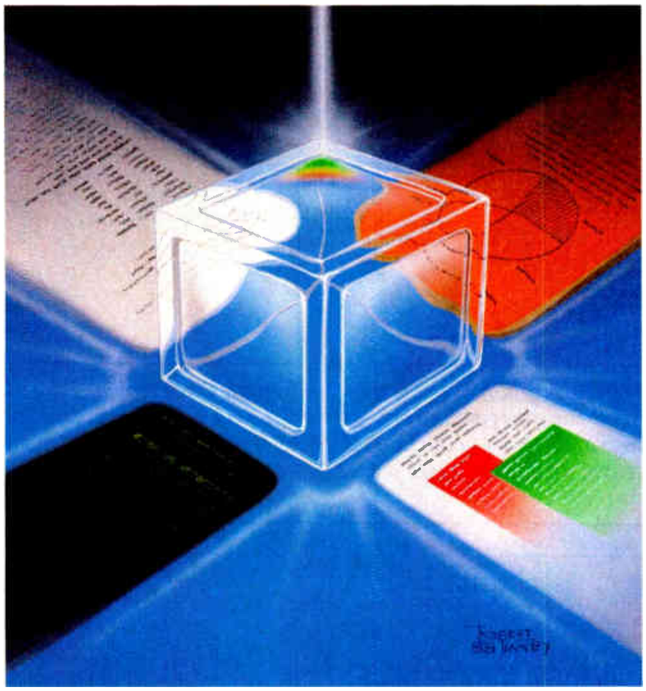
Face to Face

Where are we now, and where are we going?

Gene Smarte and Nicholas M. Baran



Four major display technologies compete for the right to go "face to face" with all of us. They appear not only in computers, but also in televisions, household appliances, medical equipment, military equipment, and in other devices that need to display text or graphics.

These technologies are the CRT, liquid crystal display (LCD), gas-plasma display, and electroluminescent (EL) display. Other technologies, such as vacuum fluorescent displays (VFDs), electrophoretic displays, and light-emitting diode (LED) displays, are comparatively minor, and we won't cover them here.

Due to the great number of display products manufactured and their complexities, it's impossible to provide technical details of all the competing products. However, we have tried to show the technology behind each approach in a representative manner.

In the midst of continual improvements in computer-processing power, I/O speeds, and storage capacity, advances in display technology are often overlooked. But with the increasing importance of the graphical user interface in all aspects of computing, advances in display technology will play a key role in defining the computer of the 1990s.

Over the years, many industry watchers have predicted that one or another display technology would dominate and eventually wipe out its competitors. However, there seems to be no basis for this prediction. As industry analyst David Mentley of Stanford Resources in San Jose, California, points out, "Each technology finds its own niche. The concept that one technology is going to dominate the market is not valid."

Two major forces are driving the display market. One is the television industry. According to Mentley, "The Japanese display effort is driven by televisions, not by computers." The Japanese dominate the television industry and are devoting major efforts to improving displays for both portable, pocket televisions and large-screen, high-definition TVs. Of course, the technological advancements in television then have a corresponding effect in the computer industry. "It's a short drop back to produce monitors instead of TVs," says Mentley.

The second driving force is the demand for color. As graphical user interfaces are becoming increasingly popular, color is almost a necessity in a graphics environment. At this time, CRTs still have the edge in displaying color.

CRTs

Even though it's about 85 years old, the CRT still has many miles left in it, according to companies who use the tubes

continued

ILLUSTRATION: ROBERT TINNEY © 1988

in their monitors. They may be investigating other display technologies, but they are not abandoning their bread and butter. The CRT's reliability and price-to-performance ratio are tough to beat, and millions and millions of these tubes are in use around the world.

Currently, the CRT is the only relatively inexpensive system that can produce large full-color images. As Dick Sager, product manager for high-resolution monitors at Mitsubishi, said, "For the past 20 years I've heard that the CRT would be dead in about 5 years."

The "Multiscan Color Monitors" review in the February BYTE takes a close look at how 14 modern color monitors performed and provides detailed technical information on monitor specifications.

A CRT Primer

Let's take a quick look at how a CRT works before we look at today's technology. Conventional CRT displays produce an image by directing an electron beam on a phosphorescent coating on the glass face of the tube. When struck by the electron beam, the phosphor glows, producing the light that reaches our eyes. When the electron beam stops hitting a phosphor, the light quickly fades. Different phosphor compositions control how long the glow lasts, their *persistence*, and, in color CRTs, what colors are produced.

Figure 1a shows a simplified cross section of a CRT. The negatively charged electron beam starts in an electron gun at the back of the tube and is accelerated toward its face by a large positive voltage. Along the way, the beam is focused into a round shape and swept across the tube face horizontally and vertically.

These days, most video-monitor CRTs use electromagnetic focusing and deflection coils, the windings of which are often referred to as a *yoke*. Turning the electron beam on and off at appropriate times via the control grid produces a glowing pattern on the tube's face. For monochrome displays, the phosphors can be just about any color: white, green, amber, and so forth. But that's just what you get—one color.

The long "neck" of the CRT significantly contributes to cabinet depth. Efforts to shorten the neck create deflection and focusing problems, because then the electron beam must be moved through large angles; it strikes the tube face more obliquely as it moves away from center.

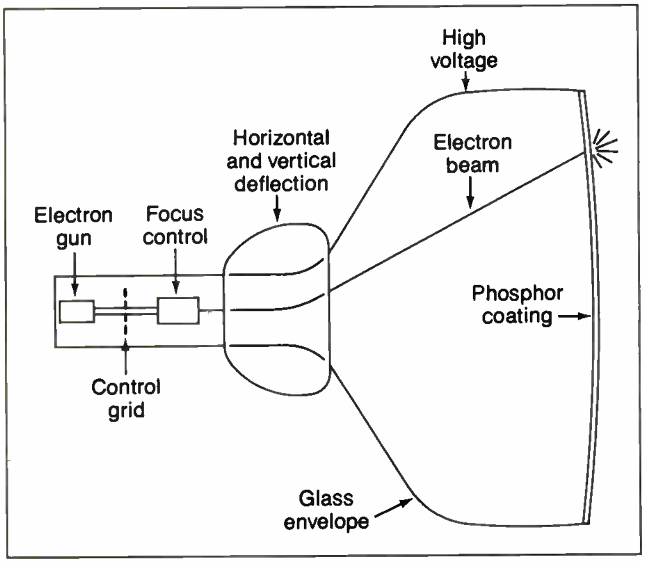


Figure 1a: *Typical monochrome CRT operation. Negatively charged electrons are produced in an electron gun and are attracted to the high positive voltage at the front of the tube. The resultant electron beam is focused on and deflected across the CRT face.*

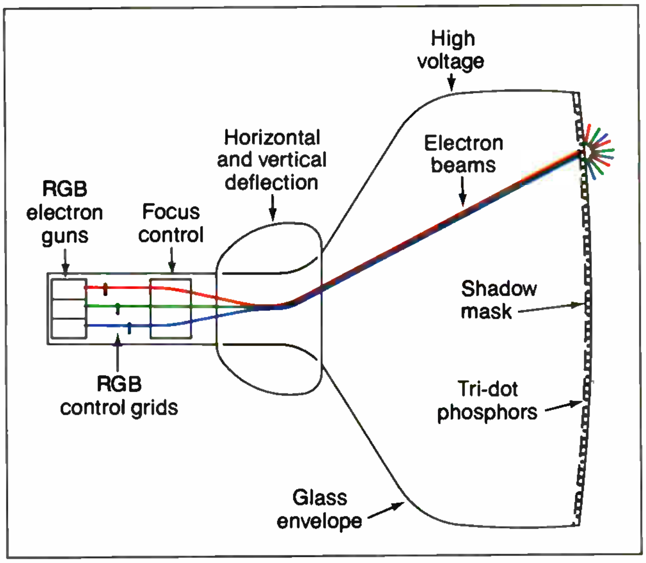


Figure 1b: *A typical color CRT uses three electron guns for red, blue, and green, and corresponding colored phosphor dots on the CRT face. A thin metal screen, a shadow mask, is perforated with tiny holes that must align with the phosphor dots (see figures 1c and 1d).*

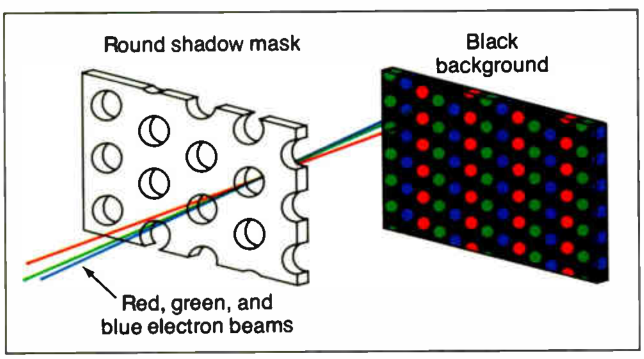


Figure 1c: *Close-up of a round-holed shadow-mask and phosphor-triad arrangement.*

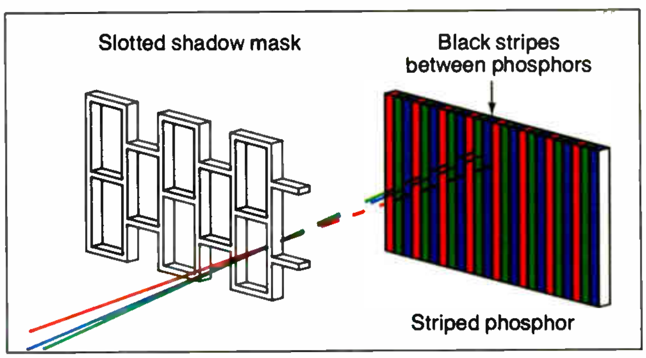


Figure 1d: *Close-up of a rectangular-holed, striped-phosphor shadow-mask arrangement.*

Full-color displays add complexity to the basic CRT design. Figure 1b shows that a typical color CRT has three electron guns, one each for red, green, and blue (Sony uses a single gun); a tube face covered with tiny triads of red, green, and blue phosphors; and a shadow mask.

You will often hear the *dot-pitch* specification mentioned when comparing CRT monitors. Dot pitch or *tri-dot pitch* is the distance in millimeters between the phosphor triads and is some measure of the resolution capabilities of the CRT itself. Many EGA monitors have dot-pitch measurements in the 0.28- to 0.31-mm range, and the trend is toward finer dot pitches.

The shadow mask is made of metal and has tiny holes in it that must be precisely aligned with the phosphor triads to prevent the beams from striking and illuminating other phosphor triads. The holes are often round with corresponding round phosphors on the face of the tube (see figure 1c).

Some CRT designs use a shadow mask with rectangular slots to illuminate alternating stripes of red, green, and blue phosphors (see figure 1d). As in a monochrome display, the beams are swept across the tube face, striking their appropriate phosphors through the shadow mask. By controlling which electron beams strike which of their corresponding phosphors, full color can be realized.

Recently, a big change in monitors has been the introduction of multifrequency scanning capability. Pioneered by NEC and its MultiSync family of monitors, multifrequency scanning capabilities have rapidly become commonplace. Early on, computer monitor manufacturers used the same horizontal and vertical scanning rates as television—that is, 15,750 Hz for horizontal and 60 Hz for vertical. To improve brightness (by hitting the phosphors more often in the same amount of time), permit faster screen updates, and reduce flicker, many monitors and controllers can now operate under a wide range of frequencies.

This flexible scanning approach also lets your monitor adapt to different graphics display standards. Generally, as the scanning frequencies increase, the image quality increases. But a system designed to operate at only one frequency can usually be optimized to produce a better-quality image than one that must be capable of accepting a broad range of operating conditions.

Bigger and Better

There's an ongoing demand for higher resolutions and larger displays in both monochrome and color. In CAD, image processing, graphics specialties, and others, the demand is for photographic resolutions. The trend seems to be toward color, even though certain applications, such as word processing, can seem cluttered with extraneous color boxes and menus. Also, monochrome monitors clearly have the edge in resolution. A CGA display is harder on the eyes than a decent monochrome monitor.

The desire for higher resolution runs into two old problems: lack of brightness and unwanted heat. With monochrome monitors, heat is a persistent, but not insurmountable, problem. There's no shadow mask to absorb and waste energy.

MegaScan Technology in Gibsonia, Pennsylvania, holds a patent on a yoke-heat dissipation technique and uses it in a 19-inch white monochrome monitor. It provides up to 4096- by 3300-pixel resolution using an electron-beam spot size of 0.005 inch. This precision translates to 300 dots per inch. Photo 1 shows the ultrahigh-resolution MegaScan screen; the actual screen looks better than the original photo, whose appearance has been slightly degraded through the offset-printing process.

This extremely high resolution is excellent for use in medical imaging and in desktop publishing for font inspection. According to Gary Zeller, a sales-support engineer for MegaScan, 3-point type displayed on the 19-inch monitor is readable, "though not for very long." This resolution comes with a price: about $16,000 for an "intermediate-level" system consisting of monitor, controller, and interface in single-lot quantities.

Also, tube shape is now affecting display quality. Because of the way the electron beam is deflected across the face of the tube, it makes sense to have the face curved hemispherically. The electron beam then acts like the radius of a circle whose circumference is the tube face. Once focused, the round-shaped beam strikes the tube face perpendicularly regardless of position as long as the beam radius matches the spherical dimension. Because of manufacturing requirements and the methods employed to deflect the beam, maintaining a round spot on the tube face is difficult anyway. And it becomes even more difficult as tube faces become flatter and flatter—another trend.

As the focused round beam moves away from the center position in a "flat" tube, the radius length increases, changing the focus, and it also begins to strike the tube face at an angle, forming an ellipse. This ill-shaped beam degrades the

continued

Photo 1: *A display on an extremely high-resolution monochrome monitor screen. The actual quality of the screen display has been degraded by the printing process. What you see is only about one-third the quality of what you get. (Photo courtesy of MegaScan Technology, Inc.)*

image. Different manufacturers address this problem through various means, but they generally employ some kind of beam-shaping circuitry to adjust the shape of the beam on-the-fly, according to where on the tube face it's located.

To get higher resolution in color tubes, shadow-mask holes and phosphor triads need to be smaller. Reducing phosphor size means that there is less material to glow, reducing brightness. Also, with smaller shadow-mask holes, fewer electrons strike the phosphors if the electron-beam intensity is held constant.

Generally, to get more electrons to strike the phosphors, you can increase the number of times the phosphors are illuminated in a given period or increase the electron-beam intensity. Unfortunately, either way, the energy that strikes the shadow mask then also increases, manifesting itself in the form of heat. This heat can warp or *dome* the mask and distort the alignment between hole and triad, degrading the image. One CRT manufacturer said that less than one-third of the electron-beam energy actually reaches the phosphors. This means that more than two-thirds never makes it beyond the mask and turns into unwanted heat.

A couple of different approaches are being taken to stabilize the shadow mask. One is to replace the common iron mask with a more thermally stable material such as Invar, an iron-nickel alloy. Another method, used by Zenith, is to put the shadow mask under tension to prevent it from moving when it heats up.

According to a Zenith spokesperson, the flat-tension mask (FTM) is tightly stretched steel that is much thinner than standard masks. As a result, fewer electrons are absorbed by the mask, while the tension in the mask prevents distortion and misalignment as it heats up. The upshot is a much brighter picture with more contrast—50 percent brighter and 70 percent better contrast, according to Zenith—and improved color purity.

Unlike other CRTs with a uniform dot pitch, the Zenith tube has an "average" 0.28-mm dot pitch. In the center of the tube, the dot pitch is 0.27; at the edges, it's 0.30. Zenith owns several patents on the technology behind the FTM. The company also says that while it has experienced the normal problems associated with a project start-up, it is going forward with the program. Other CRT manufacturers claim that the FTM is viable from a technological standpoint, but it is also expensive.

In spite of the problems that have been encountered, several CRT-based monitor manufacturers continue to increase resolution and performance. Mitsubishi recently showed a prototype of a 19-inch color monitor with a 2000- by 2000-pixel resolution. It uses 0.21-mm dot pitch and a horizontal scanning-frequency limit of 128 kHz. Toshiba has worked on the shape of its CRT, added an Invar mask, and improved the electron gun, focusing elements, and deflection system to provide a unit that is 50 percent brighter than before. The battle to improve the CRT is in full swing.

A Moving Target

The CRT has turned out to be a very robust and continuously evolving technology. As David Mentley says, "The CRT is a moving target: 1280 by 960 shadow masks are now quite common. Who would have predicted that 5 years ago?"

In addition, the development of multiscan gives CRTs a big edge over the competition. With a multiscan CRT, you can change from one resolution to another (by changing the graphics controller or mode) without having to replace the monitor.

The competing technologies are all fixed-format displays that are built for a specific resolution. Once you buy one, you're stuck with it. If you have a gas-plasma or LCD display and want to switch to a higher-resolution controller, you'll have to buy a new display, too. You *can* use these fixed-format displays at *lower* resolutions, however. For example, a 640- by 400-pixel display also supports 640- by 200- or 320- by 200-pixel resolutions (the maximum specified resolution must be evenly divisible by the supported lower resolutions).

LCDs

Once a "hold it just right and you can read it, sort of" laptop computer display, the LCD now competes favorably with parts of monochrome CRT technology and may eventually supplant the color CRT. The old problems of low contrast and poor readability in low ambient light are mostly behind us.

LCDs offer many advantages: small size, light weight, low power consumption, and good resolution, typically 640 by 480 pixels. But making large LCDs to compete head-to-head with CRTs is difficult. Manufacturing large LCD panels in which *every* pixel must be operable strains the fabrication capabilities of many companies. Prototypes are one

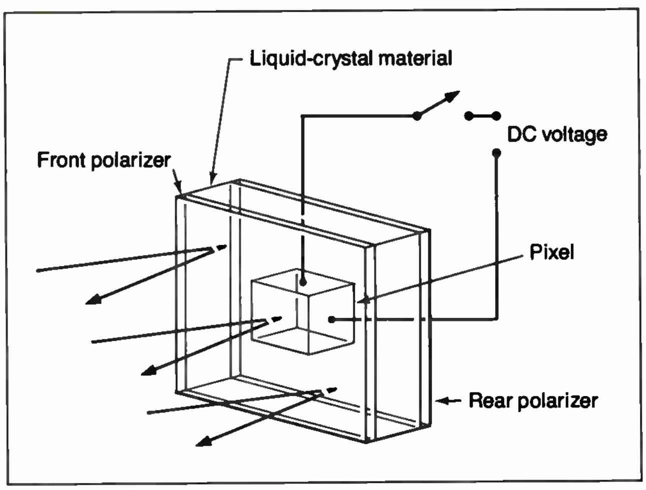


Figure 2a: *When an LCD pixel is off, the polarized light reflects uniformly on the liquid-crystal material; thus, no contrast is created.*

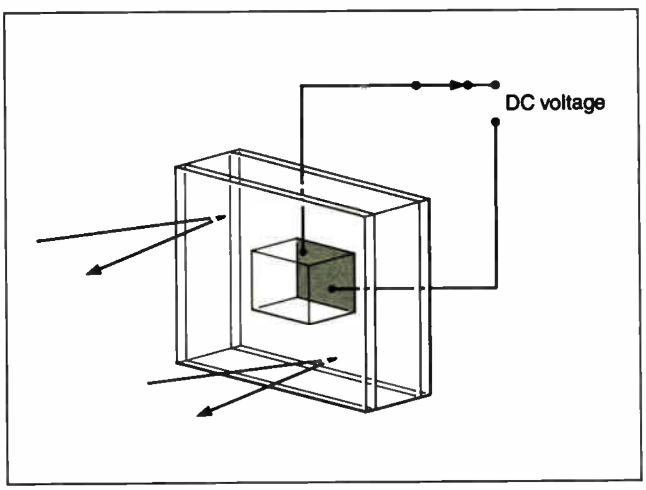


Figure 2b: *When an LCD pixel is activated, it lets polarized light pass through it to strike a rear polarizer and be absorbed. The absorbed light appears dark.*

thing; production runs are quite another.

Color LCDs currently are available only in relatively small sizes. Many are 4-inch diagonal (3½-inch viewable) displays with 480- by 220-pixel resolution and are used in portable TV receivers. Larger LCD color displays are the center of attention in the research and development departments of many companies.

An inherent advantage of LCD and other flat-panel technologies is their linearity. The screens are flat, unlike the CRT, and because the illuminating elements are addressed directly, there is no electron beam to deflect and distort.

Figure 2a is a simplified drawing of a typical twisted nematic-crystal monochrome display, probably the most common in use today. Nematic crystals are stable between liquid and solid and are responsive to electric fields, among other things.

The example LCD panel consists of a matrix of twisted crystal pixels that can be addressed via a row-and-column scheme. The crystals are sandwiched between two polarizers. In their normal twisted "off" state, the crystals modify the polarization of the light striking the panel so that most of it is reflected back; the panel color appears as the familiar uniform gray.

When voltage is applied (see figure 2b), crystal molecules untwist, changing the polarization of the incident light. When the light is able to pass through the crystals, it strikes the back polarizer and is absorbed; thus, the addressed pixel looks dark compared to the rest of the panel. Unfortunately, incident light scattered in the panel's layers and reflected back through them diminishes contrast.

The early problems with low contrast and poor readability have been nearly eliminated by using a rear-lighting, or backlit, approach that does away with a dependence on ambient light.

Because of backlighting, reflective LCD displays are on their way out. In fact, so-called supertwist LCDs require backlighting to take advantage of their increased contrast, and it's often more appealing to have a light-emitting display. Also, color LCDs require backlighting. Still, it's a trade-off between readability and power consumption. A passive LCD panel uses a tiny amount of power, while the light source used for backlighting usually consumes many times the power required to control the liquid crystals.

In addition to the portable or laptop computer displays, an interesting and growing application for LCD panels is coupling a computer and an overhead projector. Whatever you have on your computer screen can be displayed on a portable window-like panel that sits on top of the projector in place of transparencies.

An Active Future

The most promising type of LCD is the recently developed *active-matrix* or thin-film transistor (TFT) LCD. Rather than using standard multiplexing techniques (e.g., time-sharing of pixel electronics drivers) to address the matrix of crystals, the active-matrix LCD includes a thin-film transistor fabricated along with each pixel. These transistors act as switches to turn on individual pixels.

The TFT method eliminates the time dependency associated with multiplexing (diminishing contrast as more lines are displayed) and allows direct addressing of each pixel. Color is added by using organic filters and backlighting.

Currently, active-matrix LCDs have primarily been produced for full-color 3½-inch pocket TVs. The Japanese produced some 2 million active-matrix LCD pocket TVs last year. At the Society for Information Display (SID) convention in May in Anaheim, California, several manufacturers displayed 9-inch active-matrix LCD screens.

The major obstacle to producing 9-inch and larger screens is the low throughput and poor manufacturing yield of current photomasking equipment. Defective panels have to be thrown away, and typical manufacturing yields are 20 percent. However, David Mentley says, "It's going to happen." According to his research, there are some 30 Japanese companies heavily investing in advanced-matrix LCD technology. Within a few years, we should see 9- and 11-inch advanced-matrix LCD monitors.

Gas-Plasma Displays

Gas-plasma displays operate by exciting a gas, usually neon or an argon-neon mixture, through the application of a voltage. Figure 3 shows the general construction ideas embodied in gas-plasma displays. The two types of displays are AC and DC. In both cases, a matrix of electrodes, separated by the gas, allows a certain point or pixel to be addressed.

By applying sufficient voltage at an addressed matrix intersection, the gas is excited, emitting an orange-red light. The DC type is simpler to construct but usually has an inherent background glow due to the continuously present DC voltage necessary for refresh. The AC version is more complicated to build but has no background glow or image-refresh requirements.

Because gas-plasma displays produce light, they need no backlighting. Still, they use more power than a backlit LCD.

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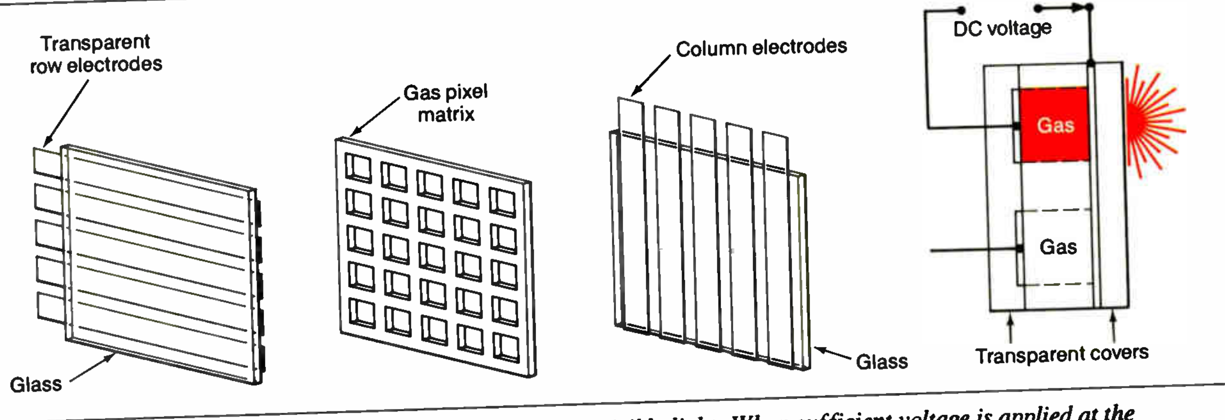

Figure 3: *Gas-plasma displays use tiny pixels of gas to produce visible light. When sufficient voltage is applied at the intersection of two electrodes, the gas glows an orange-red.*

Because of the need for operating voltages higher than normal, few battery-operated computers with this type of display have appeared. Manufacturers have to include converter circuitry to change the low voltage of the batteries to high voltage for the screen (about 200 volts for DC), and that adds power consumption, weight, and complexity.

Originally, gas-plasma technology provided only on-off control. Recent advances have improved control over the brightness of the pixels and provided several steps between the dimmest and brightest conditions, sort of an orange-red "gray" scale. Photo 2 shows a gas-plasma panel that offers both 4- and 16-step "gray" scales.

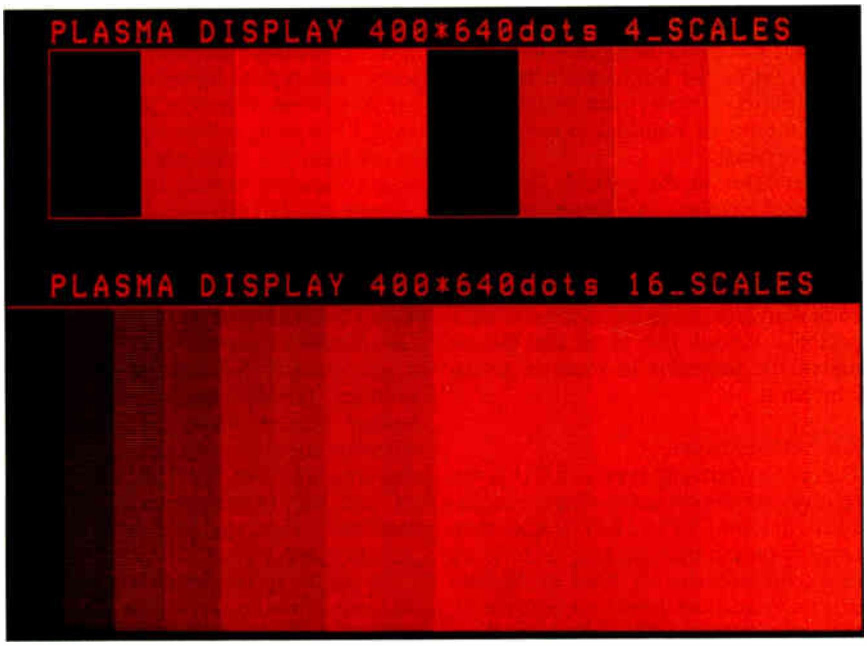

Photo 2: *Gas-plasma displays can now display up to 16 levels of so-called "gray." (Photo courtesy of Panasonic Industrial Co.)*

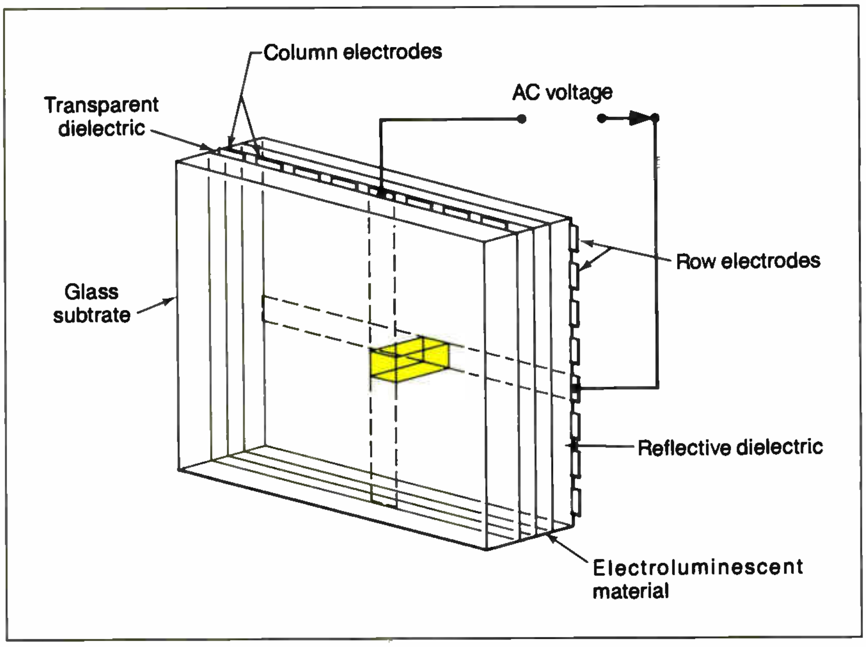

Figure 4: *EL displays address pixels of EL material with electrodes. An AC voltage causes the material to produce its characteristic yellow light.*

Gas-plasma displays have faced many problems. Their lack of full-color capabilities, their relatively short life span, and their cost have all contributed to their slow emergence. IBM's 17-inch gas-plasma display panel listed for about $3300 in 1985, which is hardly competitive with CRTs. Another company recently bought the AC plasma technology from IBM and made some innovations in reducing driver count and power consumption, hoping to reduce the cost significantly.

At the May SID show, NHK Laboratories discussed its full-color 20-inch DC plasma panel intended for use in high-definition television. (This is another example of how television can drive the display-technology industry.) Also, Fujitsu has announced 8- and 15-inch color displays with 76,000- and 256,000-pixel resolutions, respectively. Most important, the company claims that the life expectancies of the new displays now match those of CRTs. As with LCDs, a great deal of effort will be expended before large, full-color gas-plasma panels are ready for mass marketing.

EL Displays

EL displays operate on the principle of electroluminescence—phosphors emitting light in the presence of an alternating electrical field. EL displays are becoming increasingly popular in military and industrial applications requiring portability and reliability in hostile environments. Their truly solid-state construction makes them rugged.

A typical EL display consists of a thin film of EL material (phosphor) sandwiched between thin films of insulating dielectric material (see figure 4). The front material is transparent, while the rear material is reflective. The zinc-sulfide-with-manganese phosphor emits a bright yellow light when subjected to approximately 200 V AC. The voltage is applied via a grid of electrodes (also very thin), each pixel of which can be individually switched on. Other phosphors can be used for different colors.

EL displays range in size from 2 by 2 inches to 12 by 14 inches, with resolutions ranging from 320 by 128 pixels to 640 by 400 pixels. As with gas-plasma displays, a "gray" scale can be achieved by using a controller chip that provides that function. Planar Systems of Beaverton, Oregon, plans to introduce a 640- by 480-pixel display early next year. (See "Lighting the Way" on page 275 for additional information on EL displays.)

EL displays offer better contrast and

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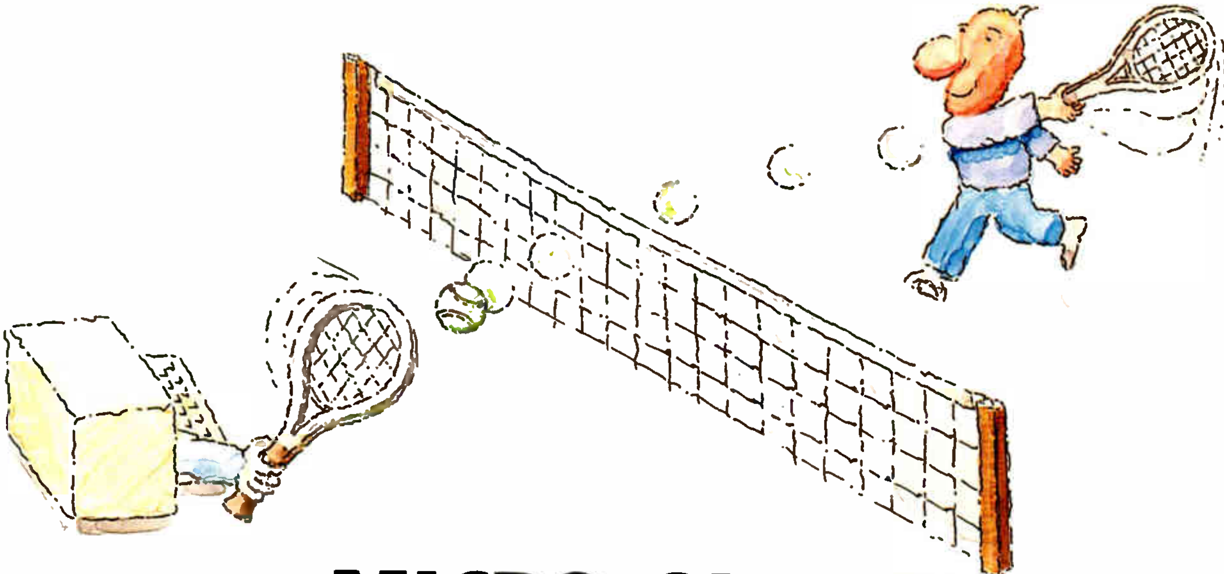

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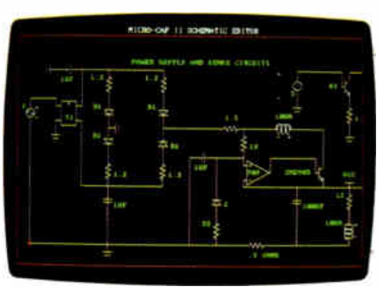

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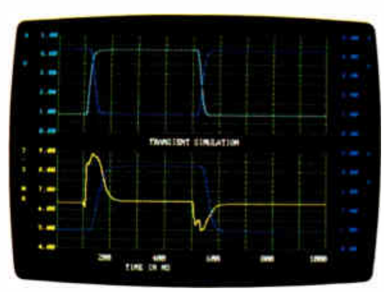

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broader viewing angles than gas-plasma and LCD displays. They use more power than LCDs but less than gas-plasma and considerably less than CRTs. As with gas-plasma, operating an EL display from batteries has its drawbacks.

In addition to being more compact and lightweight than CRTs, EL displays are much more reliable. Manufacturers claim an average mean time to failure of about 40,000 hours, in contrast to an average of 10,000 hours for typical CRTs.

While EL displays are rugged and feature excellent contrast, they are still quite expensive. A typical 640- by 400-pixel 12-inch EL display costs about $400 to manufacture today, while an equivalent CRT costs under $100. However, industry analysts expect the price of EL displays to drop to about half their present cost by 1990.

However, the EL display market is faced with the "chicken and egg" problem. The prices won't come down until the displays are manufactured and sold in larger volumes, and that's dependent on the prices coming down. According to spokespersons from Planar Systems, many workstation vendors are expressing greater interest in EL displays.

EL displays are still offered primarily in monochrome configurations. Full-color EL displays have been hampered by difficulties in producing a good blue phosphor. Planar Systems plans to offer a red and green EL display for military applications in late 1989 and hopes to bring full-color displays to market by late 1990.

In spite of their appeal, EL displays are still at the high end of the market and are likely to remain so. The color problem is another obstacle to widespread acceptance. Since most commercial computers are priced extremely competitively, it's likely that many manufacturers will continue to opt for the lower-priced gas-plasma displays, while EL will remain the favorite in military applications and perhaps in high-priced workstations.

Chips Ahead

The consensus among display manufacturers is that, although some interdependency exists, the chips and controllers to drive the displays seem able to stay up with or keep slightly ahead of the actual light-producing displays.

This is evidenced by an announcement from Yamaha's Systems Technology Division concerning its new Enhanced Panel Display Controller chip. This 128-pin package will support IBM monochrome, CGA, EGA, NEC MultiSync, LCD, EL, and gas-plasma (with "gray" scale) in 640- by 200-, by 400-, and by 480-pixel, and 320- by 200-pixel modes. For 640 by 480 pixels, the package supports 16 colors. For the LCD's 320 by 200 pixels, it supports 8 colors. (For a look at Texas Instruments' new graphics chip, see "Taking the Wraps off the 34020" on page 257.)

Back to the Future

Despite advances in display technologies over the years, information traditionally has been presented in a two-dimensional flat format. For most text-based applications, two dimensions appear to be enough. Humans are used to seeing in three dimensions, but often little is gained by adding depth to words and numbers alone. For just about everything else, however, three-dimensional displays make sense.

Experiments with three-dimensional displays go back to the stereoscopic viewers that used still photographs to add depth, proceeded through movies, and into television. Holography was once in vogue. In CAD and other real-world applications where a picture *is* worth a thousand words, a genuine need for three dimensions exists. As with most display systems, cost and image quality figure heavily into the future of such displays.

There have been many different approaches to three-dimensional displays, some involving mechanical motion and others strictly electronic. One solid-state approach from Tektronix in Beaverton, Oregon, uses special liquid-crystal shutter (LCS) eyeglasses synchronized with a CRT display.

Binocular vision—seeing two images from slightly different locations—contributes to our depth perception. Early attempts to exploit this used red and blue lenses and corresponding red and blue images. Other versions have employed polarized light, prisms, and lenticular screens.

With the LCS system, each side of the glasses worn by the viewer is alternately transparent and opaque while the corresponding image shifts slightly on the CRT screen. The viewer's retinas retain each image long enough to minimize the switching flicker and fool the brain. Having one eye see an image in a slightly different position than the other provides the three-dimensional illusion on a flat screen.

An intriguing approach to truly three-dimensional displays was demonstrated by Texas Instruments (TI) at the May SID show. A common drawback to LCS or polarized viewing of two-dimensional images to simulate three dimensions has been the limited viewing angle. As you move away from an ideal viewing position, usually directly in the center of the display, the depth illusion fades. Often

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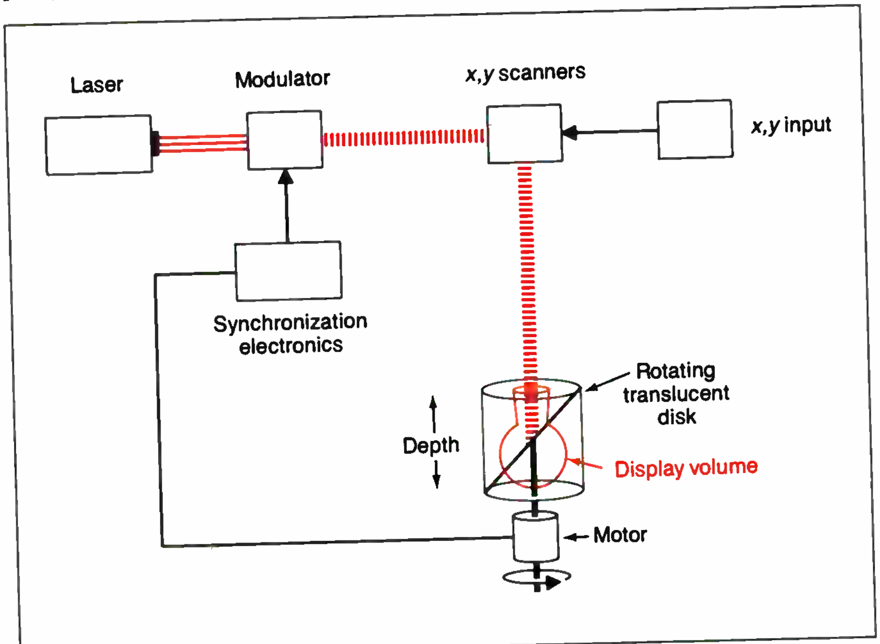
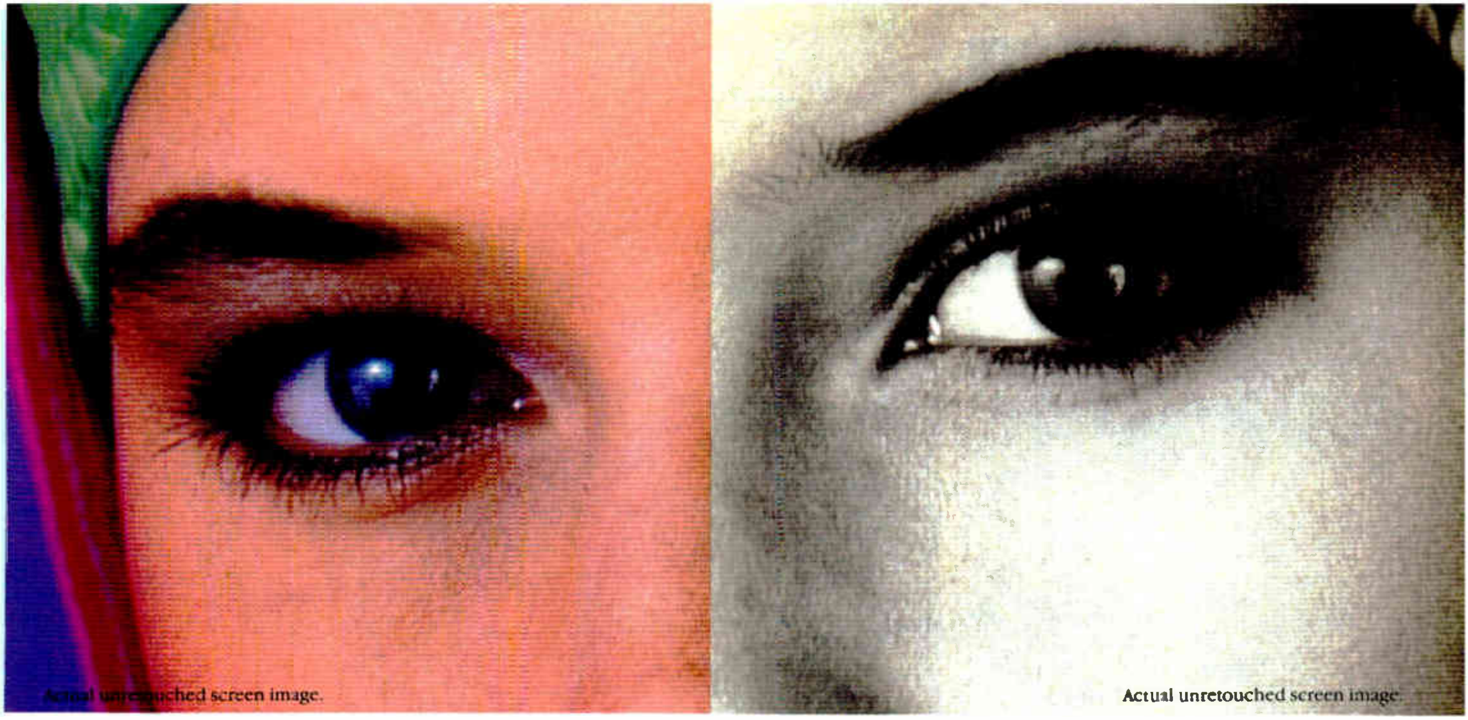


Figure 5: *Will this be the wave of the future? A prototype display system uses a laser and rotating translucent disk to produce the elusive third dimension. (Diagram modified. Original courtesy of Texas Instruments, Inc.)*



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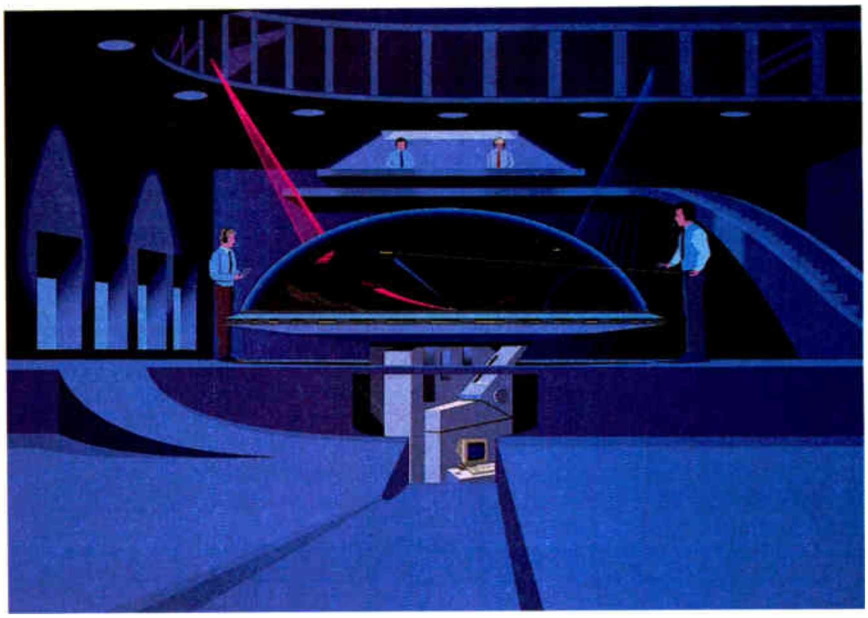

Photo 3: *Artist's conception of a three-dimensional image produced using the laser system described in the text. (Photo courtesy of Texas Instruments, Inc.)*

three-dimensional schemes also require some sort of special glasses or goggles.

Using an electromechanical approach as shown in figure 5, Don Williams of the User System Engineering Group at TI displayed a system that uses low-power laser light to project images onto a slanted 10-inch rotating translucent disk. The result is a "real-time, auto-stereoscopic, multiplanar three-dimensional display system" (patent pending).

In the $10,000 proof-of-concept prototype, the disk rotates at between 400 to 600 revolutions per minute to synchronize with the laser light source. The rotation provides a translucent display volume into which a laser projects points of light. By scanning the laser in two dimensions on the rotating disk, a viewer's eyes fuse the points of light into a "solid" object. The resulting image can be viewed from any angle and has a resolution of 500 by 500 pixels and a 4-inch depth of field. Williams said that with larger disks and higher resolutions, bigger and better images can be generated, and by mixing red, green, and blue laser light, full color would also be possible.

A potential use of this system promoted by TI would be in air-traffic control. An entire airspace around an airport might be displayed, with air-traffic controllers able to walk around the scene, viewing it from different angles and heights, and identifying aircraft using small hand-held lasers (see photo 3). Williams is a human-factors engineer, and, for him, the driving force behind three-dimensional displays is to come up with something that works well with humans.

Going Up?

Considering the advantages of thin, lightweight displays and our affection for solid-state construction, it looks like flat panels could eventually replace CRTs, but don't count our old friend out yet. It's pretty commonplace to produce large, full-color display panels when cost is of little consideration. Reducing costs so that mass production is possible will take some time. And who knows what kinds of technological breakthroughs might launch another display scheme along the way and perhaps displace all the current contenders?

The synergy of physics, chemistry, and fabrication technologies seems to be taking display development along an exponential increase. The future is bright, in full color, and maybe even in three dimensions. ■

ACKNOWLEDGMENT

Special thanks to David Mentley of Stanford Resources, Inc., a consultant on display technology based in San Jose, California.

Gene Smarte is West Coast bureau chief for BYTE in Costa Mesa, California. You can contact him on BIX as "gsmarte." Nicholas M. Baran is a BYTE technical editor in San Francisco. You can reach him on BIX as "nickbaran."

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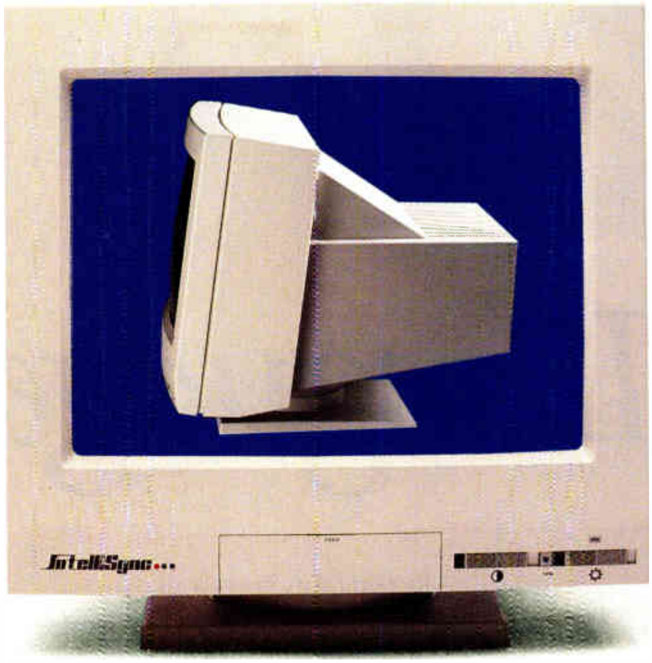

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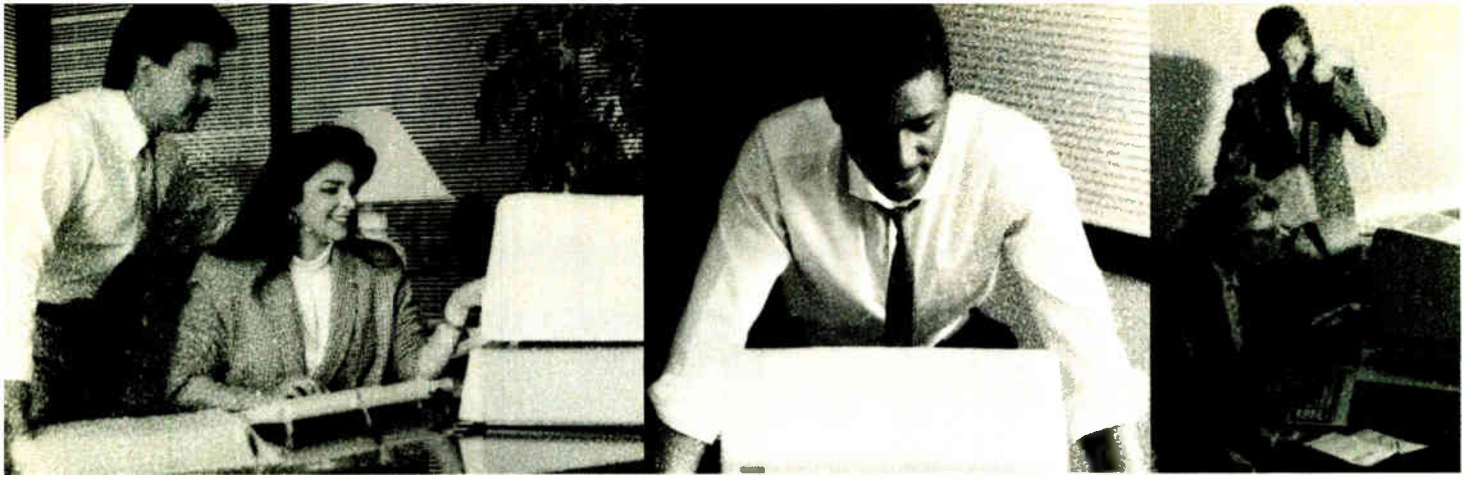

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BCC180 — $395.00
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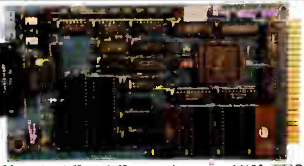


The **BCC180**, only 4.5" x 8.5" uses the same 64180 CMOS Z80 instruction compatible processor as Micromint's SB180 and SB180FX single board computers. Configured primarily for process control w/ 384K of memory, 6 parallel I/O ports, console serial port, RS 232/422/485 selectable auxiliary serial port, and an interrupt driven ROM-resident multitasking BASIC-180 compiler, the BCC180 uses the same 44-pin I/O expansion bus as Micromint's BCC52 controller board.

PROCESSOR
- CMOS HD64180, 9.216MHz 8 bit CPU, 68 pin PLCC package

MEMORY
- Up to 384K bytes total memory on board
- 128K of either static RAM (62256) or EPROM (27256)
- 256K dynamic RAM SIMM
- Full function 8K ROM monitor included

INPUT OUTPUT
- Console RS 232 serial port with auto baud rate select to 19,200 baud
- Peripheral serial port, 150 19,200 baud, selectable RS 232, RS 422 or RS 485
- 48 bits bidirectional parallel I/O
- 64K I/O available through the BCC bus edge connector

DIMENSIONS and CONNECTIONS
- Dual 22 pin (0.156") edge connector
- Compatible with all Micromint BCC-series I/O expansion boards
- Two 26 pin headers for six bidirectional parallel ports
- 25-pin DB 25 for RS 232 console I/O
- 20 pin header for RS-232 auxiliary serial port
- 4 screw terminals for RS 422/485 connection

BCC180-1-20 9MHz assembled and fully socketed BCC180 Computer/Controller with 32K bytes of static RAM, ROM Monitor, BASIC-180 development software and user's manual — **$395.00**
For Additional 256K DRAM add $100.00

BCC180-1 100 Quantity w/32K RAM w/o ROM Monitor **$209.00**

BCC52 — $189.00
BASIC-52 Computer/Controller

The **BCC52** Computer/Controller is Micromint's hottest selling standalone single board microcomputer. Its cost-effective architecture needs only a power supply and terminal to become a complete development or end-use system, programmable in BASIC or machine language. The **BCC52** uses Micromint's new 80C52-BASIC CMOS microprocessor which contains a ROM resident 8K byte floating point BASIC-52 interpreter.

The **BCC52** contains sockets for up to 48K bytes of RAM/EPROM, an "intelligent" 2764/128 EPROM programmer, 3 parallel ports, a serial terminal port with auto baud rate selection, a serial printer port, and it is bus compatible with the full line of BCC-bus expansion boards. The BCC52 bridges the gap between expensive programmable controllers and hard-to-justify price sensitive control applications. BASIC-52's full floating point BASIC is fast and efficient enough for the most complicated tasks, while its cost effective design allows it to be considered for many new areas of implementation. It can be used both for development and end-use applications.

Since the BASIC-52 is bus oriented, it supports the following Micromint expansion boards in any of Micromint's card cages with optional power supplies:

BCC22	Smart terminal board	BCC40R	8-Channel relay output board
ADP500	User vocabulary, digitized speech board	BCC53	Memory and 6 port I/O expansion board
BCC25	LCD display board	BCC13	8-bit and BCC30 12-bit A/D converter boards
BCC33	3 port I/O expansion board	BCC18	Dual channel serial I/O board
BCC40D	8-Channel optoisolated I/O expansion board		

BCC52 BASIC 52 Controller Board **$189.00**
BCC-SYST.5 "52 PAK" Starter System includes: BCC52,ROM A&B UTIL.,CC01,MB08,UPS10 **$449.00**

BCC52 OEM 100 Quantity Price -- $149.00

BCC52C Lower power all CMOS version of the BCC52 **$199.00**
NOTE: The BCC52 series is available in Industrial Temperature Range, fully tested at temperature. Prices start as low as $294.00 in single quantities. Be sure to call for a quote on your specific Industrial OEM requirements.

BCC11 — $139.00
Z8 BASIC Computer

Features:
- Uses Z8 single chip microcomputer
- On-board tiny BASIC interpreter
- 2 on-board parallel ports & serial port
- 6 interrupts (4 external)
- Just connect a terminal and write control programs in BASIC
- 6K bytes of RAM or EPROM memory on-board
- Baud rates 110-9600 bps
- Data and address bus available for 56K memory and I/O expansion
- Consumes only 1.5 watts at +5, +12, and -12V

BCC11*
BASIC System Controller
$139.00

OEM 100 Quantity Price $89.00

* **Now Available in Industrial Temperature Range**

Announcing BCC40D — $139.00
8-Channel Optoisolated I/O Expansion Board

The Micromint **BCC40D** is an 8-channel optoisolated input/output expansion board designed for use with Micromint's family of BCC-bus Computer/Controllers. Using industry-standard optoisolated I/O modules, the **BCC40D** provides on/off control and input monitoring of eight 115-230VAC or 5-48VDC devices used in data acquisition and control applications.

Up to 16 **BCC40D** boards can be used together in a single system to provide a total of 128 input and output channels. Individual channels can be read or updated by reading from or writing to a single I/O address. The **BCC40D** can be directly controlled from BASIC or it can function completely in the background under an application program using high-speed interrupt-driven ROM C firmware. This firmware sets aside a table in memory which reflects the status, setpoints, and change-of-state flags of the I/O modules. Interaction among programs within a multiboard BCC40x system merely consists of reading or setting these memory table values.

Each optoisolated channel is fused and has screw contacts for direct connection to the controlling device and/or the power source. Both input or output modules, and AC or DC functions can be intermixed on the same **BCC40D** board.

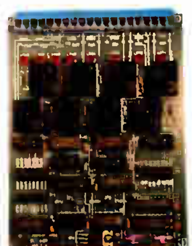
New

SPECIFICATIONS
- Latched outputs
- Uses industry-standard OAC5, ODC5, IAC5, IDC5 type modules
- Dual-ported module addressing
- LED on/off indicator on each channel
- Can be used concurrently with BCC40R and other BCC-bus peripherals
- Operates on +5V
- Operating conditions: temperature: 0-50°C (32-122°F) relative humidity: 10-90% non-condensing
- 4.5" x 6" board
- dual 22-pin (0.156") edge connector
- 16-terminal screw connector (#14 wire)

BCC40D/0	without modules	**$139.00**
BCC40D/4	with 4 modules	**$189.00**
BCC40D/8	with 8 modules	**$229.00**

OEM 100 Quantity pricing starts at $95.00

Announcing BCC40R — $169.00
8-Channel Relay Output Board



The Micromint **BCC40R** is an 8-channel relay output expansion board designed for use with Micromint's family of BCC-bus Computer/Controllers. Using efficient mechanical relays, the **BCC40R** provides contact-closure on/off control of eight AC- or DC-powered devices for data acquisition and control applications.

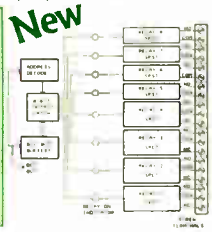
Up to 16 **BCC40R** boards can be used together in a single system to provide a total of 128 relay output channels. The relays are controlled by writing to a board-specific I/O address. The relays on a **BCC40R** board can be controlled either as a set of eight relays at a single I/O address or individual relays at eight separate I/O addresses.

The **BCC40R** can be directly controlled from BASIC or it can function completely in the background under an application program using high speed interrupt-driven ROM C firmware. This firmware sets aside a table in memory which reflects the status and setpoints of the relays. Interaction among programs within a multiboard BCC4Dx system merely consists of reading or setting these memory table values.

The eight relay outputs have screw contacts for direct connection to the controlling device and/or the power source. Four of the relays have single-pole-double-throw (SPDT) output connections and four relays have single-pole-single-throw (SPST) output connections.

SPECIFICATIONS
- Contacts rated for: 1/10 HP, 3A 120V resistive, or 3A 30VDC
- Latched relay outputs
- LED on/off indicator on each channel
- Power on/off failsafe: No arbitrary closures on power up/down
- Can be used concurrently with BCC40D and other BCC-bus peripherals
- Operates on +12V
- Operating conditions: 0-50°C (32-122°F) relative humidity: 10-90% noncondensing
- 4.5" x 6" board
- dual 22-pin (0.156") edge connector
- 20-terminal screw connector (#14 wire)

New



BCC40R 8-Channel relay output board **$169.00**
OEM 100 Quantity price $124.00

Announcing BCC18 — $175.00
Dual-Serial Board

The **BCC18** is a general-purpose dual-serial-port interface board for use with the Micromint BCC-bus. Optional support software is available for the BCC52 and BCC180 computer/controllers.

The **BCC18** Serial Board contains two serial interfaces. Each interface can be either a 110/300/1200-bps modem, or a hard-wired RS-232C/RS-422/RS-485 interface. The modem interface uses a Xecom XE1201/XE1203 MOSART (MOdem Synchronous/Asynchronous Receiver/Transmitter), capable of 110, 300, or 1200 bps communication and compatible with Bell 103 and Bell 212A standards. The hard-wired serial interface uses an industry-standard 8251A USART (Universal Synchronous/Asynchronous Receiver/Transmitter), capable of supporting asynchronous serial communications at speeds up to 19.2 kbps and synchronous serial communications at speeds up to 64k bps.

The **BCC18** can be configured with two MOSARTs, two 8251As, or one of each. Up to 16 **BCC18s** can be used in a single system (for a total of 32 serial ports).

MOSART
- Connects directly to any phone line
- DTMF or pulse dialing
- DTMF reception and decoding
- Call progress monitoring
- Parity generation/checking
- Sync byte detection/insertion
- Extensive built-in diagnostics
- Telephone-line diagnostics
- Synchronous and asynchronous operation
- Voice synthesis capability (XE1203 only)

8251A
- Full-duplex, double-buffered transmitter and receiver
- Fully programmable with several speed and character modes
- Error detection for parity, overrun, and framing
- False start bit detection, automatic break detect and handling
- Supports bisync
- Bit rate is software programmable using an on-board 8253 counter/timer
- RS-232C, RS-422, and RS-485 supported

Software
- MOSART and 8251A use the same program interface, so most software will work with both
- Optional support software for the BCC52 and BCC180 is available that makes it easy to access and use most of the features of the MOSART and 8251A from within user-written programs

BCC18S OEM configuration fixed dual 8251 RS-232 only serial port board **$175.00**

BCC18S OEM 100 Quantity Price $134.00

BCC18U-1	8251/8251 Dual RS-232/485 serial	**$209.00**
BCC18U-2	8251/1201 Modem and serial port	**$359.00**
BCC18U-3	1201/1201 Modem /Modem board	**$499.00**
BCC52/18	BCC52 serial port utilities software	**$75.00**

BCC-BUS
Expansion Products

		Single Qty. Price
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BCC13	8-bit, 8 Channel A/D Board	$129.00
BCC30	12-bit, 16 Channel A/D Board	$197.00
BCC22	25-line, 80 Character Terminal Board	$249.00
BCC25	LCD Board (4x20) or (8x40*)	$159.00
BCC55	Fully Decoded & Buffered Prototyping Board	$ 79.00
BCCxx	X-10 Power Line Controller	$ 59.00
BCC53	Multifunction Expansion Board	$160.00
MB04	4 Slot Mini-Motherboard	$ 69.00
MB08	8 Slot Full Motherboard	$ 85.00

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Taking the Wraps off the 34020

A trio of chips that puts workstation power on a small board

Ron Peterson, Carrell R. Killebrew Jr., Tom Albers, and Karl Guttag

The new TMS34020 32-bit graphics microprocessor (the '20) is well suited to workstations and personal computers requiring highly interactive user interfaces. The '20 is also suited to laser printers, which are becoming more performance-hungry, with requirements for on-the-fly font compilation, and the increased complexity of page-description languages, which are constantly demanding more performance.

Data and image compression such as facsimile and CD-ROM are other areas where the '20 will find ready applications, since fast bit-addressable processors provide inherent advantages over general-purpose processors for performing the Huffman-type encoding and decoding necessary for CCITT Groups 3 and 4 fax standards. In fact, for TMS340 Graphics System Processors (GSPs), fax-type compression and decompression is just another program (i.e., no additional hardware is required).

A Chip off the Old Block

The '20 is the newest member of Texas Instruments' (TI) TMS340 GSP family. Depending on the instruction mix, it's between 6 and 50 times faster in key graphics operations than its predecessor, the TMS34010 (the '10). The '20 runs at 10 million instructions per second (MIPS) when executing from its 512-byte instruction cache. It's designed to connect directly to a second '20 as well as to the 40-million-floating-point-operation-per-second (MFLOPS) TMS34082 graphics floating-point coprocessor (the '82 FPU). The '20 has instructions that can perform pixel- or bit-aligned block transfers at 142 megabits per second, and when using the TMS44C251 1-megabit video RAM (the 44C251 VRAM), the '20 can execute fills at up to 1.136 gigabits per second.

The '20 has all the architectural features that define TI's TMS340 GSP family (see figure 1). These features include a host-bus interface, a local-bus interface with semi-autonomous memory controller, a display-control interface and registers, instruction cache, 31 32-bit registers, single-cycle general-purpose instructions, and multiple-cycle graphics instructions. (For details on the '10, see "The TMS34010 Graphics System Processor" in the December 1986 BYTE.)

The '82 FPU is based on the same design used by many bit-slice graphics workstation engines. It directly connects to the '20's coprocessor interface and has external expansion for both microcode and data.

The '20 has also been designed to take full advantage of the features of the 44C251 1-megabit VRAM. These im-

continued

ILLUSTRATION: ROBERT TINNEY © 1988

provements allow faster fills, masked operations, and text without resorting to the expense of the wide data buses used in many workstations.

Theory of Evolution

The concept of a graphics engine designed around a fully programmable microprocessor is what made the '10 different from other graphics chips and has led to the TMS340 family's success. The device differs from a normal microprocessor in the special hardware and microcode included to support bit-mapped graphics operations. It also integrates graphics system-control features for the CRT, dynamic RAM (DRAM), and VRAM onto one device. The underlying goal in this design was to let the flexibility of bit-mapped graphics be matched by the flexibility of a graphics processor.

The definition of the '20 began during final development of the '10. Features that were too expensive or that would cause major schedule delays on the '10 were slated for implementation on the '20. The first issue was to obtain an overall speed improvement over the '10. This began with the obvious expansion of the '10's 32-bit internal and 16-bit external busing to a full 32 bits for both on the '20.

With the addition of 32-bit pixel and 32-bit external bus support, several graphics features have been enhanced on the '20. Pixel-formatted registers are expanded from 16 to 32 bits in significance; these include the color-expand registers and the plane-masking register. Other enhancements include improving the processor cycle time and utilizing the fast page mode of DRAM. Also, the instruction cache was doubled to 512 bytes on the '20 to reduce cache misses and let larger algorithms fit into the cache.

New capabilities were also added. Three-operand block transfers were needed by both laser-printer manufacturers dealing with large textured objects and system developers building extensive window environments. Many system designers using the '10 had requested better support for direct host access to the TMS340's memory, and some of the more sophisticated applications required the graphics processor to do operations

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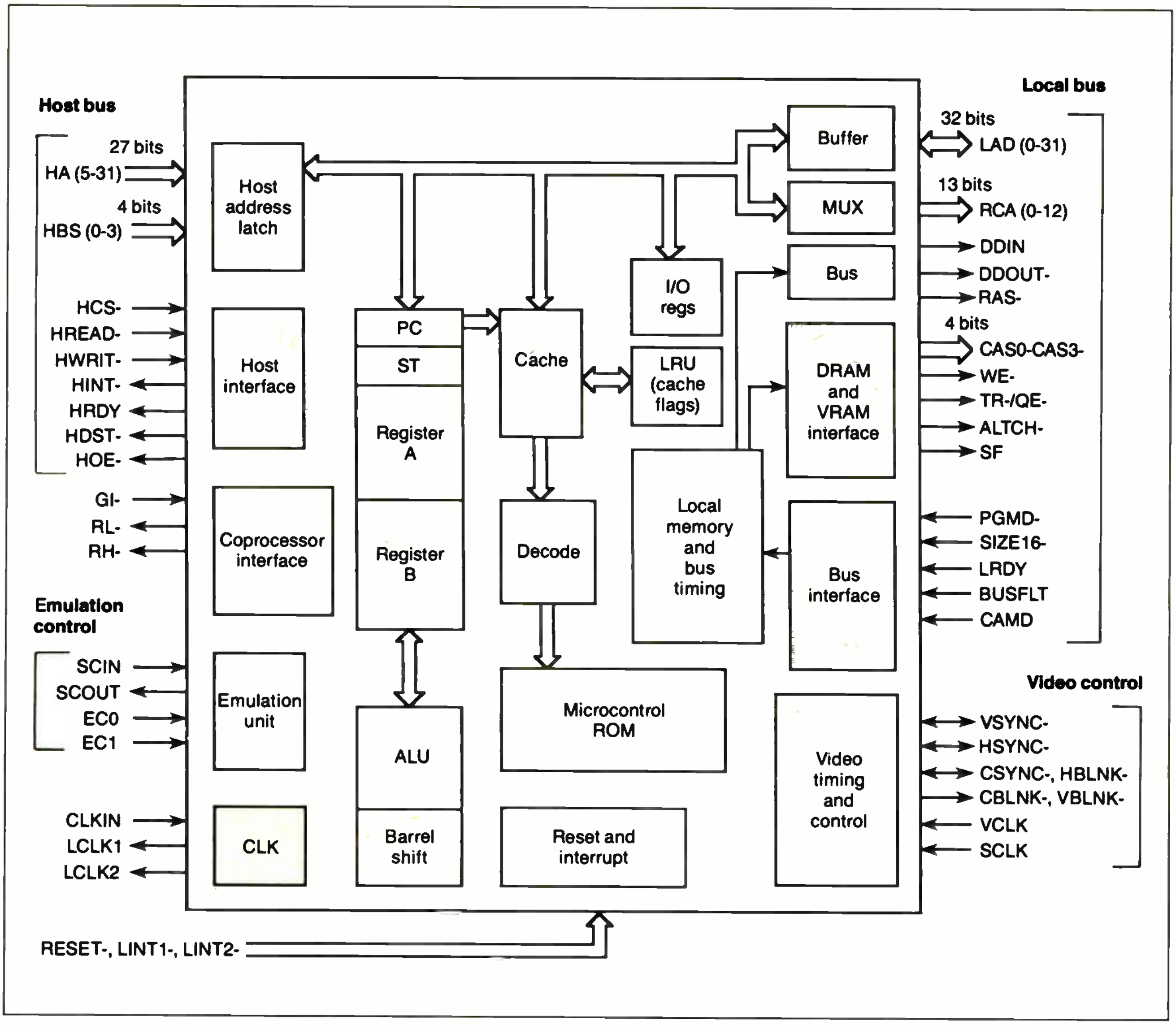

Figure 1: *The TMS34020 block diagram. Note the coprocessor interface and the built-in host attachment capabilities.*

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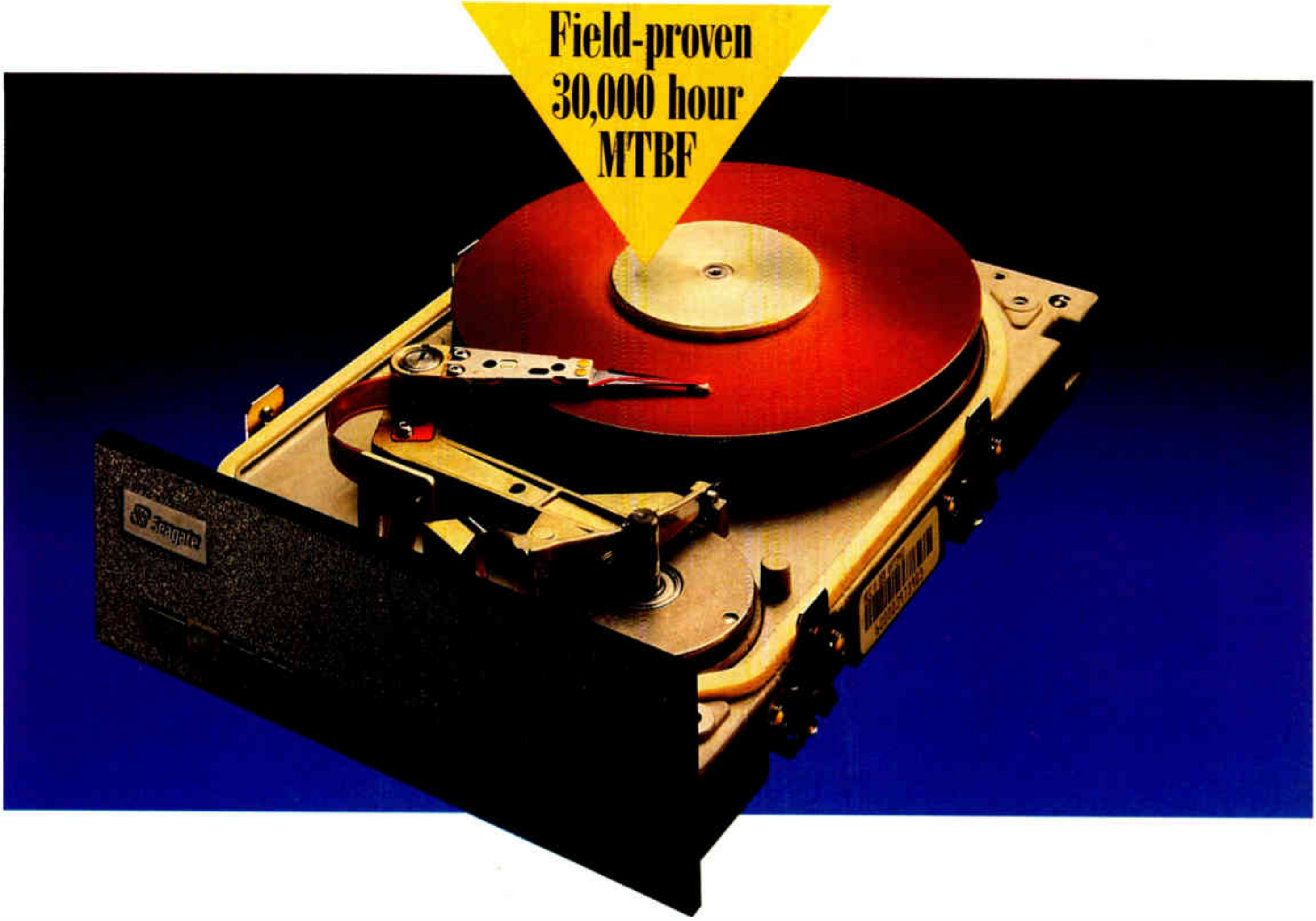

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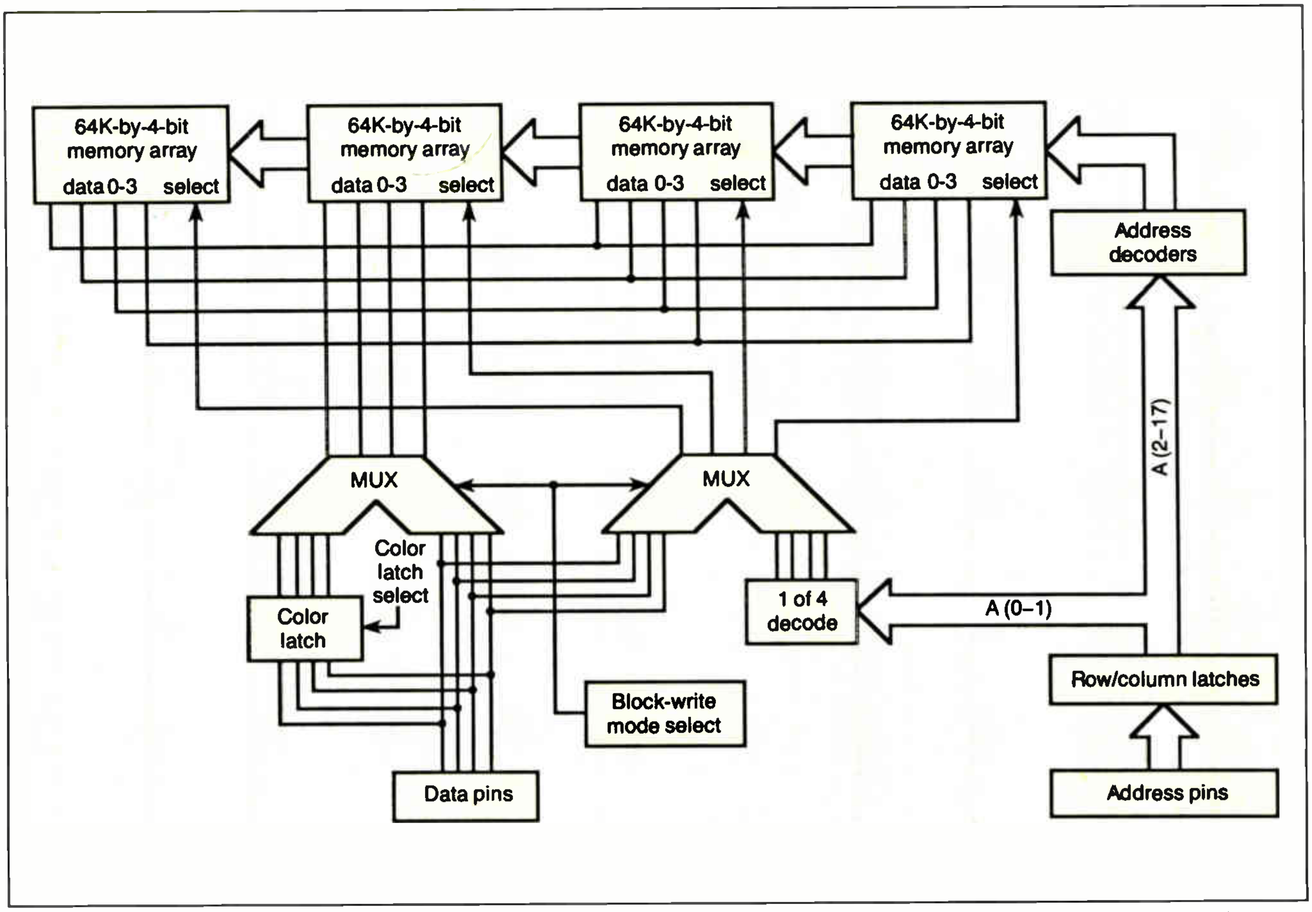


Figure 2a: *TMS44C251 VRAM internals. Notice the four banks of 64K-by-4-bit memory, for a total internal width of 16 bits.*

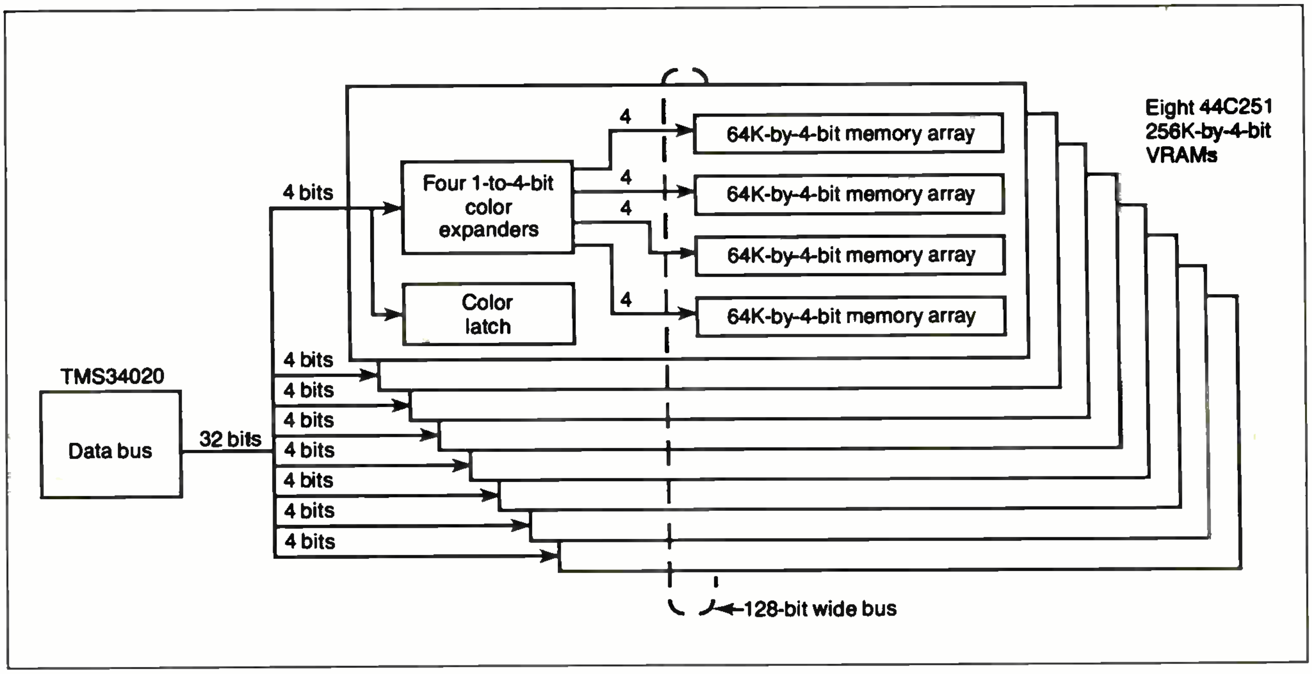
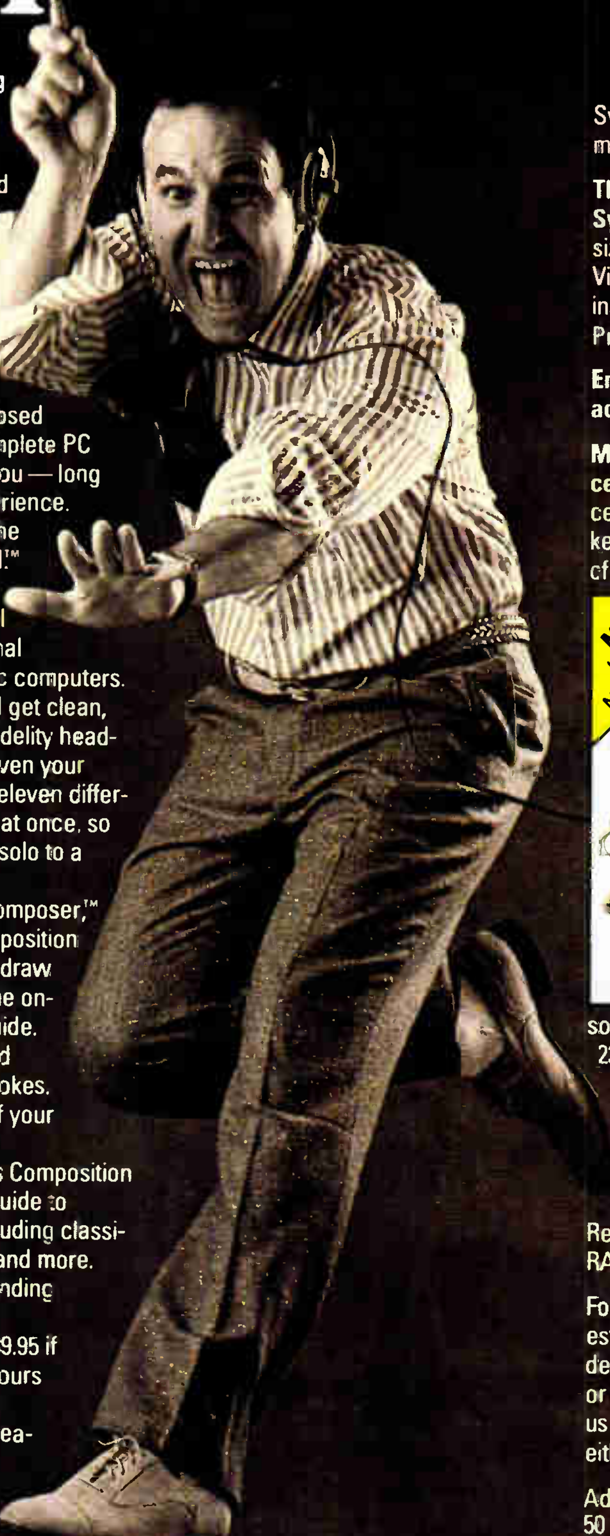


Figure 2b: *An overall picture of the 44C251 and its connection to the '20. Notice how the '20 expands the 32-bit data path to 128 bits wide inside the VRAM.*

Compose Yourself!



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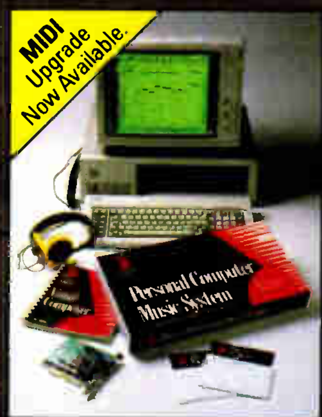

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in the host's memory space.

As a result, the host interface was totally revamped for the '20. Better CRT timing control was added to the display controller to enable broadcast-quality RS170 National Television System Committee (NTSC) timing. New *XY* addressing support and improved VRAM control were also added to pack together frame-buffer scan lines for better memory utilization. The '20's VRAM support takes advantage of the 1-megabit VRAM's split shift register as well as the older (and less efficient) 256K-bit VRAM's midline reloading.

The '20 has enhanced the *XY* addressing support of the '10 to include direct support for *pitches* other than binary for the *XY* address space. (Pitch is the distance between pixels on corresponding lines.) Both pitches that are the sum of two powers of 2 ($A + B$ where both A and B are powers of 2) and completely arbitrary pitches are supported. This makes the coding of output routines into linear memory and instruction support for packed screen organizations much easier. In addition, both X and Y values on the '20 are treated as signed 16-bit numbers.

The definition of the '20 has gone far beyond its own chip boundaries to include the development of an extremely fast graphics floating-point coprocessor, the '82. This processor is 30 to 100 times faster than the typical microcomputer's FPU. (See the text box "The Class of '82" on page 264.)

The '20 project team also worked closely with TI's memory-design engineers to allow the '20 to distribute some processing within the new 1-megabit VRAM, the 44C251. (See the text box "Making Videos" on page 272.) Coordination between the development programs and the resulting cooperation between these three chips enables simpler system design and higher performance.

A Marriage of Convenience

Since the '20 and the 44C251 1-megabit VRAM definitions were coordinated during development, the '20 supports performance and system features added to the 44C251. The designers of the '20 had the advantage of knowing and influencing the definition of the VRAM, so the two architectures fit together.

The importance of that joint definition can be seen most clearly with the block-write mode (BWM). The 44C251 has four banks of 64K-by-4-bit memory, for a total of 16 bits wide internally (see figure 2a). In normal mode, the two least-significant bits of the address select one of four banks—only one can be selected at a time—and the four data lines provide the data. In BWM, the four data lines used enable writing to any and all combinations of the four banks within each 44C251, and the special color-latch data is multiplexed to provide the data when it's written. The '20 controls the 44C251 to expand the 32-bit data path to 128 bits wide inside the VRAM (see figure 2b).

The BWM function is modeled after the TMS340 family's "binary to color expand" function. Color expansion works by turning data into control signals that select whether or not to write a color. Since each data line controls a multiple-bit color value, we use the term "color expansion."

Both the '20 and the '10 have flexible color expanders that turn 1-bit-per-pixel shape information into 1, 2, 4, 8, or 16 bits per pixel. The '20 extends this function to 32 bits per pixel. This function,

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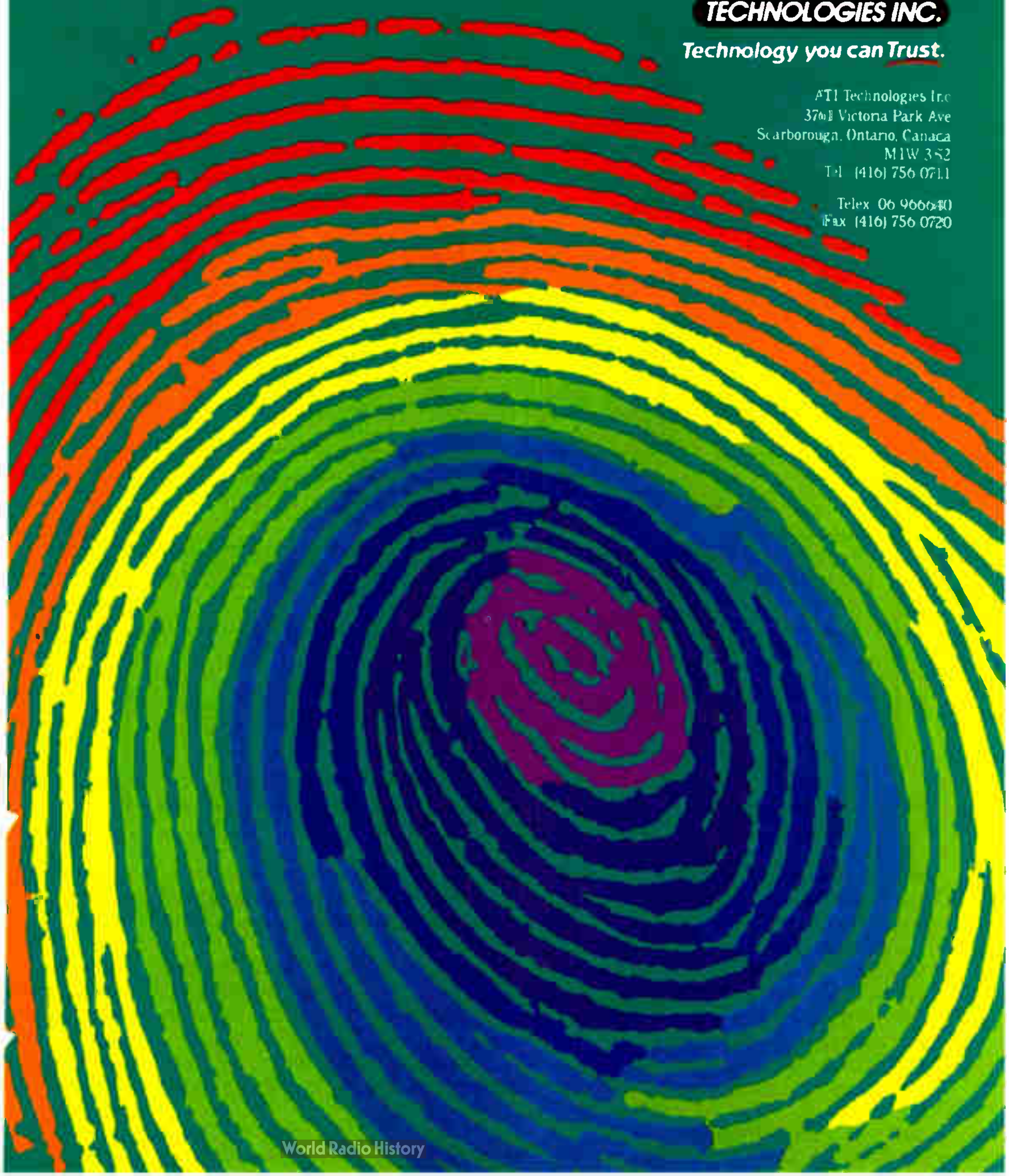


The Class of '82

The 34082 is a high-performance graphics floating-point coprocessor developed exclusively for the 34020. Integrating a microsequencer, register file, floating-point ALU, and multiplier onto one chip (see figure A), and supporting high-level graphics instructions, the '82 can execute floating-point operations at up to 40 MFLOPS.

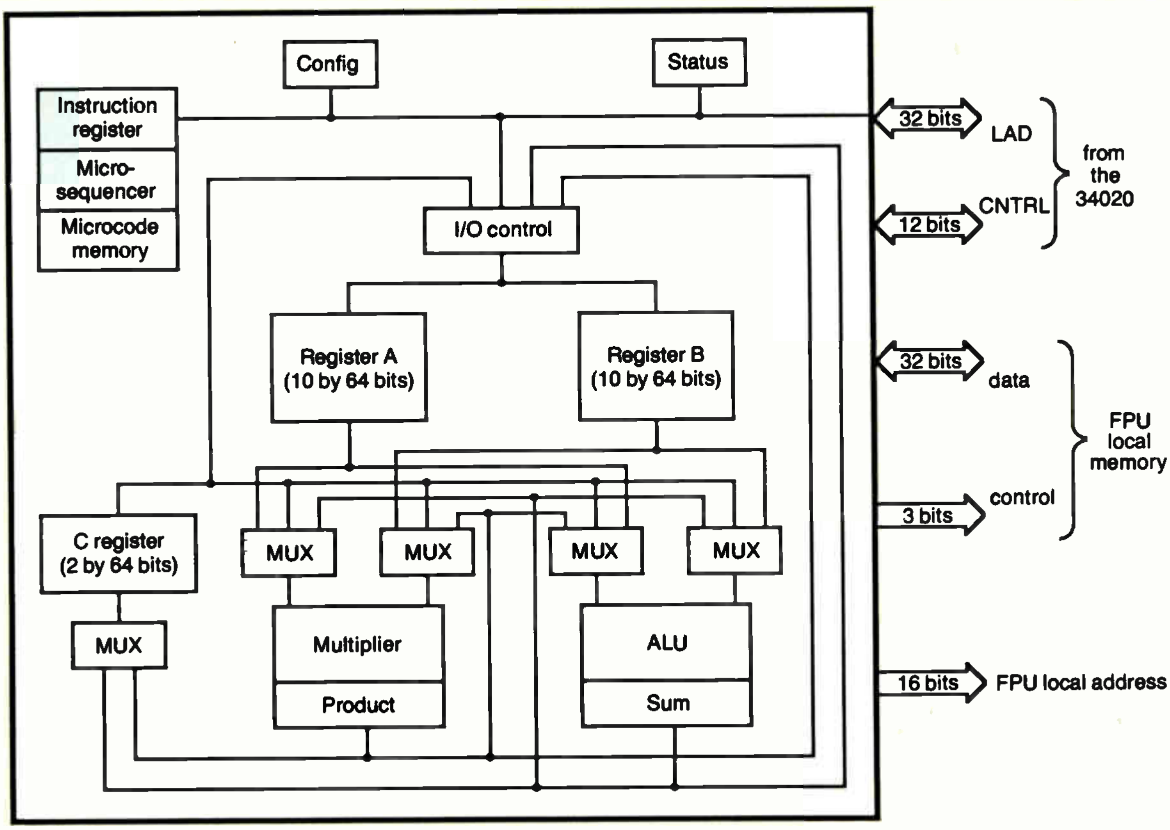
The register file on the '82 consists of 22 64-bit registers. The file has 10 A-file registers and 10 B-file registers for data storage and two C-file registers for feedback. This large register file lets complex algorithms store intermediate results internal to the device, thereby reducing the memory cycles necessary to reload these operands for future calculations. The device also incorporates a local bus for storing up to 64K 32-bit words for data and microcode expansion. This expansion memory lets you develop your own functions or store data local to the '82.

Using the '20's coprocessor interface, the '82 directly interfaces to the '20 with no "glue" logic, letting the '82 be either initially designed into the system or socketed for later addition. This interface allows connecting up to four '82s to the '20. The '20 provides a general coprocessor interface to let the external implementation of advanced functions improve performance. The '82 is one example of a coprocessor taking advantage of this interface for performance increases. The interface consists of five basic cycles for data communication and control:

1. Move data from '20 register to coprocessor.
2. Move data from coprocessor to '20 register.
3. Move data from memory to coprocessor (indirect '20 register move).
4. Move data from coprocessor to memory (indirect '20 register move).
5. Execute coprocessor command.

Not only does it support fully compatible IEEE Standard 754-1985 additions, multiplications, divisions, square roots, and comparisons, the '82 has instruc-

Figure A: *TMS34082 floating-point coprocessor block diagram. Notice the 22 64-bit registers internal to the chip.*



widely used in bit-mapped color graphics, would be very tedious without hardware help.

Although the BWM has the potential to give an additional performance increase of four times or more for fills and color text, it requires special addressing and control- and data-mapping hardware built into the '20. The mapping hardware makes writing pixels into the memory consistent with how they would be written without BWM and can be thought of as the "key" that unlocks the block-write feature.

When using the BWM, you can think of each 44C251 VRAM as having four 1- to 4-bit fixed color expanders in it; in other words, each memory can expand 4 bits of incoming data or control information into 16 bits. By combining two VRAMs (to get an 8-bit-wide color latch and expander), you can get four 1- to 8-bit expanders.

By using the '20's color-expander hardware plus additional on-chip hardware to generate the control signals necessary to interface to the VRAMs, the '20's 32-bit data bus is effectively expanded to 128 bits during BWM cycles. The '20 also supports the color-expand tions for complex graphics math. Table A gives a complete list of instructions. And the expansion capability of the '82 allows for the creation of an indefinite number of user-defined functions.

Table A: *Capabilities of the 34082 FPU instruction set.*

One-operand operations	
Absolute value	1's complement
Square root	2's complement
Two-operand operations	
Add	Divide
Subtract	Compare
Multiply	
Conversions	
Integer to single	Single to integer
Integer to double	Double to integer
Single to double	Double to single
Matrix operations	
4x4, 4x4 multiply	3x3, 3x3 multiply
1x4, 4x4 multiply	1x3, 3x3 multiply
Graphics operations	
Backface testing	
Polygon clipping	
Polygon elimination	
Viewport scaling and conversion	
2-D linear interpolation	
2-D window compare	
2-plane clipping (X,Y,Z)	
2-D cubic spline	
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3-D volume compare	
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3-D cubic spline	
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Polynomial expansion	
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Multiply/accumulate	
2-D minimum/maximum	
Vector operations	
Add	Dot product
Subtract	Cross product
Magnitude	Normalization
Scaling	Reflection

function for memories without BWM, which still gives an improvement that is roughly 10 times that of microprocessors without color-expand hardware.

Two special instructions were added to the '20 to take advantage of the BWM. VFILL is used for fast solid filling. The VBLT instruction reads binary shape information and controls the VRAM for

continued

text and pattern color expansion.

Another area of improvement is in the plane-masking function. The 44C251's "persistent write per bit" speeds up this function. The '20 doesn't have to do read-modify-write (RMW) cycles to perform the masking operation.

By combining the wider data bus, fast page mode, faster processor cycle, and BWM support on the '20, you get a performance advantage of up to 50 times over the '10 when writing color text. Remarkably, the '10's internal color-expand hardware already gave it a significant advantage over general-purpose processors at this function.

The 44C251's split shift register greatly simplifies the timing requirements for loading the shift register while it's still allowed to shift. The special control and timing are directly supported by the '20, removing the time-critical real-time reload headache from the system designer.

Strike Up the Band

The '20 significantly increases the system-bus bandwidth of the '10 due to improvements in three basic areas: a wider data bus (32 bits on the '20 versus 16 bits on the '10), exploiting enhanced page-mode accesses on DRAMs and VRAMs, and a faster clock speed or state rate. The wider data-bus and page-mode accesses let the '20 fetch more instructions in less time on a cache miss. And, at a clock speed of 40 MHz, the '20 typically fetches 16 instructions in 900 nanoseconds, while a 50-MHz '10 fetches only 3. Together, these improvements provide performance increases of three to seven times on the '20 when executing programs written for the '10.

The largest performance increases due to local-bus bandwidth improvements, however, come in the multiple-cycle data-manipulation instructions. The '20's FILLs, PIXBLTs, and BLOCK MOVEs have improved the most. For example, a fill operation on the '20 paints the screen in one-seventh the time required by the '10; you can get even more dramatic performance increases, up to 50 times that of the '10, if you use the block-write capabilities of the 44C251 VRAM. For large data transfers, the '20 incorporates an eight-word (32 bits per word) first-in/first-out that scoops up the source data, modifies it, and returns it to the destination within local memory.

Another unique feature of the '20 is the four CAS- outputs (see figure 1) that support byte-write operations, thus avoiding RMW cycles. Many graphics and string operations require intensive byte manipulation provided by the '20's CAS- strobes. Furthermore, these strobes let the '20's line-drawing engine splatter the display with 5 million pixels in a single second (RMW cycles would reduce performance to less than 3 million pixels per second).

In addition, the '20 dynamically sizes to 16- and 32-bit-wide memories via the SIZE16- input; simultaneously, the '20 can dynamically change its column and address multiplexing to support memories of different array sizes in the same system without additional hardware.

Hosting the Affair

The '20 operates as either a host processor or a graphics processor attached to a host bus. The host interface on the '20 is completely transparent to the host system. When the '20's memory is mapped directly into the host system's memory map, the '20 functions as a DRAM controller.

continued

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Table 1: *New 34020 instructions added to the current set for the TMS340 GSP family.*

Instruction	Description
Graphics instructions	
CLIP	Clip DADDR,DXDY to window
CVSXYL RS,RD	Convert source XY address to linear address
FLINE Z	Fast line draw with linear addressing
FPXLEQ	Find pixel equal to COLOR0
FPXLNE	Find pixel not equal to COLOR0
GETPS RD	Get pixel size
HPFILL XY	Horizontal pattern fill
LCOLOR	VRAM load-color latch
LINIT	Line initialization
PIXBLT B,M,L	Masked PixBlt: binary to linear
PIXBLT L,M,L	Masked PixBlt: linear to linear
PPROC RS,RD	Process pixels in registers
RPXL RD	Replicate pixel
SETCDP	Set CONVDP I/O register based on DPTCH register
SETCMP	Set CONVMP I/O register based on MPTCH register
SETCSP	Set CONVSP I/O register based on SPTCH register
VBLT	VRAM pixel block transfer
VFILL	VRAM fill array with processed pixels: linear
Coprocessor instructions	
CEXEC *S,coin,i*	Coprocessor internal operation: short
CEXEC *S,coin,i*	Coprocessor internal operation: long
CMOVCG RS,RD,*S,coin,i*	Move from coprocessor to 34020 register(s)
CMOVCG RS,*coin,i*	Move from coprocessor to 34020 register(s)
CMOVCM -*RD,*K,S,coin,i*	Move coprocessor to memory indirect (predecrement)
CMOVCM *RD+,*K,S,coin,i*	Move coprocessor to memory indirect (post-increment)
CMOVCS *coin,i*	Move coprocessor to 34020 status register
CMOVGC RD,*coin,i*	Move one 34020 register to coprocessor
CMOVGC RS,RD,*S,coin,i*	Move two 34020 registers to coprocessor
CMOVMC -*RS,*K,S,coin,i*	Move indirect (predecrement): memory to coprocessor
CMOVMC *RS+,*K,S,coin,i*	Move indirect (post-increment): memory to coprocessor
CMOVMC *RS+,RD,*S,coin,i*	Move indirect (post-increment): memory to coprocessor
where: *i* = the coprocessor ID (0–7)	
K = a count of parameters to move	
S = size of values operated on (0 = 32-bit, 1 = 64-bit)	
coin = the coprocessor instruction field	
Move instructions	
BLKMOV	Move block
General instructions	
RMO RS,RD	Rightmost one
Program-control and context-switching instructions	
IDLE	Idle: Wait for interrupt
MWAIT	Memory wait
SWAPF *RS,RD	Swap field (read-modify-write field)
TRAPL *N*	Software interrupt: long

On a host access to the '20's local memory, the host's address is latched into the '20. The address is then reformatted and presented on the LAD and RCA buses to the '20's local memory (see figure 1). Data is routed via external data buffers that are directly controlled by the '20.

The 38-pin interface supports burst rates of up to 20 megabytes per second in either block-transfer or random-access mode. The '20 provides option bits in the internal host control register to let the interface pipelining be configured for block (read or write) or RMW operations for maximum performance.

The '20 supports multiprocessing environments and can access host memory directly to improve system performance when accessing host resources. Built-in bus-fault and retry mechanisms handle address violations and bus-contention conditions. The '20 supports data operations in *big endian* (data indexed from the most-significant data bit) and *little endian* (data indexed from the least-significant data bit) modes, thus removing *swizzling* (data remapping) operations.

Hold That Line

The '20's Hold/Holda protocol not only lets another processor suspend the master GSP from operating on its local bus, but also lets other GSPs be directly wired onto the same local bus. Three signal lines—grant in (GI-), low-priority request (RL-), and high-priority request (RH-)—provide the handshake mechanism on this interface (see figure 1). These three lines are necessary to handle special problems associated with both graphics systems and DRAM- and VRAM-based systems.

In a typical Hold application, the '20 must reassert bus control if a shift-register-transfer (display-refresh) or memory-refresh cycle is pending. Internal counters schedule latency of these events to provide maximum performance. Internal refresh queuing of up to 12 DRAM refresh cycles limits bus rearbitration.

Two or more '20s can be directly wired together to increase system performance. Multiple GSPs synchronized to the same local clock can efficiently handshake over the three-wire interface, allowing control of the bus to be passed between processors on every local memory cycle. With the increased size of the instruction cache and the improved efficiency of instruction acquisition, a significant performance increase can be obtained by using this interface.

Learning the Rules

The '20 has built on the '10's full suite of general-purpose instructions and combined them with a rich set of application-specific graphics instructions (see table 1). Note that the processors have a sufficient set of the necessary assembly language instructions to support a robust C language with direct field support.

Both the '10 and the '20 have direct support for operations on fields in memory. Since they are bit-addressable processors, fields in memory can start on any bit boundary; the instruction set fur-

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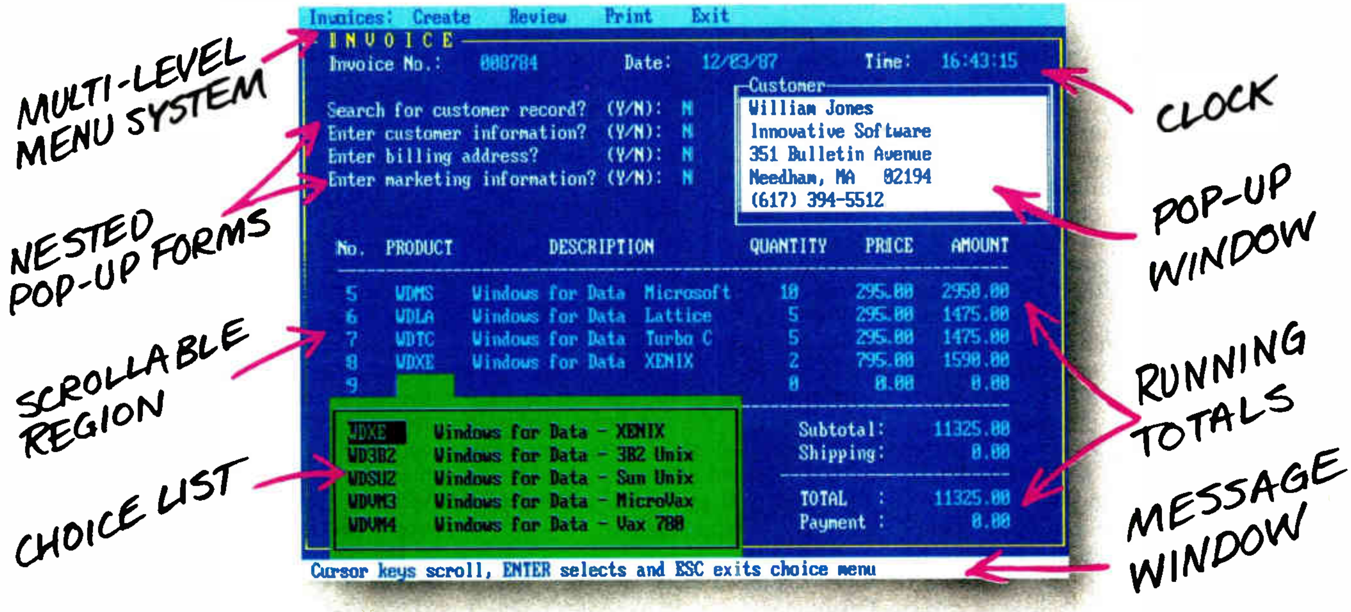

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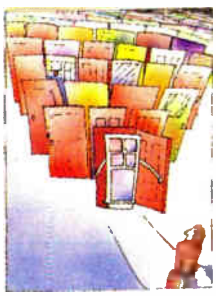

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ther supports varying field widths (from 1 to 32 bits). This can be especially important in manipulating C "fields" and in the memory storage required for packed arrays in C. The TMS340 family's hardware support for fields augments these operations. (Pixels are a special case of regularly sized, packed fields in frame-buffer memory.)

Two-operand pixel-block-transfer instructions (PIXBLTs) perform 16 binary and 6 arithmetic raster operations on a pair of two-dimensional pixel arrays. The two-operand PIXBLTs are useful for manipulating and moving bounded objects and operating with solid color.

You can simulate more elaborate operations using multiple PIXBLTs, arithmetic raster operations, and the 10's binary-expand operations. Using the binary expand, fonts stored as bit patterns form color text (with transparency), and two-color patterned operations can be performed on the bit map. The flexibility of the PIXBLT instructions lets you build operations such as the 8514/A's compare operations, as well as foreground and background raster operations. In addition, you can build support for nonrectangular objects on top of two-operand PIXBLTs.

The '20 extends the '10's PIXBLT instructions by adding a third operand, a binary-mask operand. While the '10 supplies hardware support for rectangular window regions and pixel blocks, many applications have begun to require control and rendering of nonrectangular window regions. The third mask array supports this feature on the '20. The mask is used to describe the window region on a pixel-by-pixel basis. This provides complete flexibility in describing a region: It can be filled, concave, convex, outlined, have holes, and so on.

The three-operand PIXBLT employs the binary-mask array to act on the first operand, the source-pixel array. This mask array selects individual pixels in the source array to be combined with the destination array (an independent operand). For text, the source array can be an arbitrary pattern (dithered or halftoned) describing the "color" or "shading" of the text (see figure 3). The mask array contains the description of the shape of the character, or glyph. The destination array is the displayable "canvas" onto which the character is painted.

In this way, the bits having a value of 1 in the mask select pixels (1, 2, 4, 8, 16, or 32 bits deep) in the source-array pattern to transfer to the destination location. There is the additional option of performing one of 22 raster operations on the selected source or destination pixels, as well as several transparency and plane-masking options.

See-Through Pixels

Raster operations on the TMS340 family include all the Boolean combinations of 2 bits and their complements, plus an arithmetic set. This latter set supports addition and subtraction of pixels as well as a unique pair of comparison operations. The first computes the maximum of the source and destination pixels. The second computes the minimum pixel value. These operations are useful for layering "planes" of data via the intelligent ordering of pixel indexes or colors. They have been used to "drag" sprite-like objects around the screen without corrupting background or foreground images. Pixels are combined through binary or arithmetic raster operations to form a resultant pixel.

Raster operations for the '20 contain several new transparency modes. Transparency is the notion that there are cases in which it is useful to inhibit the writing of new pixel data to the destination based on information within the actual operands of the raster operation. Thus, transparency circumvents the normal determination of what value is to be written to the destination pixel.

The four '20 transparency modes are transparency inhibited, transparency on resultant pixel = 0, transparency on source pixel = 0, and transparency on destination = COLOR0. The first two are '10-compatible modes.

When transparency is inhibited, raster operations proceed as normal. For transparency on the resultant pixel equal to 0, the '20 checks the pixel value that results from the raster combination for zero-valued pixels. The zero value is then replaced with the original destination-pixel value so that the destination-pixel location is not changed.

For transparency on the source pixel equal to 0, the source-pixel value is checked before the raster operation for zero-valued pixels. Each zero value is identified so that the destination pixel retains its original value. This is useful for maintaining transparent pixels in the source-pixel array while using other '20 raster operations.

For transparency on the destination equal to COLOR0, the destination-pixel value is checked before the raster operation for pixels that equal the "background" color (stored in the 32-bit COLOR0 register). Each background-value pixel in the destination is not modified by the raster operation. This is useful for maintaining background pixels in the destination bit map, regardless of the value of the source pixel and which of the 22 raster operations are enabled.

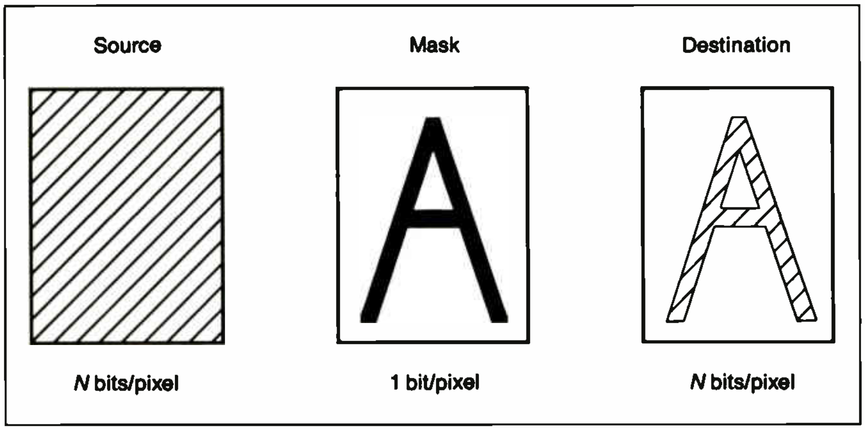

Figure 3: *The three-operand* PIXBLT. *The third operand is a 1-bit-per-pixel array that provides a mask for pixel-by-pixel control over the destination pixels.*

Working on the Line

Several design areas on the '10 in the area of line support were targeted for enhancement on the '20. Among these were fast line draw, line initialization, and support for patterned lines and arrays.

To enhance line-draw performance, the '20 has added a fast line-draw instruction to the '10's Bresenham-algorithm line draw (see "Better Bit-Mapped Lines" in the March BYTE). This FLINE instruction performs the same arbitrary-angle algorithm found on the '10, but it assumes preclipped endpoints as input. This allows the CPU to bypass the window-checking microcode and execute the heart of the line-draw algorithm at memory-bandwidth speeds (raster operations, plane masking, and transparency

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are all active).

To reduce overhead during line initialization, the LINIT instruction performs the necessary setup for the LINE instruction. LINIT speeds up and simplifies the operation overhead associated with line initialization. More important, LINIT allows larger algorithms utilizing the LINE instruction to fit into cache, thereby increasing drawing performance.

For enhanced patterned-drawing support, the '20 adds a horizontal-fill instruction, HFILL, which supports patterns described in a 32-bit internal register. The repeating pattern is taken from the register and rotated as pixels are drawn if the register contains a nonzero pattern. The PATTRN register contains the current drawing position in bit 0 at the end of the instruction.

But Can I Use It?

The '20 offers a full line of development-tool support built on the '10 support environment. A full Kernighan and Ritchie optimizing C compiler utilizing many of the extended features of the TMS340 architecture is available. Supporting the C language environment is a full set of assembly language tools for building relocatable, ROMable, or all-RAM executable files. A TMS340 family common-object-file-format (COFF) loader, C I/O package, and high-level-language debug support are planned for the '20.

The '20 is object code–compatible with the '10. This means that math libraries, graphics libraries, graphics interfaces, and graphics-standards software are already available for the '20. These will be enhanced over time to use the extensions of the '20.

A Family Reunion

With the entrance of the '20 and '82, the TMS340 architecture addresses a very wide range of graphics applications. The '10's smaller package size and high level of system integration is ideally suited to high-volume cost-sensitive applications. The more powerful '20 provides an upwardly compatible migration path for '10 designs and meets the needs of higher performance systems.

By adding a TMS34082 Graphics Floating-Point Unit and TMS44C251 VRAM to a 34020-based system, a small board can have all the graphics and math capabilities of a high-end workstation. ■

Ron Peterson, Carrell R. Killebrew Jr., Tom Albers, and Karl Guttag are all members of Texas Instruments' design team for the 34020. They can be reached on BIX as "editors."

Making Videos

The video RAM (VRAM) is a dynamic RAM (DRAM) modified to let it transfer a large number of bits from the memory array to a separate internal serial-shift register. Prior to VRAMs, the majority of the available bandwidth in conventional frame buffers (designed around DRAMs) was used for display refreshing. This left virtually no time for a processor to update the display data.

After making the transfer, the contents of the shift register are independently shifted out to the display. As a result, the random port of the VRAM allows unimpeded access to the graphics processor. With the increasing resolutions of graphics displays and denser memory devices, the VRAM is becoming indispensable to frame-buffer design.

The original 64K-bit VRAM was organized as a 64K-by-1-bit device and had a single 256-bit shift register with four *tap points* (the starting column position for the shift register). Memory-array-to-shift-register transfer cycles could be made only during horizontal retrace when the serial clock to the shift registers was stopped.

The next-generation VRAM was a 256K-bit device that combined the functionality of four 64K-bit VRAMs on a single chip. The device was organized into a 64K-by-4-bit device and contained four 256-bit "serial-shift" registers. A static RAM and counter emulated the shift-register function of its predecessor, allowing the shift function to start from any tap point.

Transfers in the middle of a line were enabled by changing the timing of the shift-register-to-memory transfer. This "midline reload" allowed designs to use fewer VRAMs for certain frame-buffer sizes, but the timing was so critical that few systems could take advantage of it. Furthermore, various manufacturers experimented with features including fast page mode, Boolean functions, and alternate shift-register timing modes.

The latest VRAM generation is a 1-megabit device that has several architectural enhancements to improve performance. The organization is 256K-by-4-bit with four 512-bit shift registers. Some manufacturers plan an alternative 128K-by-8-bit VRAM. It's important to note that when graphics architectures use data buses wider than 128 bits, some memory devices will be only partially used, because they need extra devices just to reach the required data-bus width due to the "deeper" organization of the by-4 memories. To compensate for the increase in the depth of the memory, the 1-megabit VRAM includes features to improve its performance without requiring wider buses.

Most 1-megabit VRAMs support the block-write mode (BWM), which gives a performance improvement of four times or more on key graphics operations, such as fills and color-text generation. Fast page-mode accesses (common on 1-megabit DRAM) further improve memory bandwidth. Some 1-megabit VRAMs will support "persistent write per bit," which lets color masking be "locked in" on the VRAMs, reducing read-modify-write (RMW) cycles. The 1-megabit VRAM will also support "split-shift-register transfers," simplifying the timing and control circuitry necessary for real-time reloading of the serial-shift register. The split shift registers provide memory savings in non-binary-powered display resolutions.

BWM is the most significant new architectural feature on the 1-megabit VRAM. On the 256K-by-4-bit VRAM, an internal 4-bit color register is loaded from the 4-bit-wide data bus during a special write cycle. At 4 bits per pixel, this latch contains the color value to be written; at 8 bits per pixel, two VRAMs are concatenated to form an 8-bit register.

When the VRAM's control signals select BWM, the two least-significant bits of the address are ignored, and the four "data pins" control the writing of the contents of the color register into any or all of four consecutive locations (a "block") in memory. A "1" on a data line initiates the writing of the color-register value, while a "0" prevents that writing to the corresponding position in the block. With four data lines controlling the four 4-bit memory cells, the net effect is an effective increase of four times in write bandwidth. The ability to support individual pixel control in BWM allows this feature to be used for rendering color text and area filling.

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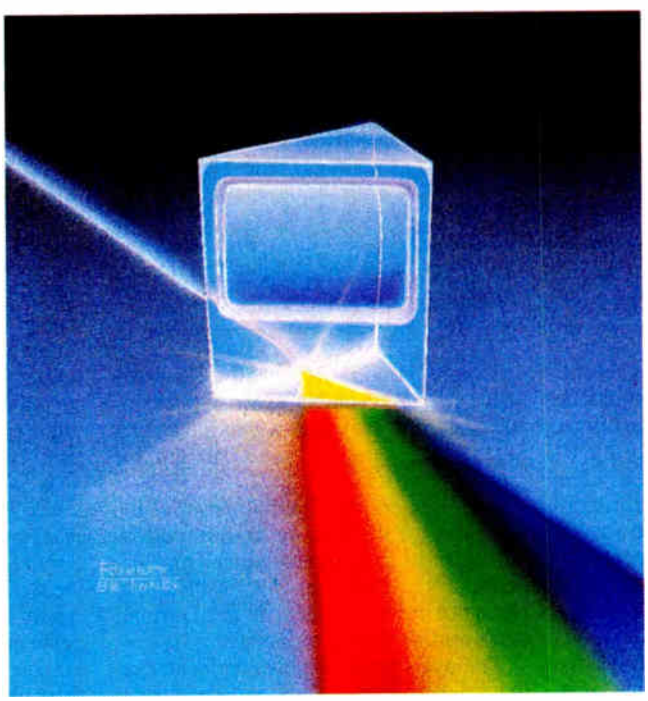
Lighting the Way

The brightness of EL is expanding from yellow only to red, green, and blue

Rolland Von Stroh and Brian Dolinar



The importance of light-emitting flat-panel displays, the performance advantages of thin-film electroluminescent (TFEL, or EL) displays, and the development of color capabilities make EL a heavyweight contender in the high-information-content display field.

Ergonomic yellow color, brightness, contrast, angle viewability, ruggedness, reliability, and long life all stem from the structure of EL displays. These displays use a solid-state construction (no gases or liquids trapped between glass plates).

EL consists of layers of thin films (angstroms thick) that are deposited on a single glass substrate. These layers are composed of metals and dielectrics, similar to a semiconductor device. The solid-state nature is responsible for both the long life and ruggedness of EL displays.

The core thin-film layer is a phosphor layer of zinc sulfide (ZnS) treated with manganese (Mn), which emits light when subjected to a high-voltage field. The phosphor layer is insulated from the outer electrodes—one reflective and one transparent—by two insulating dielectric layers (see figure 1).

The thinness of the overall thin-film stack provides several benefits: There is almost no physical thickness (approximately one micron) to the display, and light is emitted uniformly across a pixel and in a direction normal to the pixel surface. The light doesn't emanate in all directions, causing a Gaussian distribution, or "fuzzy-pixel," effect.

This means that with EL you see bright, highly defined pixels. *Cross-talk* between on and off adjacent pixels, so common with light-emitting technologies, is almost nonexistent with EL due to the thin-film structure. This lack of cross-talk also provides the extremely wide viewing angle (about 160 degrees) and eliminates *parallax*—an important point for touch panels.

What You See Is...

The chief attribute of any display would have to be its *viewability*. It consists primarily of brightness, fill factor, contrast, angle insensitivity, and acuity. The amount of light a display emits is considered its *brightness*; this can be measured as an average or as pixel brightness. *Fill factor* is determined by comparing the amount of illuminated area to the surrounding nonilluminated area; it's given as a percentage. The greater the fill factor, the greater the apparent, or perceived, brightness. For a 640- by 400-pixel format, EL has a pixel brightness of 30 footlamberts (ft-L) and a fill factor of 50 percent, for an average yield of 12.5 ft-L.

Contrast is the ratio of on-pixel brightness to the surrounding off-pixel bright-

continued

ILLUSTRATION: ROBERT TINNEY © 1988

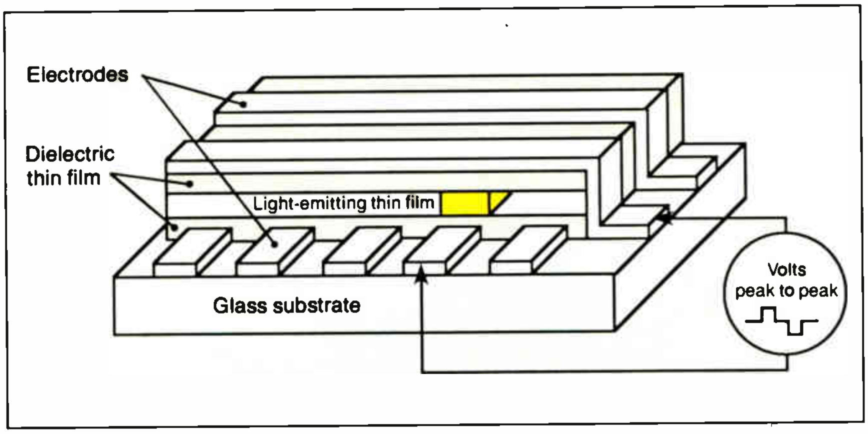


Figure 1: *The basic device structure of the thin-film electroluminescent display panel.*

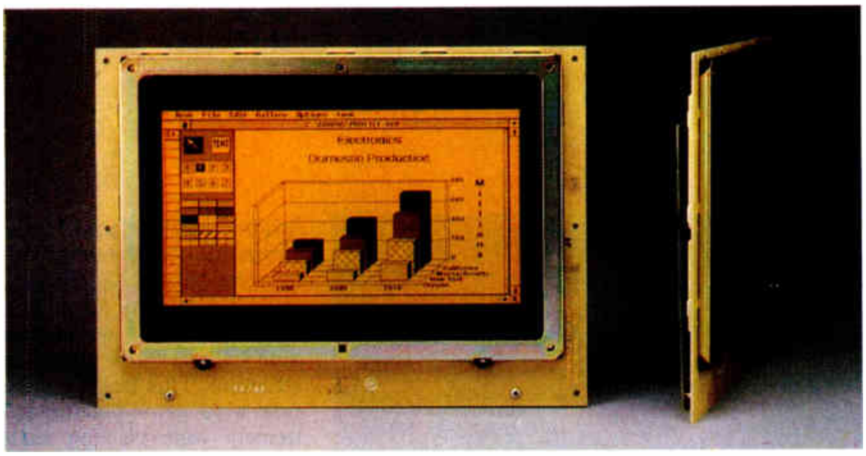


Photo 1: *The ergonomic yellow of the principal EL phosphor. Note the thinness of the overall display panel. (Photo courtesy of Planar Systems, Inc.)*

ness. The greater the ratio, the higher the resulting contrast. At 500 lux of ambient light, a typical EL display/contrast ratio value is 20 to 1. A display's ability to maintain its contrast ratio over a wide viewing angle is called its angle insensitivity. We measured contrast ratio at various angles in a 500-lux environment and found that an EL display remains at or above 10 to 1 over a full range of viewing angles—up to about 160 degrees.

Acuity is the uniformity of light emission across a pixel and the amount of a pixel's edge definition. Once the contrast ratio is high enough to easily distinguish between on and off pixels, image crispness is determined by how uniformly the on pixels emit light and how minimally that light "leaks" into the adjacent off-pixel areas. EL has a highly uniform distribution of light over the pixel area and is also highly one-directional since the light-emitting layer is so thin.

An overall rating of good viewability consists of good ratings in all these characteristics. Acceptable contrast with inadequate brightness or a small viewing angle, for example, won't suffice for most applications.

The light emitted by the principal EL phosphor, ZnS:Mn, is amber yellow with a peak of 585 nanometers. This "ergonomic" yellow (see photo 1) is the phosphor recommended by the German and Swedish display authorities.

The eye's peak response is located in the yellow-to-green region of the visible color spectrum (see figure 2). Although green is the more eye-sensitive color, amber yellow is less fatiguing to the eye over extended, intensive-use sessions.

Reflections

A contrast-enhancing filter helps any display technology achieve its optimum performance. Increasing ambient light reduces the display's contrast ratio until it reaches a level where the display is washed out. To enhance the contrast, you need to use a filter with an anti-reflective coating; this will preserve a good luminance from the on pixels while reducing any undesirable reflection off the screen.

There are two primary types of ambient-light reflections that you must consider when viewing an EL display. The first is the front-surface reflection off the substrate glass on which the display is constructed (i.e., the front of the screen). About 5 percent of the incident light is reflected from this front surface; about 70 percent of it comes from the rear electrodes of the EL display. An unfiltered EL display is a 75 percent–efficient mirror (see figure 3). Both reflections need to be reduced, and although both appear to be a problem, they are not. In fact, the reflection off the rear electrodes actually enhances the contrast of an EL display when you use it with a filter.

For medium-to-high ambient-light levels, you'll want to use a circular polarizer (CP). It will remove nearly all ambient reflection from the rear electrodes. However, the fact that the rear electrodes are reflective enhances the CP's ability to improve the display's contrast.

When the light reaches the quarter-wave retarder, the single electric-field vector divides into its two components, one pointing along each axis of the retarder (see figure 4). These components travel at different speeds. The result is right-circularly polarized light. This means that the tip of the electric-field vector traces a right-helical path through space. The direction of the helix is determined by the right-hand rule. When circularly polarized light is reflected off a smooth, shiny surface, the direction of its polarization changes. In this case, the right-circularly polarized light changes into left-circularly polarized light.

When this light reaches the quarter-wave retarder, it approaches from the rear, and the retarder imparts an additional quarter-wave left-helical motion to the light wave's electric-field vector. The result is light that is linearly polarized perpendicular to the axis of the linear polarizer. Since this light cannot pass through the polarizer, you can't see any reflection from the back electrodes.

You also need to reduce specular as well as diffuse reflected light from the front surface of the filter. Two basic modes of anit-reflection work well: thin-film coating and etched, or frosted, surfaces. They are very different in their properties, however. Figure 5 shows the percentage of reflection on the front surface for untreated glass, etched glass, and thin-film coating.

The etched surface reduces reflections by scattering or diffusing the reflection. In high-ambient light like you'd find outdoors, the reflection washes out the display, since the etched surface doesn't diminish the reflected light but only scatters it. That is, the contrast between the signal and reflected light degrades to less than 2 to 1, and displayed information becomes illegible. The etched surface is effective for indoor applications and for ground-based sun-shielded applications.

The thin-film coating has a lower reflection and is used for high-ambient-light applications, where the etched surface would be illegible.

Rough, Tough, and Ready

EL uses surface-mounted CMOS drivers and other circuitry, modulating between 185 and 215 volts. Surface mounting gives EL displays toughness and reliability and makes them easy to repair.

The luminance-voltage characteristics

continued

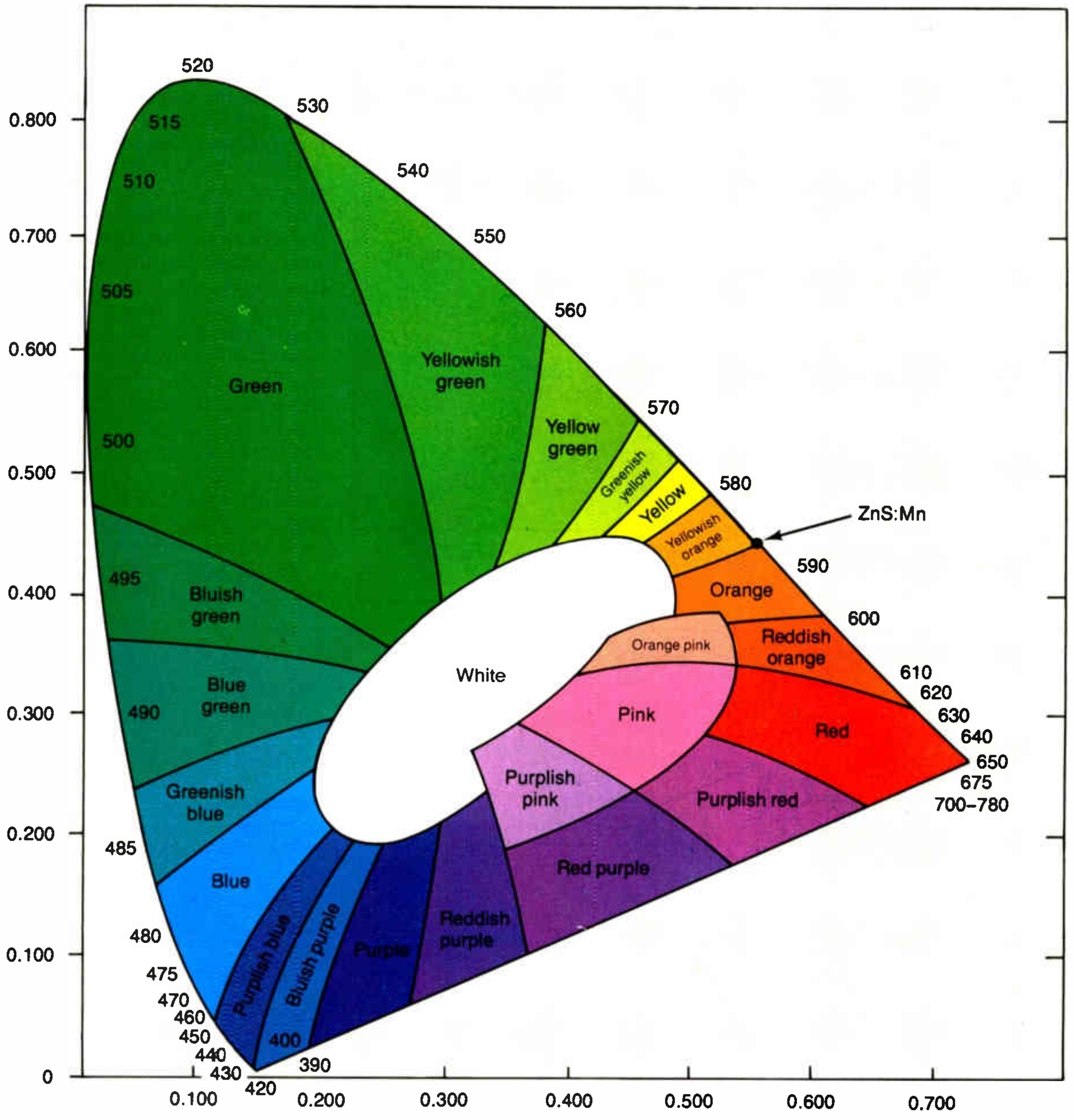


Figure 2: *The 1931 CIE chromaticity diagram of the color spectrum with approximate color names.*

of a typical EL device feature a threshold voltage below which little light is emitted, then a steeply rising slope just above the threshold, and finally a leveling off, or saturation region. This nonlinear characteristic means that you can address the device electrically at a high multiplexing ratio and still maintain excellent contrast.

Hooking It Up

Three basic elements are involved in interfacing EL monitors with computer-graphics hardware: a display-refresh RAM, a monitor controller, and a video clock. The RAM must be shared between the system CPU, which writes graphical data as bit patterns into the memory, and the monitor controller, which reads this data on a cyclical refresh cycle and translates it into information the display drivers and EL panel can use. In noninterlaced systems, this refresh cycle usually takes place at a 60-Hz rate to create a flicker-free image. In other words, the display controller reads one entire frame of RAM display data every sixtieth of a second.

The monitor controller converts this RAM data into a serial video-data (VID) stream and provides a video clock (VCLK) and two basic synchronizing signals: horizontal sync (HS), which determines when to present each row of pixels, and vertical sync (VS), which determines when to present each new display frame. Usually, there is enough time between the presentation of individual pixel rows or display frames for the CPU to update the display-refresh RAM.

EL monitors operate on the same basic signals that CRT monitors do. Thus, off-the-shelf CRT-controller chips, which provide all the basic control signals plus the interface logic required to communicate with the display-refresh RAM and CPU, can now meet the monitor-control requirements of many systems.

In addition, since flat-panel use is increasing, display-control chip manufacturers are providing the necessary control signals and timing specifications so you can easily integrate EL into many of the designs using these chips. Both new-generation chips (e.g., those produced by Yamaha, Paradise, and Gemini) and older CRT-controller chips work with EL. Due to similar phosphor speed, line-at-a-time addressing for EL is much like that for noninterlaced CRT circuits. You don't need to learn new interfacing techniques. The newer chips also contain many new modes, such as simulated gray scale, to display contrast for color software on a monochrome monitor.

RS-232 cards, video-controller cards, and touch panels have all been designed

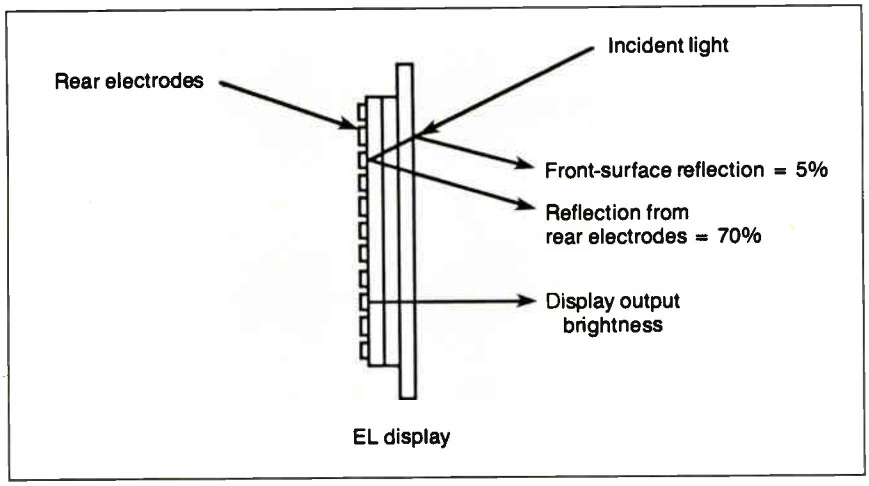


Figure 3: *Unfiltered EL display reflections. An unfiltered EL display is a 75 percent–efficient mirror.*

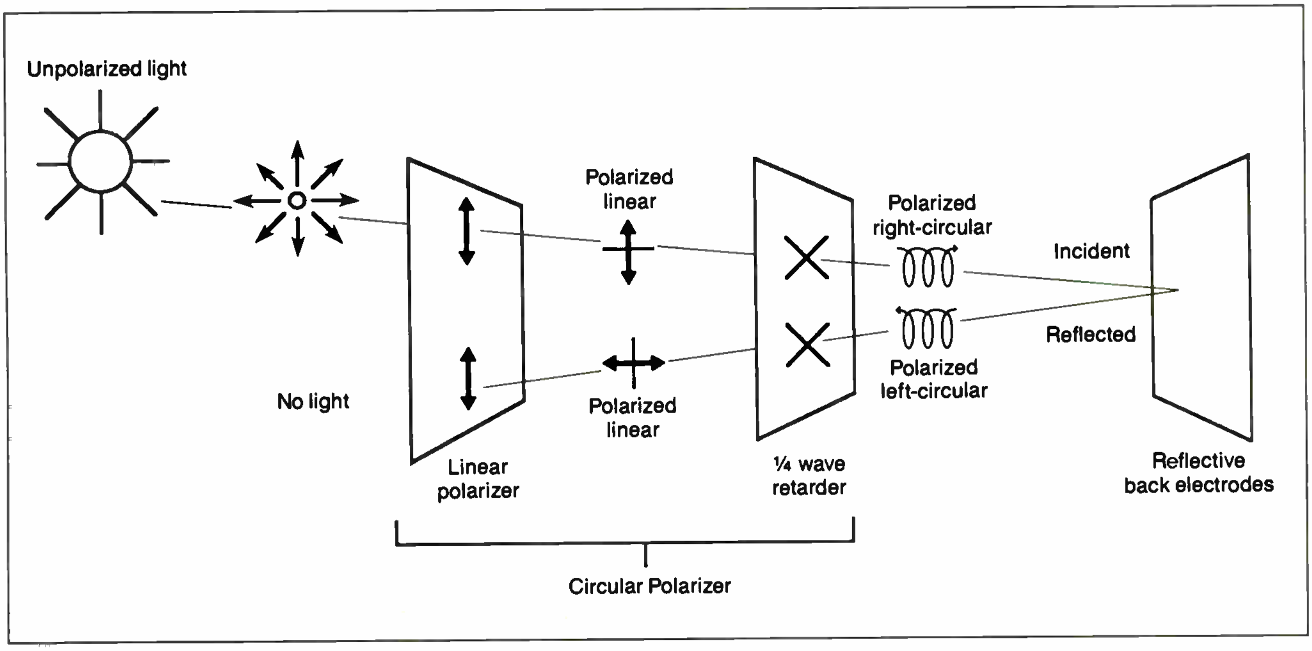


Figure 4: *This diagram shows how unpolarized incident light can be controlled and its reflection eliminated by using a circular polarizer.*

for use with EL. Touch-entry devices work well with it. EL is flat, not curved like a CRT, so parallax with touch is not a problem. A touch-entry overlay—whether resistive or capacitive—reduces the optical transmission of a display. Infrared, resistive, and capacitive touch panels work well with EL due to its crisp image quality, low electrical emissions, and light-emitting properties.

The ability to perform to various data-communication interface standards, such as RS-232, VT-100, or VT-220, is not a function of the EL device itself, but rather of the availability of chips and cards to support these applications. Support for these standards is available.

In Living Color

Planar Systems of Beaverton, Oregon, has developed the phosphors and processes to produce prototypes of two- and three-color EL displays. Full RGB monitors are feasible, and the next step is to come up with an economic manufacturing practice for color. The company recently shipped its second full-color prototype to the U.S. Army Laboratory

continued

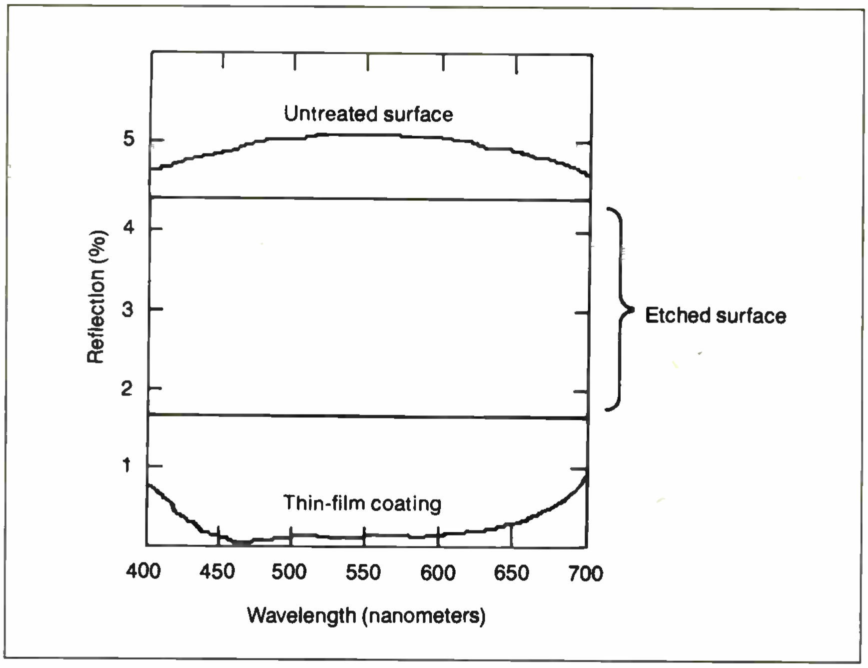


Figure 5: *The comparative percentages of reflection off various front surfaces. Untreated glass fares the worst, and thin-film coating works better than etched glass in high-ambient-light situations.*

Command (LABCOM) Division in Fort Monmouth, New Jersey (see photo 2). The color prototypes have a pixel matrix of 320 by 240 (by 3 colors) and offer an active display area of 4.8 by 3.6 inches (a 6-inch diagonal). The pixel pitch is 0.005 inches (200 lines per inch).

Red, green, and blue phosphors are currently composed of $ZnS:SmCl_3$ (zinc sulfide with samarium chloride), $ZnS:TbF_3$ (zinc sulfide with terbium fluoride), and SrS:Ce (strontium sulfide with cerium), respectively. A split-pixel approach, patterned for red, green, and blue (see photo 3), optimizes the tradeoffs in brightness, processing cost, and electronic addressing. When you mix them, the pixels are bright enough to generate a full white. For TV video, however, you want more brightness and color saturation from the blue phosphor. Planar is working on that problem, looking at processing enhancements, and exploring other phosphor compositions.

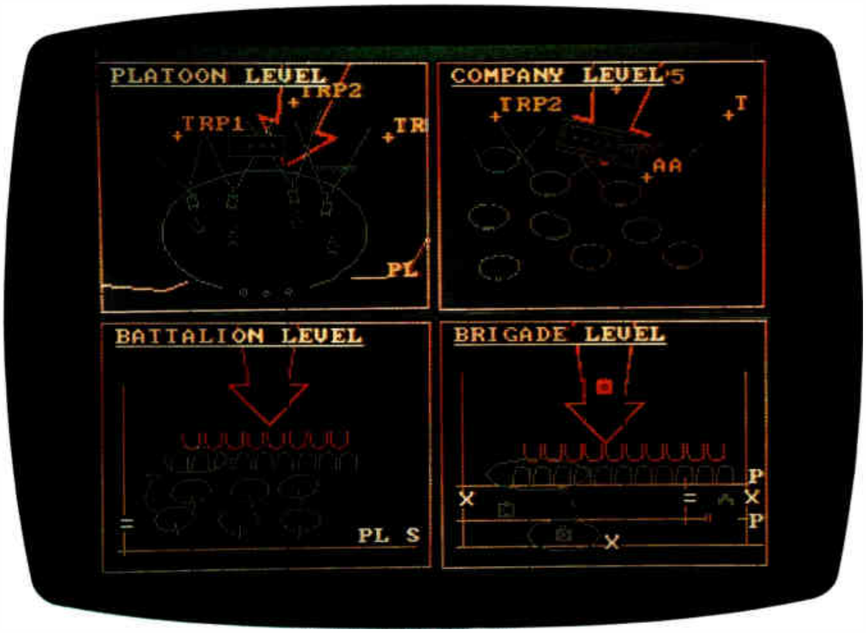


Photo 2: *An example of a color display on a full-color EL prototype display from Planar Systems. (Photo courtesy of Planar Systems, Inc.)*

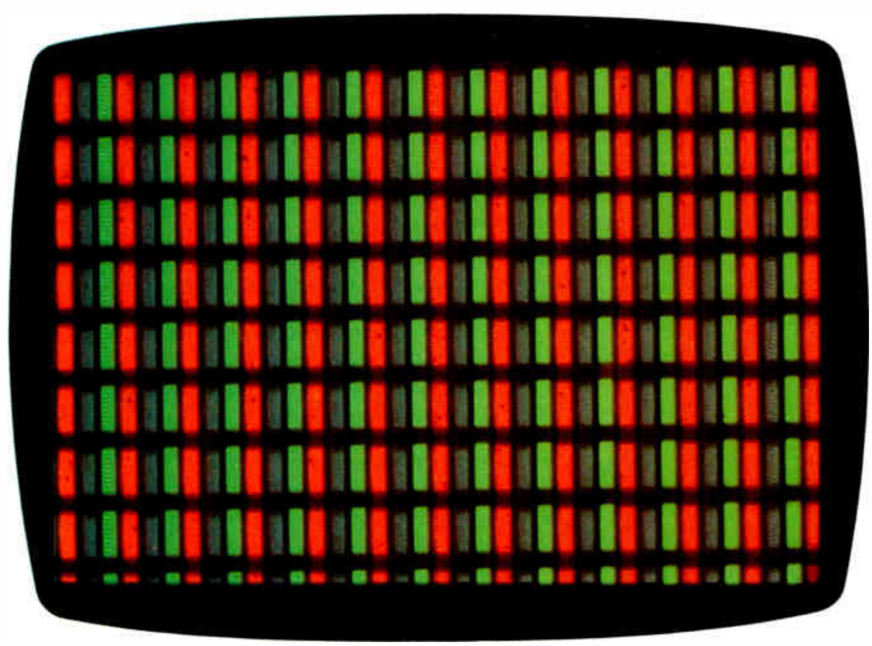


Photo 3: *The red, green, and blue pixel matrix used to produce color in the traditionally "yellow only" EL display. (Photo courtesy of Planar Systems, Inc.)*

Bigger, Better, and Brighter

Over the last 2 years, the typical power consumption of a full-page EL display has decreased from the mid-20-watt range to under 10 watts. This has been accomplished by combining less-power-hungry drivers with power-recovering drive architecture. Since an EL display is a large capacitor, you can recover the capacitive current through an inductive design, reducing the power dissipation.

At the same time, breakthroughs in materials, architecture, and processing have brought a 50 percent increase in EL brightness. For outdoor applications, the brightness of EL panels increases with the refresh rate (up to 1 kHz).

Monochrome emulation of full-color information requires control of pixel-by-pixel brightness at various levels. EL's large bandwidth of on-to-off contrast provides wide levels for a discernible gray scale. Full 16-level gray-scale EL drivers have been developed and used to display sharp, clear video and graphics. EL provides a full range of gray-scale design options: voltage, pulse width, and refresh-rate modulation.

Multiplexed addressing of digital flat-panel displays has constraints in size and pixel count due to the time required to address each frame a line at a time within the common 60-Hz refresh cycle. Planar has recently expanded these constraints to produce glass panels of roughly 19 inches diagonal with a resolution of about 1024 by 1024 pixels. These developments potentially expand EL markets to workstations and other large-panel applications where compactness, high resolution, and image stability are important.

A Bright Future

In the past, EL's main problem in market acceptance has been its price. Now, it's in high-volume production, bringing down the costs of the ICs, circuit boards, glass, and other materials used in its creation, and thus the final cost of the EL panels as well. The bright clarity of EL, once too expensive for most of us, is coming into view. ■

Rolland Von Stroh is vice president, marketing, of Planar Systems, Inc. in Beaverton, Oregon. Brian Dolinar is marketing engineering manager at Planar. They can be reached on BIX as "editors."

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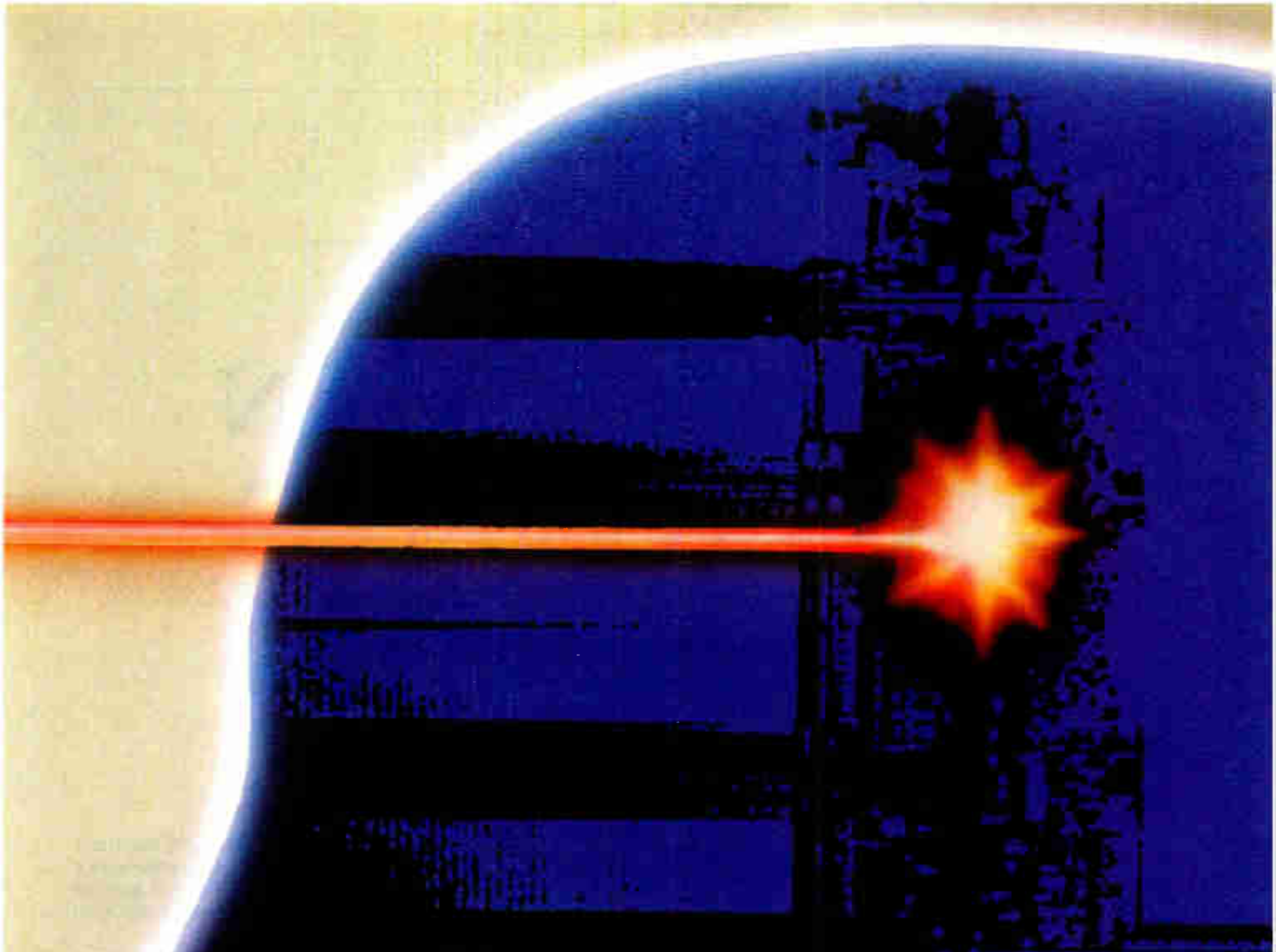

BETWEEN MAN AND MACHINE

New advances in user-interface technology could change the way we interact with our computers

Ernest R. Tello

Nearly a quarter of a century has passed since the publication of Marshall McLuhan's *Understanding Media*. During that time, the appearance of the personal computer has vindicated many of McLuhan's farseeing views. If he were alive today, he would probably characterize the personal computer as a marriage of several previous inventions: the clock, the calculator, the typewriter, and the television. But the personal computer is more than just a marriage of separate inventions. It is a unique medium that specializes in conducting marriages between different media and technologies.

McLuhan believed that electronics represents an extension of the human nervous system. If he was right, then the new technologies being developed at research centers represent a quantum leap in the ways that human beings will be able to extend themselves into the worlds of digital electronic simulation and control. And given the speed with which new ideas migrate into end-user products, you might be seeing some of these innovations sooner than you think.

Datahands and Databodies

At present, getting data into a computer usually means typing it in or using a pointing device such as a mouse or trackball to interact with the screen. One company developing new ways of interacting with the computer is VPL Research of Redwood City, California. VPL specializes in devices that let you manipulate an on-screen "virtual" device that is the same shape as the actual input device. The firm now has two commercial products: the DataGlove and the DataSuit.

The DataGlove (see photo 1) is a hand-gesture interface invented by VPL's Thomas G. Zimmerman and Young L. Harvill. Used with advanced graphics workstations, the DataGlove lets you manipulate virtual tools and objects just as you would the real tools and objects they emulate. The DataGlove has applications in high-end graphics workstations, robotics, biomedicine, and human-factor engineering.

Running through the light material of the glove are treated optical fibers that measure the degree of bending of the user's hand joints. The DataGlove also contains a magnetic sensor that tracks the absolute position and orientation of the top of the user's hand in reference to a magnetic source located within 30 inches of the glove.

A control unit connected to the glove transmits the position and orientation of the hand and the measured values of the hand joints to a host computer. The control unit can send this information, at up to 60 times per second, through the RS-232C or RS-422 port to your computer in a user-definable format. Using a Macintosh Plus, SE, or II, or an IBM PC, XT, or AT, you can create personalized calibration files and a library of your own gestures.

Recognizing and representing human hand gestures is a challenge that rivals speech and handwriting recognition in its potential difficulty. Gestures range from symbolic signals or commands, such as the peace sign, to dynamic actions such as grasping, lifting, tossing, and squeezing. VPL researchers have developed a technique in which they use dynamic-gesture templates and perform a finger-by-finger evaluation to match gestures with these templates.

VPL's newest product, the DataSuit (see figures 1a and 1b), is a whole-body input device that, using the same principles as the DataGlove, captures, records, and displays the movements of the human body. The DataSuit is used in applications such as kinesthetic learning, monitoring and feedback of certain aspects of human performance, and simulations for training personnel in hazardous environments. It can track up to 68 joints of a person's body moving within a 10- by 14-foot area.

The DataSuit system relies on software called Body Electric, a name derived from a poem by Walt Whitman and subsequently used by science fiction author Ray Bradbury. The software drives a graphical animation of a stick-figure representing the user. Body Electric incorporates a dataflow language called Flex, a hierarchical interactive tree interface called Tree, and an interpreter called Script, to customize the applica-

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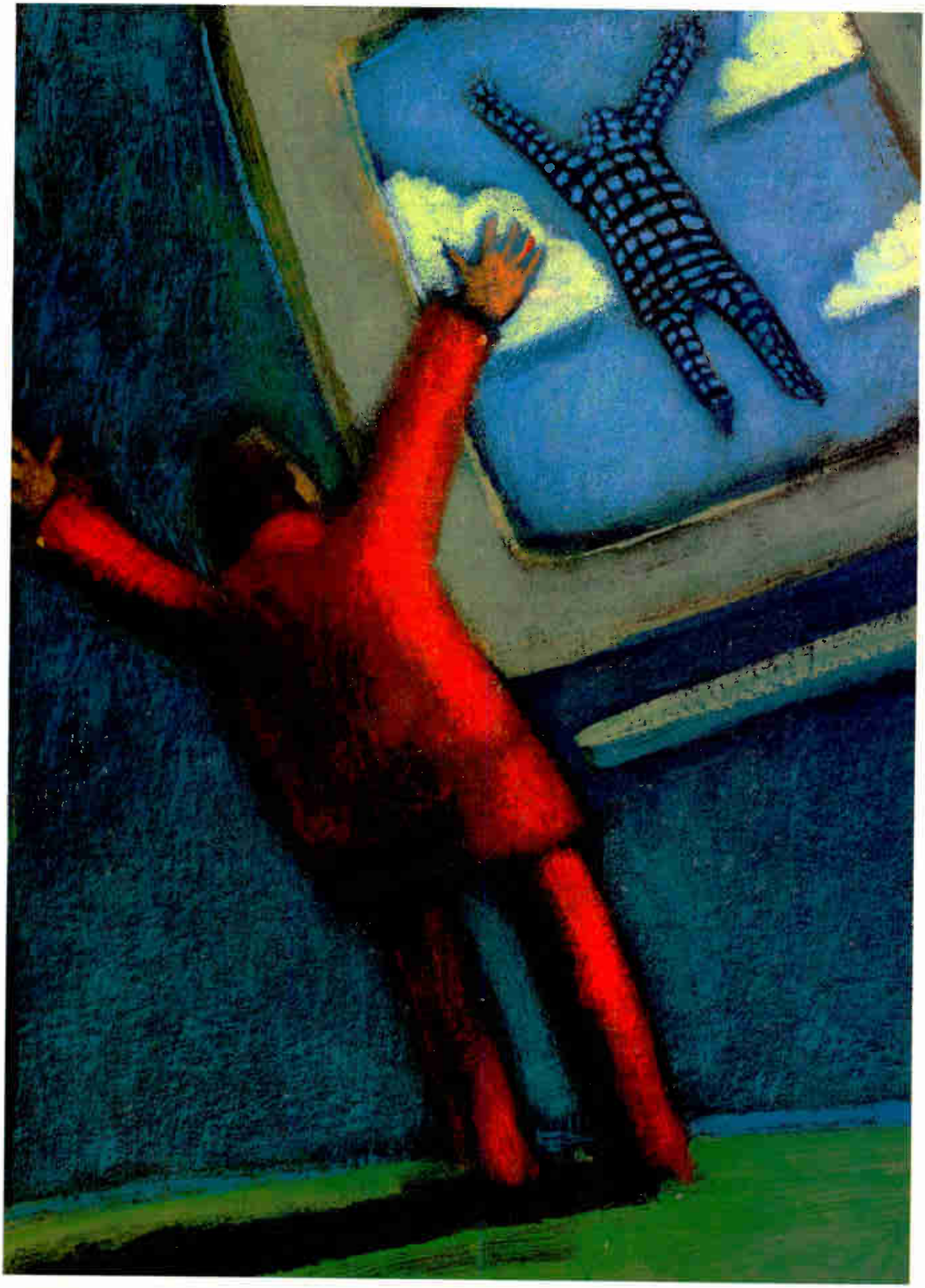

ILLUSTRATION: KEVIN HAWKES © 1988

tion to the user's requirements.

VPL is developing a commercial version of the DataGlove, incorporating a more sophisticated tactile-feedback system that will allow you to actually feel virtual objects that exist only on the computer screen. This system will evolve into *force-feedback*, a technology that will constrain your hand when it comes into "contact" with the virtual object.

The Force

Systems that imply force-feedback technology are being studied at other institutions, such as George Washington University, where Teresa W. Bleser, John L. Sibert, and their coworkers have created an intriguing artists' paint system.

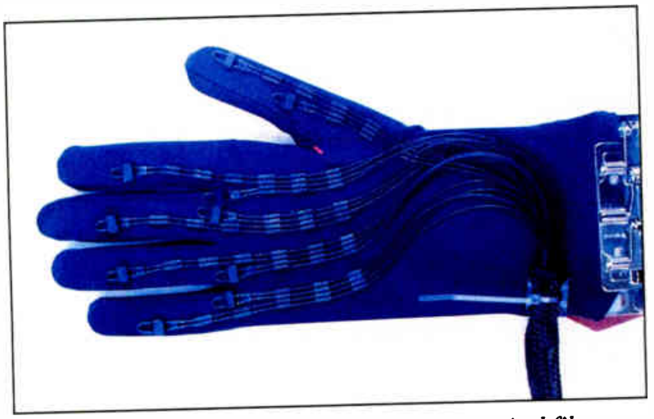

Photo 1: *The DataGlove is a device that uses optical fiber sensors to measure and evaluate the range of joint movement, hyperextension, and abduction in the hand.*

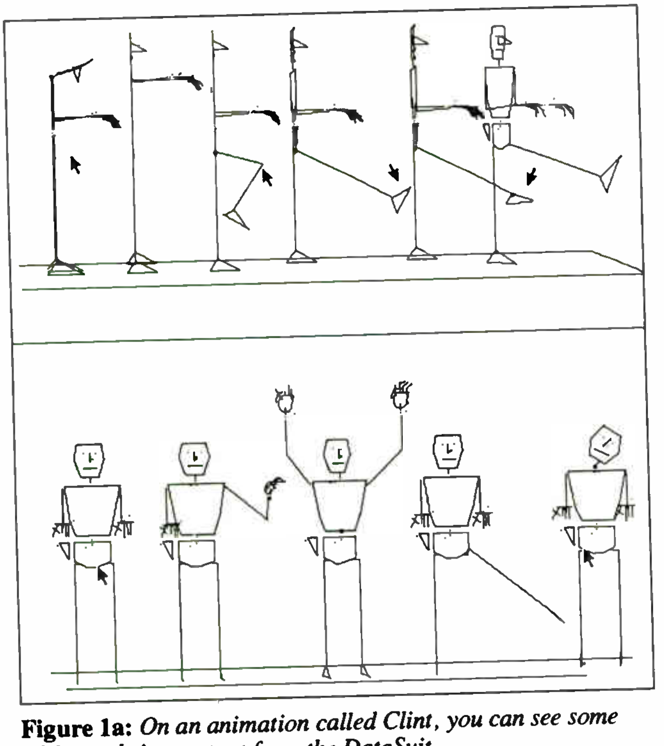

Figure 1a: *On an animation called Clint, you can see some of the real-time output from the DataSuit.*

With this technique, called GWPaint, artists use a data tablet that senses not only the position of their drawing stylus, but also its orientation and the amount of force they apply. The computer uses this information to simulate the articulation of a piece of charcoal. When the stylus senses that the artist is applying downward force, it dynamically increases the width of the line. The computer can also vary the texture of the line with the angle of attack.

Another force-feedback device, the *joystring* (see figure 2), was invented by John Staudhamer of the University of Florida at Gainesville, and modernized and developed by Richard J. Feldman of the National Institutes of Health in Bethesda, Maryland. The joystring consists of a T-shaped hand grip whose vertices are kept in a state of tension by three taut, thin guy wires. Force sensors at the ends of the wires measure the force produced by various twisting movements of the user's hand and transmit that information to the computer. The computer, in turn, directs servo motors to exert the equivalent forces in real or virtual environments. In effect, the joystring recognizes and communicates the force and torque that you generate.

In settings where temperatures or other conditions make it impossible for humans to be physically present but where dexterity and strength are essential, force-feedback systems measure and mimic the delicate dynamics of our arms and hands. Another area in which this technology has been used is for remotely operated telerobots like those that handle radioactive materials. Applications such as physical therapy and athlete training systems could also emerge, using sophisticated tactile-sensing and feedback systems.

Eyeing the Future

Although magicians often claim that the hand is quicker than the eye, in some applications the hand may be too slow—or too busy doing something else—to interact with a computer. A technology called *eye tracking* makes the human eye a computer-input device for such situations.

Perhaps naturally, one of the first organizations to show a serious interest in eye-tracking technology was the U.S. Air Force. However, the results of research in this area make it clear that there are more applications for it than in fighter jets.

Basically, eye tracking works by using special cameras that lock onto the eye, then bounce a beam off its cornea and continually record the direction in which the light is reflected. Current techniques allow resolution fine enough to determine

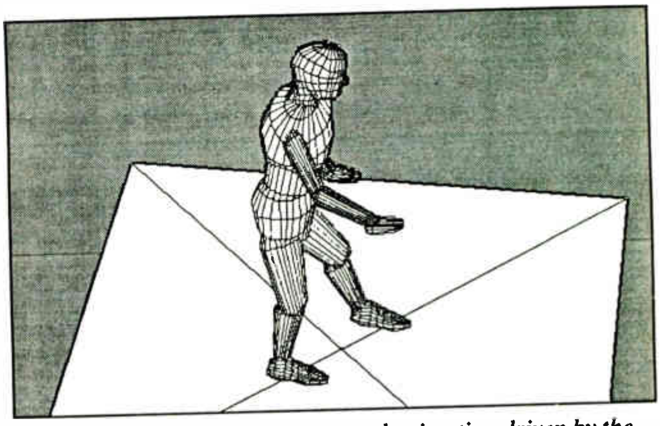

Figure 1b: *Ralph is a post-processed animation driven by the DataSuit. Potential applications for the DataGlove and DataSuit include high-end workstations, robotics, biomedicine, and human-factor engineering.*

which word on a computer screen you're focusing on. Various software systems have been devised for making use of this kind of information. For example, when coupled with a natural-language processing system and voice recognition, such a system would let you glance at a word and ask various questions about it, such as its meaning and other occurrences of the word.

Another scheme is graphical-display software programmed to respond dynamically to the user's focus of attention. Such systems could determine that you were focusing your eyes on one specific portion of the screen display and alter the display accordingly—bringing a window to the foreground of the screen, for instance.

Several eye-tracking projects are currently under way by both universities and commercial firms. At Texas A&M University, there has been ongoing research on an eye-tracking system using the frames of eyeglasses equipped with infrared-emitting diodes and phototransistors. Basically, this device uses electro-optical sensing in such a way that the positioning of the eye determines the amount and intensity of the light emitted to the phototransistors.

Because the eye's response time is so rapid (20 to 30 milliseconds) you could conceivably give a computer commands with your eyes much faster than with your hands or even a mouse. Applications for a system like this include aircraft and air traffic control handling, wheelchair maneuvering, and certain types of microsurgery.

Sentient Systems Technology of Pittsburgh, Pennsylvania, develops eye-tracking systems for use mainly by health care personnel and handicapped persons. The Eye-Typer 300, an eye-gaze-controlled keyboard system, lets you enter information into a computer by focusing your eyes for a specified amount of time (called dwell-time) on LEDs positioned like a checkerboard around the edge of the unit. The camera, centrally located in the device, measures the reflection of an infrared light on your cornea relative to a reflection on a "target" worn on your face just below the eye. If you want, you can customize the specific fields on the face of the unit to represent words, phrases, or pictures.

You can plug the Eye-Typer 300 into an IBM PC, XT, or AT. You can send your input out the RS-232C port to a printer. A one-line liquid crystal display (LCD) across the bottom of the computer lets you see your input. As you "type" each letter, word, phrase, or picture with your eyes, the computer repeats it back to you using an embedded speech synthesizer. When you hit a carriage return, the computer repeats the entire sentence you have just entered. You can also use this device to operate an environmental control system and, for example, work lights, televisions, and other appliances.

A request from NASA led Analytics of Willow Grove, Pennsylvania, to come up with OASIS (Ocular Attention Sensing Interface System), an eye-tracking system that uses a combination of eye and voice input. With OASIS, without taking your hands off the controls of your airplane or car, you can, for instance, look at an analog gas gauge, ask it exactly how many gallons are left in the tank, and get a vocal answer.

The OASIS device consists of eye-position and voice-processing firmware, eye-tracking signal processing, and head-motion algorithms. Analytics provides the type of customized application I/O or interface software you would need to work with your existing system or create a complete system from scratch.

Another possible application for OASIS would be providing quality control functions on, for example, a widget production line. As the widgets go by, you would look at each one and speak into a microphone (either placed in your helmet or remotely embedded between the monitor and a keyboard), saying the words "Accepted" or "Rejected." The widgets would drop into the proper bins by themselves, without your having to stop to look down and write, or physically throw the widgets into "good" or "bad" bins. In this type of interface, your eye position works as the cursor, and your voice operates as a button, in place of computer keys.

Talk to Me

Systems that let you talk to your computer, long a staple of science fiction, are just now appearing as commercially available systems for desktop computers. Generally, these voice-recognition systems have a vocabulary in the range of 1000 to 10,000 words and have to be trained to recognize individual users' voices. Another limitation is that with most of these devices, you have to adjust your phrasing and choice of vocabulary to the machine.

Ray Kurzweil, the creator of the "voice typewriter," optical character readers, and music-synthesis devices, is the founder of Kurzweil Applied Intelligence in Waltham, Massachusetts. Kurzweil has produced a 5000- to 10,000-word voice-recognition system that consists of a printed circuit board and proprietary software for use with an 80386-type personal computer.

The Voice RAD and Voice EM systems let you talk directly into your machine, which can then send the information to your printer for text output. You still have to train the computer to recognize your voice, but you can customize your output by inputting "voice macros"—that is, teach your system words that

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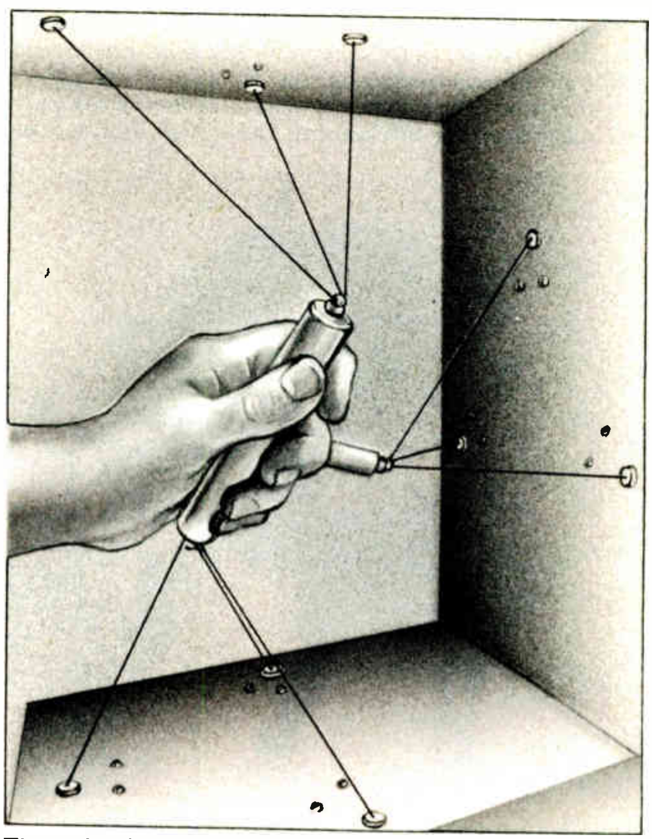

Figure 2: *The joystring is a force-feedback device that recognizes and communicates the force and torque that you generate.*

stand for complete phrases. Used largely by the medical community, the systems let doctors dictate a patient's medical findings or x-ray results into their computers and, without having to go through a transcriptionist, immediately receive a hard copy of the information.

Creating workable real-time speech-recognition systems will require some very advanced hardware—perhaps computers that use parallelism or the concept of neural networks. Among the companies and universities currently tackling this problem are BBN Laboratories and Thinking Machines, both of Cambridge, Massachusetts; Battelle Institute Columbus Labs in Columbus, Ohio; and Carnegie Mellon University in Pittsburgh, Pennsylvania.

Heads Up

At the Aerospace Human Factors Research Division of NASA's Ames Research Center in Mountain View, California, scientists have combined three of the most promising new interface technologies into one integrated environment. The Virtual Interactive Environment Workstation (VIEWS) uses head-tracked and head-mounted displays, gesture-tracking, and voice input and output. (NASA's Langley research branch is also working on head-mounted VIEWS devices. See photo 2.)

VIEWS consists of a head-mounted stereoscopic display that projects a wide-angle three-dimensional panorama, which you can control with your head movements, voice commands, and hand gestures. The system lets you explore a 360-degree field of vision that can be either a simulated or remotely sensed environment, and you can have direct interaction with its virtual components.

The head-mounted display unit uses two medium-resolution monochrome LCD display screens, which can be seen through a wide-angle binocular optics viewer. The display is coordinated with the user's head movements in real time via a 6-degree-of-freedom tracking mechanism. The system uses various

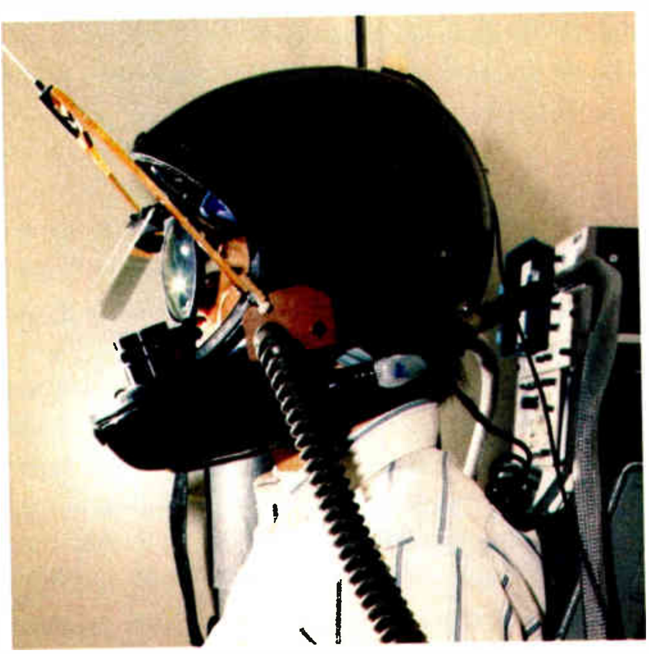

Photo 2: *Used as a research tool at NASA's Langley facility, this helmet is a flight simulator that enables pilots to try out technologies such as eye tracking, voice recognition and synthesization, and three-dimensional graphics displays.*

video mixing and switching devices, combining both commercially available and custom equipment to merge images from a variety of sources into a single integrated representation.

VIEWS also incorporates a commercially available binaural, three-dimensional sound system. With headphones, you can hear sounds, either from within or outside your immediate field of view. A speech-recognition module lets you give vocal commands in a natural, conversational manner.

NASA's interest in these technologies stems from its desire to incorporate on the planned space station an implementation of the concept of "telepresence"—the ability to put yourself into almost any environment you can envision. The agency has committed itself to using the most advanced user-interface technology for control of autonomous and semi-autonomous telerobotics devices.

Breeding Ideas at MIT

The MIT Media Lab in Cambridge, Massachusetts, is a wellspring of human-machine interface research. Since the early 1970s, people such as Nicholas Negroponte, director of the Media Lab, and Seymour Papert, director of the Learning Research Group and head of the School of the Future project, have been actively working to develop novel ways for humans and machines to interact.

Papert's research has had wide-ranging benefits, such as the Logo programming language and the field of Turtle Geometry. Negroponte's interest in the expressive communication of the human body encompasses the subtle expressions of the face—particularly the eyes and lips.

One of the projects under Negroponte's direction involved research with a full-body optical tracking suit that allows a computer to record the expressive movements of the entire human body. These recorded movements were used to drive a computer-animation system called the "Graphical Marionette," an undertaking that is part of ongoing work being sponsored by the Japanese Broadcasting Corp.'s NHK-TV. In another of his ventures, Negroponte studied how the human sense of "presence" (i.e., audio and visual representations of a person) might be captured and transmitted over long distances via various media.

Delle Maxwell, a graduate of Negroponte's program, made use of her graphical animation background when she worked on NHK-TV's Dr. Holon project. This venture involved the creation of a (pre-Max Headroom) computer-generated TV-show host that, through hand gestures, could express emotion and personality while also walking and turning its body.

Another MIT Media Lab graduate student, Steve Strassman, has made an impressive achievement with his Hairy Brushes program. Hairy Brushes lets an artist "dip" a virtual paintbrush into different types of ink, use fast or slow drawing, apply splatter effects, and even simulate a drybrush style.

Strength in Synergy

As evidenced at Ames Research Center and MIT's Media Lab, the fullest potential for advanced user interfaces could come through the use of a combination of two or more interface technologies. By using more than one interface technology at a time, you can overcome the limitations of each; thus, the user can work in a way that is more natural. For example, using a natural-language interface combined with some type of pointing interface—whether a mouse, a datahand, or perhaps even an eye tracker—could simplify complex language-parsing problems and save precious CPU time for other tasks.

Eventually, full-body tracking suits may become valuable for systems that use video-camera-based vision systems to de-

A Stick with a Difference

Janet J. Barron

If it's important that you keep your hands on the wheel of your car while you are driving, think how important it is that pilots keep their hands on the controls of the plane while they are flying. A new user interface invented by scientists at NASA's Langley Research Center in Hampton, Virginia, lets pilots do just that. It is called the Thumball, a joystick with a trackball installed on it.

The Thumball was developed to enable pilots of military and commercial planes to make adjustments to the plane's electronic data system without taking their hands off the controls. With this device (see figure A), they can precisely enter data, position a cursor, and receive digital readouts in two axes on a CRT screen. Pilots will be able to use it to make changes in heading, pitch, or trim, or to make other precise adjustments. Currently, and until the Thumball becomes commercially available, pilots must take their hands off the controls and turn knobs to provide these functions.

The Thumball's mechanism, called a *spherical integrator*, works like an optoelectronic mouse. A pilot will be able to operate the device with his thumb while his hands remain on the controls. So far, only one of the devices exists. It is installed in the cockpit of a simulator at Langley for testing.

The Thumball is one step in NASA's development of the concept of a "Glass Cockpit." In this project, NASA is placing all the aircraft's controls and readings on one CRT display. This way, pilots can have a wider field of view than they now have and can see all the readings by looking at one screen instead of a whole bank of instruments.

In Boeing 757s and 767s, the Glass Cockpit's beginnings are already in place, says NASA's H. Douglas Garner.

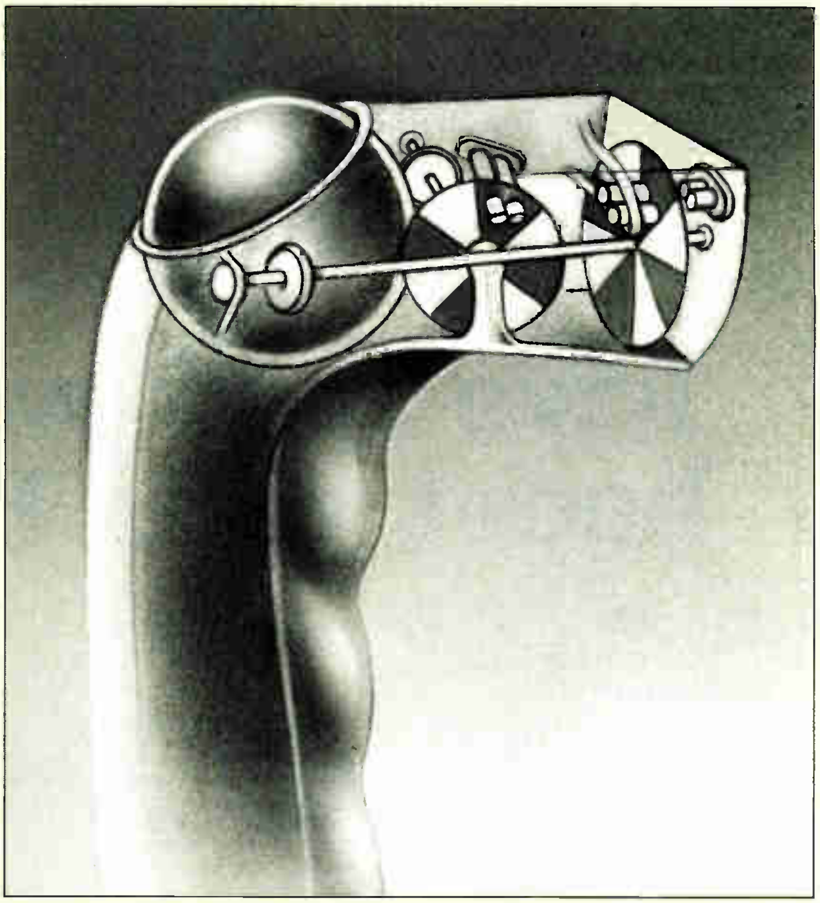

Figure A: *The Thumball, a joystick with a mouse on top, lets pilots enter data into their flight computers without taking their hands off the jet's controls.*

While inflight, the pilots and the passengers are able to "see" where they are geographically. In the cabin, passengers can watch large projection screens showing macro and wide-angle representations of the plane's position.

The Thumball was created by Garner, Anthony M. Busquets, Thomas W. Hogge, and Russell V. Parrish of NASA's Langley Research Center.

Janet J. Barron is a BYTE technical editor. You can reach her on BIX as "neural."

rive gesture-recognition and other types of pattern-recognition data. With advances in artificial intelligence techniques, object-oriented programming, and graphics methodologies, you may someday soon be working in a three-dimensional simulation of an office environment. Such a setting would allow you to zoom in on objects not physically in sight or available for your use (such as a filing cabinet), extract information from the object (say, a letter or document), and manipulate the data with tools, such as a pair of virtual scissors.

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Ernest R. Tello of Santa Cruz, California, is a contributing editor for BYTE and the author of Mastering AT Tools and Techniques *(Indianapolis, IN: Howard W. Sams). He can be reached on BIX as "editors."*

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THE BASIC REVIVAL

The "beginner's" language has significant new features and a structured approach

Namir Clement Shammas

This year marks a quarter of a century since the birth of BASIC at Dartmouth College. Just as people change and mature as they age, so has BASIC changed in 25 years.

The original BASIC interpreters became very popular because they were easy to use and widely available. But the advent of both the IBM PC family and Borland's very affordable, fast Turbo Pascal compilers opened the eyes of many BASIC programmers who had pushed the language to its limits. BASIC implementations, such as Applesoft BASIC and Microsoft BASIC, lacked many important features, such as callable subroutines, multiline functions, and local variables. In addition, Pascal already had a better reputation as a neat, structured language that fostered efficient modular coding.

Correcting these shortcomings, as well as other faults, has led to a BASIC revival. The new ANSI BASIC standard includes many new features, some of which have outdone Pascal, Modula-2, and even C. And the ANSI standard serves as a launching point for a number of BASIC implementations, such as True BASIC, Turbo Basic, and QuickBASIC, that also add their own extensions to the language.

A Break with the Past

The new BASIC implementations do not require the use of the much-criticized line numbers. Instead, numeric or alphanumeric labels can direct jumps in program flow. Listings 1a and 1b compare the coding of the same program under BASICA and QuickBASIC, respectively. Notice that the line numbers are removed in listing 1b, and lines 1030 and 2000 of listing 1a are replaced with the more meaningful and highly readable labels `GetNum:` and `Center:`. Even if the line numbers 1030 and 2000 were kept in the QuickBASIC version, they would still be regarded as labels. Using labels is a more mature route for highlighting program locations relevant to unconditional or subroutine jumps.

Turbo Basic and QuickBASIC support new features related to data objects: long integers, structures (in QuickBASIC), and formal dynamic and static arrays. In previous BASIC interpreters, integers were limited to 2 bytes; this, in turn, limited the record number of random-access files to 32,767. Thus, only half the range of integer values was useful to file I/O. The new long-integer types extend the range of whole numbers to 2 billion. Using long integers, you can not only reach the previously sought limit of 65,535 records, but also go well beyond that number (the limitations are imposed by the operating systems). You use the & suffix to declare a variable or a function as having a long integer.

QuickBASIC supports constants of all simple types, such as the following:

```
CONST MAX.DIM% = 100, MAX.REC& = 65535
CONST MISSING.DATA# = -1.0E30
```

The type-declaration character is not part of the constant, and it can be dropped when using the constant in the program. For this reason, constant identifiers are unique: No two constants can have the same name and have different data types.

The support of symbolic constants is something new and important to BASIC. Symbolic constants replace numbers or strings with more meaningful identifiers. They also make updating the same constant value throughout the program quick, easy, clear, and less error-prone. Structured languages such as Pascal, C, Ada, and Modula-2 also support constants.

Unlike the BASIC interpreters, the early BASIC compilers that worked with Microsoft BASIC and BASICA programs did not support dynamic arrays. Now, the Turbo Basic and QuickBASIC compilers support formal dynamic and static arrays. The `$STATIC` and `$DYNAMIC` compiler directives declare arrays as static or dynamic, respectively. You can also include the `STATIC` or `DYNAMIC` keywords with the `DIM` declarations to override the current default type of arrays.

You can erase and optionally redimension dynamic arrays at

continued

run time using the ERASE and DIM statements, respectively; applying ERASE to a static array merely assigns zero or null characters to its elements. True BASIC regards its arrays and matrices as dynamic. You can even redimension an array nondestructively to add more elements. BASIC's new support of dynamic arrays is very significant, since programs can now size up arrays and matrices on the fly. Languages like Pascal, Modula-2, and C support dynamic arrays via dynamic memory allocations using pointers.

Listing 1a: *A BASICA program.*

```
1000 T$ = "Test Program" : GOSUB 2000
1010 T$ = "version 1.0" : GOSUB 2000
1020 PRINT : PRINT
1030 INPUT "Enter positive number ";X
1040 IF X <= 0 THEN 1030
1050 PRINT SQR(X)
1060 END
2000 ' Center string
2010 L = LEN(T$)
2020 PRINT SPC(40-L\2);T$
2030 RETURN
```

Listing 1b: *The QuickBASIC version of the program in listing 1a.*

```
T$ = "Test Program" : GOSUB Center
T$ = "version 1.0" : GOSUB Center
PRINT : PRINT
GetNum:
INPUT "Enter positive number ";X
IF X <= 0 THEN GetNum
PRINT SQR(X)
END

Center:' Center string
L = LEN(T$)
PRINT SPC(40-L\2);T$
RETURN
```

Listing 2a: *The BASICA version of a quadratic equation solver.*

```
1000 CLS
1010 PRINT "Solve for X in A*X^2 + B*X + C =
          0" : PRINT
1020 INPUT "Enter A, B, C "; A,B,C
1030 Determinant = B*B - 4*A*C
1040 IF Determinant > 0 THEN 2000
1050 IF Determinant = 0 THEN 3000
1060 ' solve for imaginary roots
1070 Root1 = B/2/A
1080 Root2 = SQR(-Determinant))/2/A
1090 PRINT "Root = ";Root1;" +/-i ";Root2
1100 END
2000 ' solve for real and different roots
2010 Root1 = (B + SQR(Determinant))/2/A
2020 Root2 = (B - SQR(Determinant))/2/A
2030 PRINT "Root1 = ";Root1;"   Root2 = ";Root2
2040 END
3000 ' solve for real and equal roots
3010 Root1 = B/2/A
3020 PRINT "Roots are ";Root1
3030 END
```

QuickBASIC 4.0 has introduced record structures that resemble those of traditional structured languages. To define a personal data record, for example, you declare the type PersonalRec as follows:

```
TYPE PersonalRec
    PersonName AS STRING*30
    Profession AS STRING*40
    Age AS INTEGER
    Weight AS SINGLE
END TYPE
```

This QuickBASIC record is made up of a 30-character name field, a 40-character profession field, an integer-type age field, and a single-precision floating-point body-weight field. QuickBASIC records cannot contain fields that are either arrays or dynamic strings, but nested record declaration is allowed. Compare the above with a similar Pascal record:

```
Personal_Rec   = RECORD
   Person_Name : STRING[30];
   Profession  : STRING[40];
   Age         : INTEGER;
   Weight      : REAL;
END;
```

An array of records for the personal data is declared as

```
DIM People(MAX.PERSONS) AS PersonalRec
```

Thus, QuickBASIC 4.0 has introduced the syntax to declare new data-type identifiers—something new to the purist BASIC programmer.

Beyond Simple Decisions

Decision-making constructs are more sophisticated under the new BASICs. They include, in a nutshell, an expanded IF statement and a powerful new SELECT CASE. These arm the new ANSI BASIC with constructs found in structured languages. For example, the old one-line IF...THEN...ELSE statement can be extended into a multiline version. You can also use ELSEIF clauses like those in Pascal.

Listing 2a shows a BASICA program that solves for the root of a quadratic equation. Listing 2b contains the Turbo Basic version, which uses an IF...THEN...ELSEIF...ELSE statement. Note the difference in code readability between the two versions. Listing 2c shows a Turbo Pascal version of the same program; notice how similar the IF statements are in listings 2b and 2c. The new multiline IF statement also shows that BASIC fosters structured coding and simultaneously demotes the use of GOTOs.

The SELECT CASE statement is a new decision-making statement that resembles the Pascal CASE and C switch statements—and, in fact, it's even more powerful than CASE and switch. It is similar to the IF...THEN...ELSEIF statement, but it lets you try several tests. Consider the following SELECT CASE statement in QuickBASIC:

```
SELECT CASE NumData
  CASE IS <= 0 ' relational test
      ' same as IF NumData <= 0 THEN
      Message$ = "YOU HAVE NO DATA"
      ErrNum = 1
```

```
CASE 1,2,3 ' enumerated list
     Message$ = "TOO FEW OBSERVATIONS"
     ErrNum = 2
CASE IS 4 TO 30 ' a value range
     Message$ = "MINIMAL SAMPLE SIZE"
     ErrNum = 3
CASE ELSE
     Message$ = ""
     ErrNum = 0
END SELECT
```

This example illustrates the three basic types of CASE labels: relational test, enumerated list, and value range. The relational CASE label in BASIC extends the use of SELECT CASE in place of IF...THEN...ELSEIF statements beyond that of other structured languages. In addition, the CASE labels can include several clauses of various types; for example, the statement CASE 1,2,3, IS > 100, 10 TO 30 is acceptable.

Another important feature, found in QuickBASIC and Turbo Basic, is that the CASE labels can also contain expressions. These compilers will accept a statement like CASE x/y, IS > SQR(h+1), for example. The popular structured languages do not support this use of expressions in CASE labels. The SELECT CASE statement lets you construct very powerful multiway decision making.

BASIC has also expanded the number and types of loops. The previous BASIC interpreters provided the fixed-iteration FOR ...NEXT loop and the conditional WHILE...WEND loop, and now the new ANSI standard also recognizes fixed, conditional, and infinite loops.

While the FOR...NEXT loop is still used in the new BASICs, the EXIT FOR statement now provides an elegant exit from that loop. There is also a DO...LOOP loop that provides the following versatile variations:

```
DO [WHILE <expression>]
   <loop statements>
LOOP [UNTIL <expression>]
```

The DO WHILE...LOOP loop is essentially the same as the conditional WHILE...WEND loop found in BASICA and Microsoft BASIC. The DO...LOOP UNTIL loop is new and resembles the REPEAT...UNTIL loops in Pascal and Modula-2. DO...LOOP is an open or infinite loop with parallels in Ada, C, and Modula-2, but not in Pascal.

Listing 3 shows a QuickBASIC program that employs DO ...LOOP, DO WHILE...LOOP, and DO...LOOP UNTIL. Note that you can use a DO...LOOP with both the UNTIL and WHILE clauses; this serves to monitor the continuation of the loop when two conditions must apply. (The conditions are separated into the UNTIL and WHILE clauses to enhance logical readability.) You can use the EXIT DO statement to exit any type of DO ...LOOP, especially the infinite type; listing 3 uses it to exit the outer DO...LOOP.

In general, the various forms of DO loops and the EXIT DO statement promote structured thinking and coding.

New Functions and Subroutines

The new BASICs promote the more powerful multiline functions. The familiar DEF FN<name> function can now be spread over multiple lines; under many of the older BASIC interpreters, you had to mimic such functions using subroutines. The other type of function does not begin its name with the letters FN, so you must list it in DECLARE DEF statements.

Under the new BASICs, functions can be recursive. Listing 4 shows a recursive factorial function. As with any multiline function, END DEF marks the end of the function. The function result is returned by assigning an expression to the function identifier. Function arguments are passed by value and, except in True BASIC, cannot be arrays. With the multiline function, the new BASICs support the EXIT DEF statement to allow an

continued

Listing 2b: *The Turbo Basic version of a quadratic equation solver.*

```
CLS
PRINT "Solve for X in A*X^2 + B*X + C =
       0" : PRINT
INPUT "Enter A, B, C "; A,B,C
Determinant = B*B - 4*A*C
IF Determinant > 0 THEN
  ' solve for real and different roots
  Root1 = (B + SQR(Determinant))/2/A
  Root2 = (B - SQR(Determinant))/2/A
  PRINT "Root1 = ";Root1;"   Root2 = ";Root2
ELSEIF Determinant = 0 THEN
  ' solve for real and equal roots
  Root1 = B/2/A
  PRINT "Roots are ";Root1
ELSE
  ' solve for imaginary roots

  Root1 = B/2/A
  Root2 = SQR(-Determinant))/2/A
  PRINT "Root = ";Root1;" +/-i ";Root2
END IF

END
```

Listing 2c: *The Turbo Pascal version of a quadratic equation solver.*

```
Uses CRT;

VAR A, B, C, Determinant, Root1, Root2 : REAL;

BEGIN

ClrScr;
WRITELN('Solve for X in A*X^2 + B*X + C = 0');
          WRITELN;
WRITE('Enter A, B, C '); READLN(A,B,C);
Determinant := B*B - 4*A*C;
IF Determinant > 0 THEN BEGIN
  { solve for real and different roots }
  Root1 := (B + SQRT(Determinant))/2/A;
  Root2 := (B - SQRT(Determinant))/2/A;
  WRITELN('Root1 = ',Root1,'   Root2 = ',Root2)
END
ELSE IF Determinant = 0 THEN BEGIN
  ( solve for real and equal roots }
  Root1 := B/2/A;
  WRITELN('Roots are ';Root1)
END
ELSE BEGIN
  { solve for imaginary roots }
  Root1 := B/2/A;
  Root2 := SQRT(-Determinant))/2/A;
  WRITELN('Root = ';Root1;' +/-i ';Root2)
END;

END.
```

The Working Environment

As BASIC has matured and developed, the programming environment for developing software has also improved. Today's compiled BASIC packages offer integrated editors, file managers, debuggers, and a DOS interface. They are a far cry from the old interpreted BASIC environment.

True BASIC

The True BASIC environment is notable for its simple visual appearance (see photo A). The screen is split into two areas: the command history and the screen editor. Typing `Help` provides you with on-line help for specific topics—which you'll need, because True BASIC does not display a menu for the available environment-related commands.

You can display any directory using the `FILES` command, with the default aimed at listing `*.TRU` files in the current directory. True BASIC enables you to change directories, save the file currently being edited under a new name, update the edited file, or start a new one. You can also type True BASIC language statements from the command level. This lets you test predefined functions for proper use or examine results after a program terminates.

Typing `RUN` causes the program displayed by the editor to start executing. If the True BASIC compiler detects an error, it displays an error message and the line number in the command window. True BASIC points to the nature of the error and to the routines and files (if any) where the offending code is located; the editor does not automatically invoke other files that contain the located compile-time error. The compiler displays a list of errors found in the program.

True BASIC implements `DO` commands, which let you run secondary programs and external subroutines. Normally, the `DO` command invokes a utility that interacts with the program in the screen editor buffer. If the filename following the `DO` command contains a complete True BASIC program, then the invoked program performs a task not directly affecting the edited program; for example, you can invoke a menu-driven DOS shell program to format a disk, copy files, or delete files. Alternatively, you could invoke programs that provide on-line help to accompany your custom programs. But `DO` commands really shine when they invoke external subroutines that interact with the program in the editor. The True BASIC distribution disk provides external subroutines to perform program formatting, cross-referencing, and tracing via `DO` commands.

Another versatile feature of the True BASIC environment is the `LOAD` command, which lets you load BASIC libraries and modules, making them part of the language. This means that an executing program need not explicitly declare loaded libraries or modules, so compiling is faster. (True BASIC is actually a semicompiler that verifies the correctness of the entire program before it executes.)

Turbo Basic

Turbo Basic's environment is similar to the well-received environment in Turbo Prolog (see photo B). The default setting features five windows, including the one-line main menu and the Edit, Message, Run, and Trace windows. The options in the main menu let you invoke the filer, edit a program, compile, compile/run, set compiler switches, select environment options, reconfigure windows, and set up debugging features. The main menu File option lets you manipulate selected files and directories, invoke the DOS shell, and exit.

The commands for the Turbo Basic editor are very similar to WordStar commands in nondocument mode. You can customize the key commands using the Install program. The main

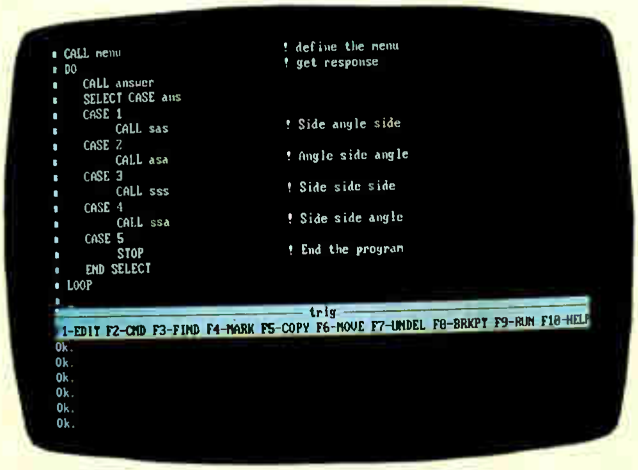

Photo A: *The True BASIC programming environment.*

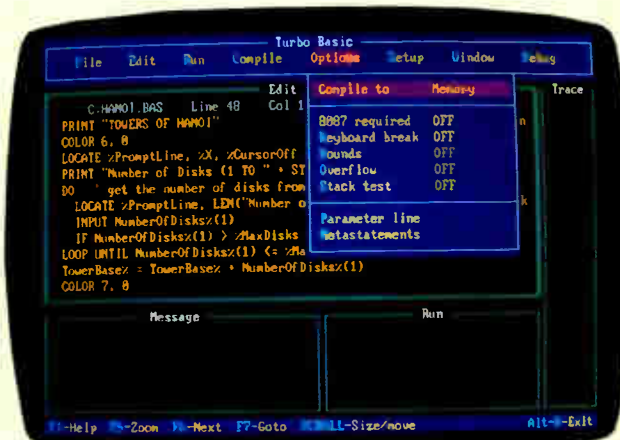

Photo B: *The Turbo Basic programming environment.*

Photo C: *The QuickBASIC programming environment.*

menu's Compile option features automatic debugging similar to that of True BASIC, except that if Turbo Basic finds an error in an included file, it will load that file into the editor.

Turbo Basic offers three classes of compiler options. The first lets you select the destination of the compiled code—to memory, or to an .EXE file. The second class specifies the compiler toggle switches, such as the 8087 requirement, keyboard break, checking bounds, detecting overflow, and stack checking. The third class of suboptions lets you directly enter the command-line arguments and specify the sizes for the stack, music buffer, and I/O communications. These sizes may also be specified by metacommands embedded in the source code.

The Setup and Window options let you fine-tune certain aspects of the Turbo Basic environment, such as colors, code directories (i.e., include, source, and compiled files), and window configurations. The Debug option permits you to turn tracing on or off, and the Run-Time Error suboption makes Turbo Basic display the message that accompanies the error instead of merely displaying an error number.

QuickBASIC

The new QuickBASIC 4.0 environment (see photo C) comes with a number of very significant enhancements over previous versions. For example, it enables you to open new text windows to edit a specific function or subroutine. This new feature makes the environment responsible for locating your sought routine and placing its code in a separate window.

The QuickBASIC environment initially displays two windows. The editing window occupies most of the screen, and the one-line main menu is located right above it. The second, much smaller window contains two lines reserved for the immediate mode. This mode lets you type BASIC commands and execute them immediately, just as in BASICA or GWBASIC.

The File options perform functions similar to those in Turbo Basic, but with a few differences. The QuickBASIC environment permits you to load (and also unload) more than one file into memory. When the environment loads a QuickBASIC source code file, it precompiles it and (if it uses subroutines) builds an internal subroutine map. Pressing the F2 function key pops up a window that displays the name of the main routine(s) in memory, along with indented lists of subroutines. You use the cursor keys to select a main program or a subroutine. The QuickBASIC environment provides on-line help screens that show the editor's commands, an ASCII table, and the QuickBASIC keywords.

The QuickBASIC editor is connected with the QuickBASIC threaded p-code compiler/interpreter. When you type a line of code and then press Enter or move the cursor, the compiler verifies the new line and immediately flags any syntax error. The editor uses most WordStar nondocument editing commands.

The View options enable you to view code hierarchy and select a code segment, as discussed earlier. You can also view the next routine in the code hierarchy, the next statement, the output screen (even after program execution has terminated), and the code of included files.

The Run options let you create .EXE programs (as either stand-alone files or smaller files requiring the QuickBASIC run-time library), create compiled libraries, and start/restart a program in memory. The Debug options offer debugging tools. You can specify variables to be monitored in the Watch window, and you can also set breakpoints that stop the program when specific lines are reached or when specified expressions attain certain values. Other options let you trace the program execution and keep track of the last 20 statements executed.

early function exit. These enhancements undoubtedly give functions additional power; nevertheless, they still lag a bit behind those of languages like Pascal and C.

While GOSUBs can employ labels to direct their subroutine jumps, a new and more powerful class of callable procedures is taking their place. The procedures have a name and a parameter list. Parameters are passed by value or by reference—the general rule is that expressions are passed by value, and variables (simple or arrays) are passed by reference. Enclosing a simple variable in parentheses causes it to be passed by value, as an expression; QuickBASIC also supports the BYVAL keyword to explicitly specify that a parameter is to be passed by value. The parameter list is the main data interface between the procedure and the calling program unit. The variables in other programming units cannot be accessed or shared without special declarations.

An important feature in these procedures is the ability to handle arrays of any size. The LBOUND and UBOUND functions return the lower and upper array bounds, respectively; they work with both one-dimensional and multidimensional arrays. Turbo Basic implements these predefined functions slightly differently from the proposed ANSI standard (which QuickBASIC and True BASIC follow). With the LBOUND and UBOUND functions, you can write general-purpose routines for manipulating arrays and matrices much more easily than in Pascal or, to a lesser extent, Modula-2 and C.

BASIC procedures can have local variables. When using local arrays, you must dimension them early in the procedure and remove them before the end. While the BASIC implementations impose a strict data interface between the procedure and other programming units, they differ in implementing local variables and accessing (or sharing) global variables. In QuickBASIC, you declare local and global variables using STATIC and SHARED, respectively. SHARED variables can also be exported (i.e., created by the procedure and submitted to the pool of global variables). Turbo Basic uses the LOCAL, STATIC, and SHARED declarations to define local, static, and shared global variables within procedures. True BASIC places procedures before the unique END of a program, giving them access to all global variables. By contrast, procedures located beyond the END statement or in external libraries cannot share global variables. All the variables in these procedures are strictly local.

Listings 5a and 5b show the True BASIC and Turbo Basic versions of the same procedure. The listings illustrate using local variables and handling arrays of various sizes.

Modular Approach

QuickBASIC and True BASIC implement modules. These, along with external libraries, foster a new level for structured programming in BASIC. True BASIC modules are made up of functions and procedures, as well as the following sections:

```
MODULE <name>

PUBLIC <list of exported variables>
PRIVATE <list of local routines>
DECLARE DEF <list of functions>
SHARED <list of variables global in module only>
<module initialization statements>
<function or subroutine declarations>
END
```

The PUBLIC declaration lists the names of simple variables and arrays exported to client programs. This creates public vari-

continued

Listing 3: *A QuickBASIC program that demonstrates* DO...LOOP, DO...LOOP UNTIL, *and* DO WHILE...LOOP.

```
CLS
DO

  INPUT "Want to calculate a square root? ";A$
  IF A$ = "" THEN A$ = "N"
  A$ = UCASE$(LEFT$(A$,1))

  IF A$ <> "Y" THEN EXIT DO ' exit main loop

  DO
    INPUT "Enter a positive number ";X
    PRINT
  LOOP UNTIL X > 0

  S = X /2
  DO WHILE ABS(S*S - X) > 0.000001
    S = (X/S + S) / 2
  LOOP

  PRINT "Square root of ";X;" = ";S : PRINT

LOOP

END
```

Listing 4: *A recursive function written in Turbo Basic.*

```
DEF FNFactorial#(N%)

   IF N% > 1 THEN
     FNFactorial# = N% * FNFactorial(N%-1)
   ELSE
     FNFactorial# = 1.0
   END IF

END DEF
```

ables that are global and accessible to all parts of the module, as well as to the program that calls the module. The PRIVATE declaration lists the functions and procedures that are local to the module; all routines that are not listed are strictly private. The DECLARE DEF statement indicates the names of all the functions declared within the module. The SHARED declaration lists the scalar and array variables that are accessible to all the routines in the module, but not to any client program; they should not appear in the routines' argument lists.

Module initialization is carried out automatically before the program starts running; thus, any PUBLIC variable involved in the initialization step must be assigned an initial value from within the module itself. This makes the initialization step independent of the client programs.

The Grand Picture

The new ANSI BASIC standard and the implementations based on it have brought significant improvements to the BASIC programming environment. BASIC programs benefit from structured coding: They're more clearly defined and easier to read and maintain. This structure is apparent at two levels: within the program itself, and in the multiline functions and procedures. The avenue for writing reusable BASIC libraries has reached new and unprecedented levels on microcomputers.

The BASIC revival is indeed real and is worthy of the notice

Listing 5a: *True BASIC listing of a callable procedure.*

```
SUB Basic.Stat(X(), Mean, Sdev)
! Return average and standard deviation
                             of an array X()
LET SumX = 0
LET SumXX = 0
LET Sum = Size(X)

IF Sum < 2 THEN ! return with numeric
                              error values
  LET Mean = -1.0E+30
  LET Sdev = -1.0E+30
  EXIT SUB
END IF

FOR I = LBound(X) TO UBound(X)
   LET SumX = SumX + X(I)
   LET SumXX = SumXX + X(I)^2
NEXT I

LET Mean = SumX / Sum
LET Sdev = SQR((SumXX - SumX^2/Sum)/(Sum-1))

END SUB
```

Listing 5b: *Turbo Basic listing of a callable procedure.*

```
SUB Basic.Stat(X#(1), Mean#, Sdev#)
' Return average and standard deviation of
                                an array X()
LOCAL Sum#, SumX#, SumXX#, I%
SumX# = 0
SumXX# = 0
Sum# = UBound(X#(1)) - LBound(X#(1))

IF Sum# < 2 THEN ' return with numeric
                              error values
  Mean# = -1.0E+30
  Sdev# = -1.0E+30
  EXIT SUB
END IF

FOR I% = LBound(X#(1)) TO UBound(X#(1))
   SumX# = SumX# + X#(I%)
   SumXX# = SumXX# + X#(I%)^2
NEXT I%

Mean# = SumX# / Sum#
Sdev# = SQR((SumXX# - SumX#^2/Sum#)/(Sum#-1))

END SUB
```

of many veteran BASIC programmers who have migrated to Pascal and C. There was a valid cause for this exodus of programmers. But now, there is a good reason to give BASIC a second look: It's getting better all the time. ■

BIBLIOGRAPHY

Shammas, Namir. *The New BASICs*. Redwood City, CA: M&T Publishing, 1987.

Namir Clement Shammas is a columnist for several computer magazines and a freelance writer living in Glen Allen, Virginia. You can reach him on BIX as "nshammas."

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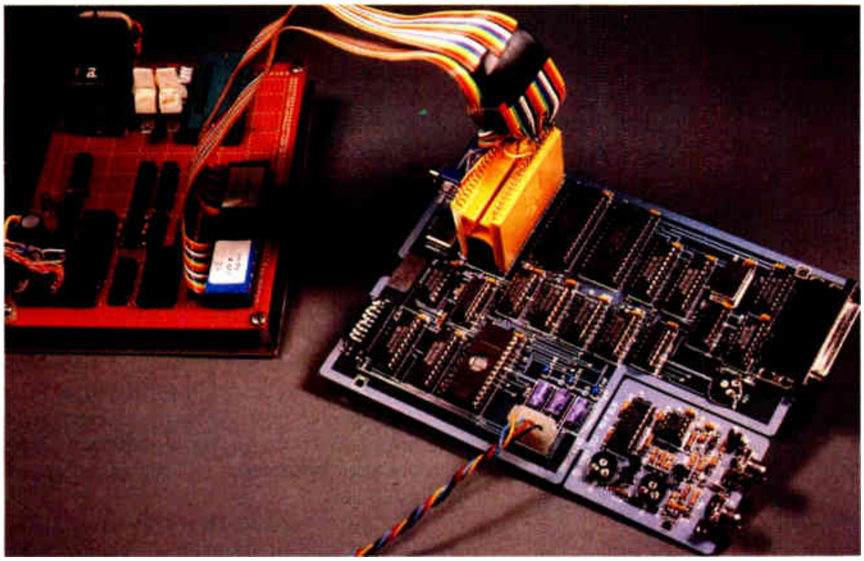
Part 2

WHY MICROCONTROLLERS?



The DDT-51 is a low-cost IBM PC-based Intel 8031/8051 development system

Photo 1: *Prototype of the DDT-51 development system.*

Having explained last month why we want to design projects around a single-chip microcontroller, it's time to talk about getting the software into the microcontroller. As I previously suggested, your options are either burn and crash (burn the program into an EPROM and figure out why it crashed) or use a development system.

The DDT-51 8031 development system I'll describe in this article offers many of the features of more expensive software development systems, at a fraction of the price. Unlike those systems, you can build this one yourself, modify the features to suit your tastes, and wind up with a system tailor-made for your application.

I'll start with the DDT-51 system hardware, then describe the software interface that lets an IBM PC control the target 8031 system.

The DDT-51 Development Tool

Nothing ever works the first time. When you are debugging microcontroller-based hardware, you need to be able to load and run a program, stop at breakpoints, single-step through critical parts of the code, disassemble instructions, examine and change registers, and continue where you left off. An ideal development system helps you do all that without using any 8031 system resources: no pins, no ICs, no program RAM—nothing at all. In-circuit emulators (ICEs) come closest to that ideal, because they replace the microcontroller with a hard-wired equivalent of the microcontroller chip—an equivalent that lets you directly observe the chip's (normally hidden) inner functions.

The DDT-51 system isn't quite that ideal, but it comes close. It needs one interrupt input, one output pin, and a 2K-byte RAM chip to hold debugging code and data. A 40-pin DIP clip attaches directly to the 8031 IC, and there are no other connectors to the target board. Photo 1 shows the prototype DDT-51 development system board, and figure 1 shows a block diagram of the hardware.

The software that runs on the host IBM PC is called DEBUG31. DEBUG31 shows all the 8031's internal RAM and the main registers when the microcontroller is stopped, as illustrated in figure 2. You can load new values into the registers, set a breakpoint to trap the program, and single-step through the code. You use function keys on the host to control all these operations.

Like an ICE, the DDT-51 supplies the data, address, and control lines needed to simulate an 8031's operations, although at a much slower rate. When the connections are disabled, the 8031 will run as though the DIP clip wasn't there.

Under the Hood

As described last month, an 8031 doesn't have an internal program ROM, so it needs an external EPROM (usually a 2764). If you replace that EPROM with a pin-compatible 6264 8K-byte RAM, the DDT-51/PC link can load and change the

continued

8031's program. Once you've got the program loaded, the 8031 can execute it normally, just as though it were in EPROM.

The debug RAM is a key component of the DDT-51 system, but some 8031 systems may not need any RAM. Because the DIP clip connects to the 8031 bus control lines, it's easy enough to put the debug RAM on the DDT-51 board. I used a 2K-byte RAM simply because it is the smallest one that's readily available. An 8K-byte RAM would work just as well.

Unfortunately, the 8031 wasn't designed to share its bus control lines with other hardware. All the bus lines float when the RESET input is high (they use tristate drivers), but the program halts until RESET goes low again. The program restarts from address 0000 hexadecimal after a RESET, rather than continuing where it left off, which is exactly what a RESET should do. What's needed is a dual-ported RAM that can be accessed by either system independently, with separate control, data, and address lines. The two systems can then store and examine data in the common RAM without interaction.

Although the PC and the 8031 can both access the debug RAM, they can't do so simultaneously. To keep the hardware simple, there are no interlocks to prevent collisions (both systems attempting to access the RAM at the same time). If a collision does occur, one processor will always get bad data because the proper buffers are not active. The PC and 8031 programs must adhere to a software gentleman's agreement to prevent RAM conflicts. It turns out that this is not at all difficult to accomplish.

How do they do that? Once the 8031 program starts running, the DDT-51 can pull INT1 low to interrupt normal execution. A few debugging instructions added to the 8031 code handle the interrupt and examine a location in the debug RAM to determine what function was requested. The 8031 copies the results into the debug RAM and returns to normal operation, giving DEBUG31 (on the PC) free access to the RAM.

The gentleman's agreement is controlled by two wires: the IRQ line, triggering an 8031 interrupt, and the 8031 HALTED line, which is set while the interrupt handler is in control. Remember that the 8031 isn't halted after the interrupt, but is in the middle of the interrupt handler.

Figure 3a describes the physical connection between the PC and the target system; figure 3b shows the timing diagram that manages access to the debug RAM. DEBUG31 on the PC writes control information into the debug RAM and pulls the IRQ line low. The 8031 responds to the interrupt, examines the debug RAM, and executes whatever functions are needed. When it's done, it sets the HALTED line active and waits for DEBUG31 to restore the IRQ line to a high level. The 8031 then sets HALTED low, reloads the registers, and returns to normal operation in the interrupted program.

Figures 4a and 4b show the DDT-51 system circuit diagram. The DDT-51 system divides neatly into four sections: the PC parallel-port interface, bus buffers to control the various lines, the debug RAM, and an EPROM programmer.

The Port Swings Both Ways

The DDT-51 system trades hardware for software. The DDT-51's hardware pro-

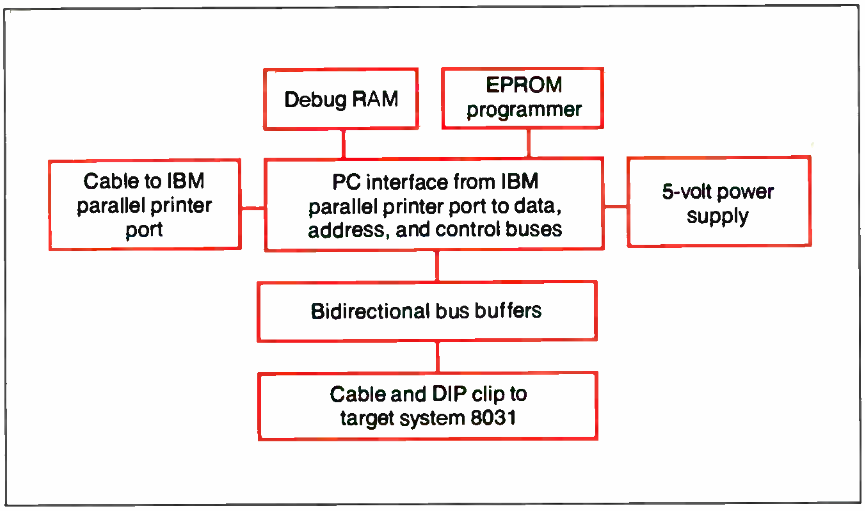


Figure 1: *A block diagram of the DDT-51 development system.*

```
HALTED at single step

Reading debug RAM, interrupt count is 2

A=ED    B=00    DPTR=0016    SP=07    PSW=00    (CY AC F0 0V P)    PC=0056 → LCALL 00DB
Reg Bank 0: EE ED ED ED ED ED ED ED    Reg Bank 1: 56 00 00 ED EE 00 16 00
Reg Bank 2: 3F 84 00 00 ED ED ED ED    Reg Bank 3: ED ED ED ED ED ED ED ED
Bit-addressable RAM:
20  ED ED ED ED ED ED ED ED ED ED ED ED ED ED ED ED
General RAM:
30  ED ED ED ED ED ED ED ED ED ED ED ED ED ED ED ED  ...........
40  ED ED ED ED ED ED ED ED ED ED ED ED ED ED ED ED  ...........
50  ED ED ED ED ED ED ED ED ED ED ED ED ED ED ED ED  ...........
60  ED ED ED ED ED ED ED ED ED ED ED ED ED ED ED ED  ...........
70  ED ED ED ED ED ED ED ED ED ED ED ED ED ED ED ED  ...........

Use F9 to step, F10 to run
```

Figure 2: *A sample display from the DEBUG31 program, shown here in single-step mode.*

vides only essential functions; the software handles most of the logic. DEBUG31 merely sets and reads bits in the DDT-51 hardware to find out what's going on in the target 8031. Sounds simple enough.

Because speed of interaction between the host PC and the DDT-51 is important, the DDT-51 connects to the PC via a bidirectional parallel port (using the serial port would greatly increase the hardware complexity of the DDT-51). Unfortunately, an irritating problem with the design of the PC is that its standard parallel printer port is output only.

All the hardware needed to read or write 8 bits of data is already in place, but it lacks a connection to enable that function. While you can buy a custom parallel I/O board, I think changing a single trace on the existing board might be worth it to some readers. Figure 5 shows the single cut and addition to convert a standard parallel printer port to bidirectional operation.

Of course, all the clone boards (even the IBM boards) seem to use different IC numbers and assign the bits to different pins on the ICs, so this modification can be a real mystery. If you are unwilling to chop up your printer port card, buy a $50 clone printer port card. They are usually bidirectional. Some clone cards also omit the input connection between the data bus and pin 14 of the LS174. I suppose they figure that because the output is unused, the input is irrelevant. It's easy to find the two unused pins, however (a modified port will still work correctly with all your other software, simply because the code doesn't know about the change and won't take advantage of it).

DEBUG31 examines each of the three possible printer ports, working down from LPT3, to find which one has the modification installed. This provides a convenient way to check your work. DEBUG31 will tell you which card it's using.

Creating Five Ports from One

The DDT-51 system needs more than one I/O port to control all its hardware. Rather than burden the PC with more ports, I used an 8255 parallel peripheral interface (PPI) chip and a pair of LS374s to get five more ports. DEBUG31 controls these ports using the four standard printer control lines.

IC9, the control register, holds bits that must be active all the time, like the 8031 RESET and IRQ lines. It also supplies the 8255's register addresses and several bits for the DDT-51's bus logic.

IC12, the system register, holds the 8031 system bus control bits. There are 4 unused bits in this register that can be used for additional functions. The outputs are disabled whenever the 8031 drives the DDT-51's address and data buses, so that there is no conflict.

IC8, the 8255 bus interface, drives the high byte of the external address bus through port B and writes and reads the external data bus using port A. Port C samples the 8031 HALTED line. Other port C bits monitor the outputs of the DDT-51 logic circuits when running diagnostics from the PC.

Every 8031 system has a latch that demultiplexes the low-order byte of the address from the combined address/data bus. You might think that, because the outputs of that latch don't connect to the 8031, the DDT-51 system would need another DIP clip to get access to that part of the address bus. Instead, it is simpler to duplicate the latch, using IC10.

The DDT-51's debug RAM presents a similar problem, since the RAM requires a chip select line and the target 8031 system may not have an address decoder. I added IC11 to provide chip selects on 8K-byte boundaries throughout the 64K-byte address space. The EPROM programming socket, which is empty in normal use, also gets a chip select line from this decoder.

Bus Buffering

Both the 8031 and the DDT-51 system have control lines to read and write the program RAM (normally on the 8031 board) and the debug RAM (on the DDT-51 board). There are more combinations of data, address, and control line directions than might seem possible at first, which is why the logic isn't as simple as you'd expect.

IC9 supplies two control lines, called

continued

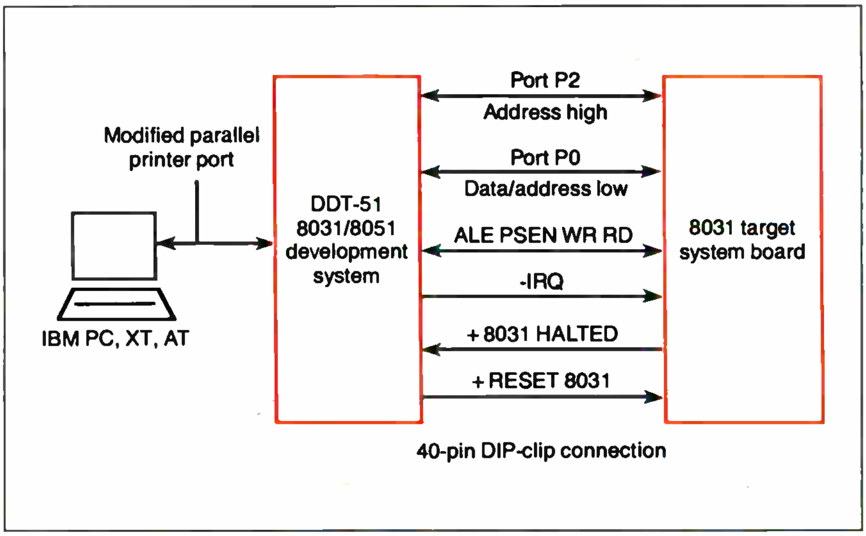


Figure 3a: *Physical connections between the DDT-51 and its host and target systems.*

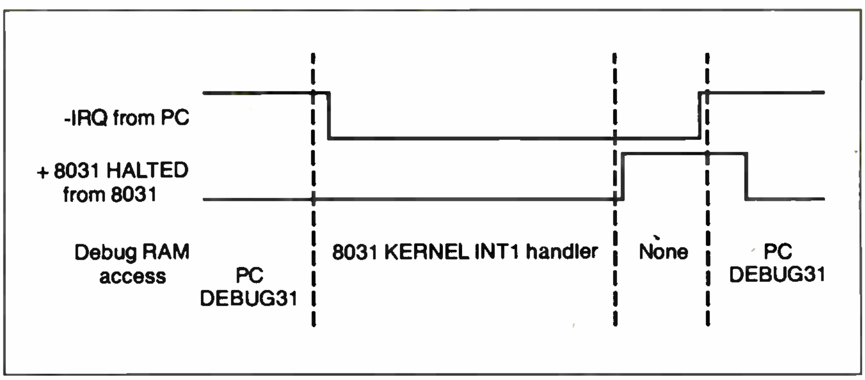


Figure 3b: *A timing diagram showing the system's "gentleman's agreement" for controlling access to the debug RAM.*

CTLS TO 8031 and CTLS FROM 8031, to select one of three states. The 8031 controls the DDT-51 logic when CTLS FROM 8031 is active, DDT-51 logic controls the 8031 system when CTLS TO 8031 is active, and the two systems are isolated from each other when both lines are inactive.

Setting the direction of the data and address lines isn't a simple task. For example, when the target 8031 system writes to the debug RAM, both the address and data come from the 8031. When it's reading from the debug RAM, the address comes and the data goes. A similar situation, in reverse, occurs when the DDT-51 reads the 8031's program RAM.

IC14 sets the DATA TO 8031 and DATA FROM 8031 lines by deciding which way the data must flow based on the current address, read or write activity, and signal source. This must be handled by hardware because it varies cycle by cycle as the 8031 runs its program.

When the two systems are isolated, the PC can access the debug RAM and the 8031 can access the program RAM without interacting. If either system tries to access the other while they're isolated, the data returned will be indefinite.

You've probably noticed that there's no hardware preventing both the CTLS TO 8031 and the CTLS FROM 8031 lines from being active at once. Further, as the schematic shows, this is definitely an illegal condition; it should never occur with properly operating PC code.

The reason for using an LS374 (IC10) to latch the address should now make sense. The bus buffers can't be activated until the control and address lines indicate in which direction the data should go. When the 8031 system supplies the ALE signal, the DDT-51 hardware accepts the 8031 data bus and tries to latch it in IC10. An LS373 is a *transparent* latch, meaning that the outputs track the inputs whenever the clock is high. When the 8031 lowers ALE, the bus buffers turn off and the data goes away before an LS373 can reliably latch it.

The LS374 is an *edge-triggered* latch, which means that the outputs change at the upward transition of the clock. Using ALE to clock the latches gives a sharp edge just before the data buffers turn off. This way, the LS374 records the inputs correctly.

Debug RAM

The debug RAM is simply a 6116 2K-byte static RAM chip, driven by the buffered address and data lines. Either sys-

continued

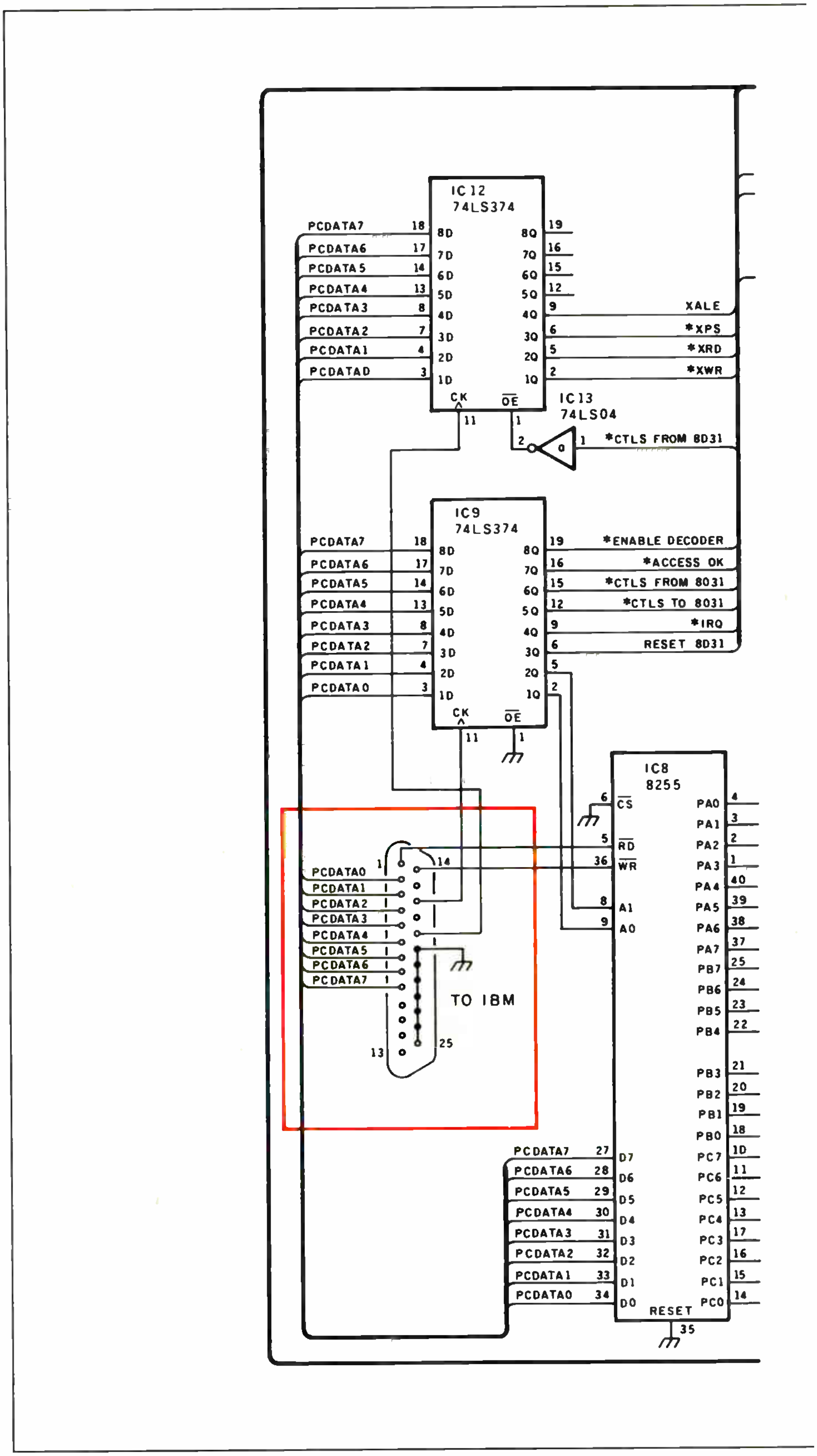
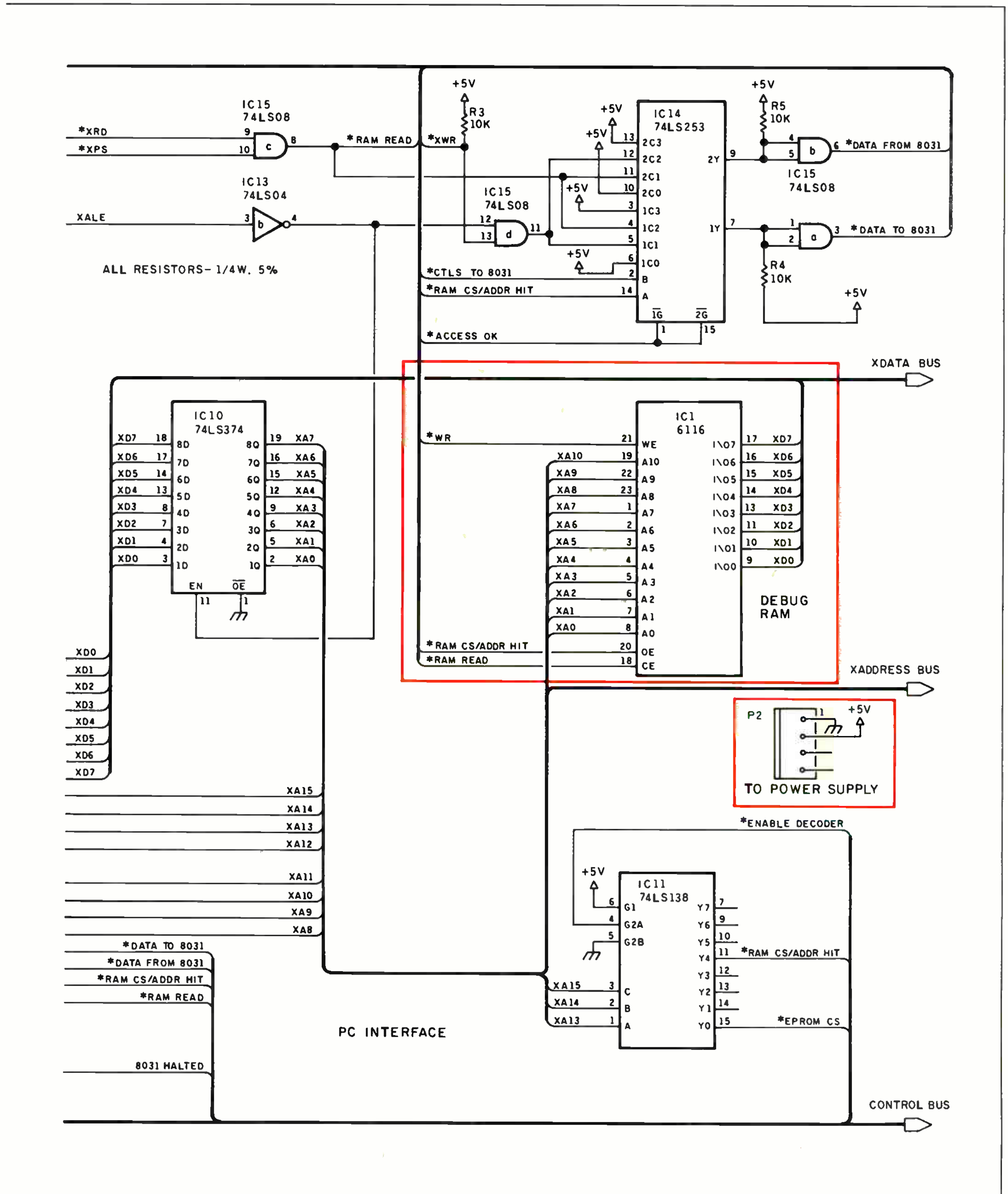


Figure 4a: *The DDT-51 schematic, showing the PC interface and the debug RAM.*


IC15
74LS08
*XRD
*XPS
*RAM READ
*XWR
R3
10K
+5V
IC14
74LS253
R5
10K
*DATA FROM 8031
IC13
74LS04
XALE
IC15
74LS08
*DATA TO 8031
ALL RESISTORS- 1/4W, 5%
*CTLS TO 8031
*RAM CS/ADDR HIT
R4
10K
*ACCESS OK
XDATA BUS
IC10
74LS374
IC1
6116
*WR
DEBUG
RAM
*RAM CS/ADDR HIT
*RAM READ
XADDRESS BUS
P2
TO POWER SUPPLY
*ENABLE DECODER
IC11
74LS138
*RAM CS/ADDR HIT
*EPROM CS
*DATA TO 8031
*DATA FROM 8031
*RAM CS/ADDR HIT
*RAM READ
PC INTERFACE
8031 HALTED
CONTROL BUS

tem can access it. DEBUG31 assumes that the debug RAM is located at 8000 hexadecimal.

EPROM Burning

Although the DDT-51 system is used to develop programs using RAM instead of EPROM, there (presumably) comes a time when you've finished the program and you're ready to ship it. At that point, you need an EPROM programmer. DDT-51 incorporates the world's least expensive 2764 EPROM programmer.

The programmer section of figure 4b shows all the hardware required to program a 2764 EPROM. The programming supply voltage comes from two 9-volt batteries hard-wired to add +18 V to the +5-V power supply. A simple emitter follower reduces this 23-V level to 21 V and provides enough current for the programming pulse. The 0.1-microfarad capacitors filter out noise glitches from the logic. You'll have no problem with battery life unless you start using this programmer for production quantities.

It turns out that programming a 2764 EPROM is much like writing to a rather slow RAM. First, you set up the address and data lines, select the chip, and pulse pin 27 low for 50 milliseconds. If pin 1 has +21.0 V on it while pin 27 is low, you've just programmed 1 byte of the EPROM. That's all there is to it.

DEBUG31 can already write data to any 8031 address, so programming an EPROM simply requires an "EPROM burn" software flag to lengthen the write pulse to 50 ms. A manual switch applies 21.0 V to the zero-insertion-force (ZIF) socket.

This system handles code that fits into a single 2764 EPROM. A DIP switch on the DDT-51 system board sets the chip-select address range so you can burn EPROMs at different addresses. And 8K bytes of EPROM holds a lot of 8031 code, particularly for smaller projects. Unlike the Circuit Cellar serial EPROM programmer (see the October 1986 Circuit Cellar), however, there are no circuits to prevent damage occurring when you insert or remove an EPROM from a "live" socket. Make sure you turn the DDT-51 system's power off and disconnect the DIP clip from the 8031 before inserting or removing the EPROM.

Of course, 2764s allow faster "intelligent" programming methods, but I haven't implemented them (I thought an EPROM programmer that required zero additional chips was pretty good). As a result, the DDT-51 system is both the world's least expensive and slowest

continued

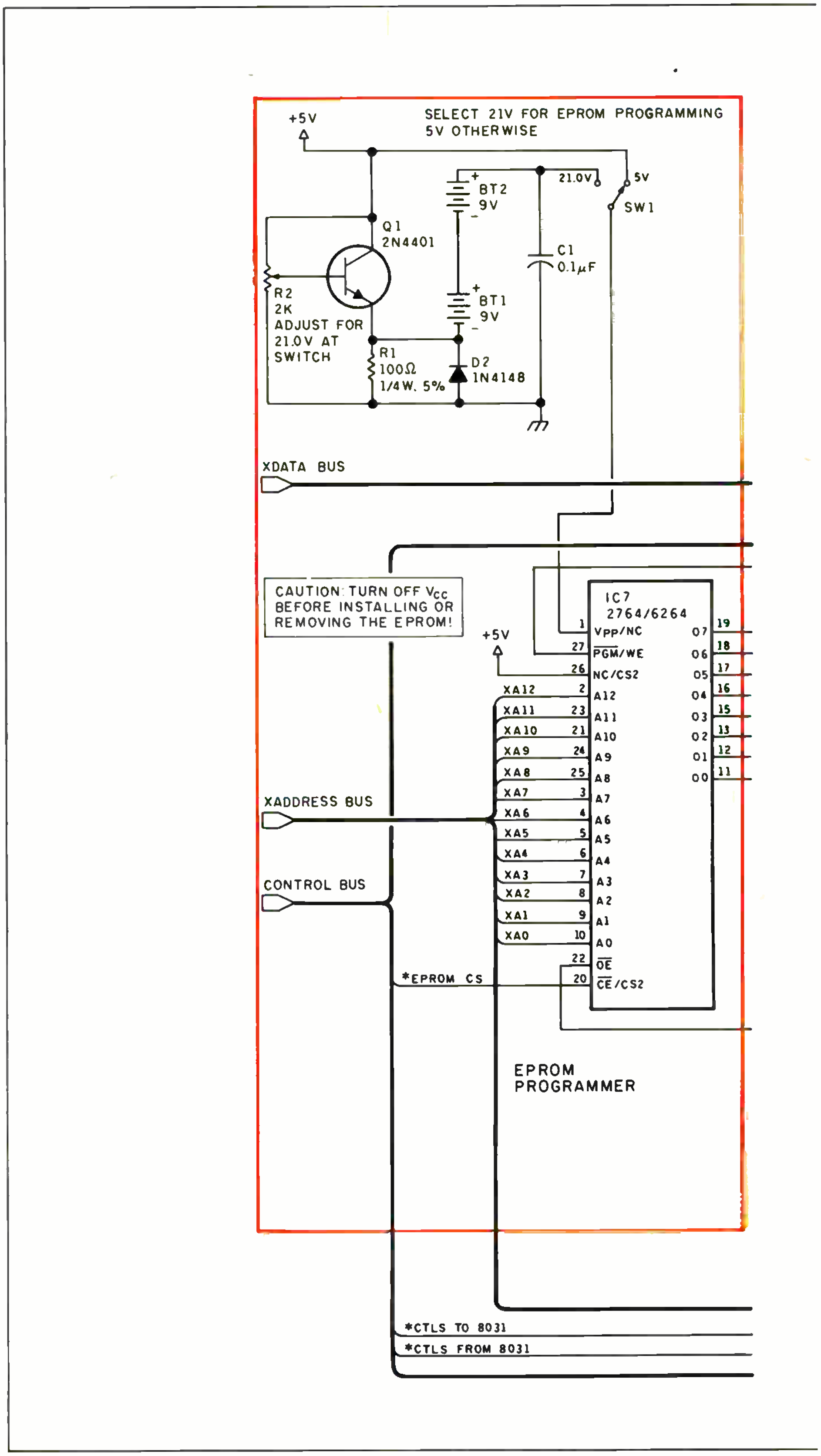
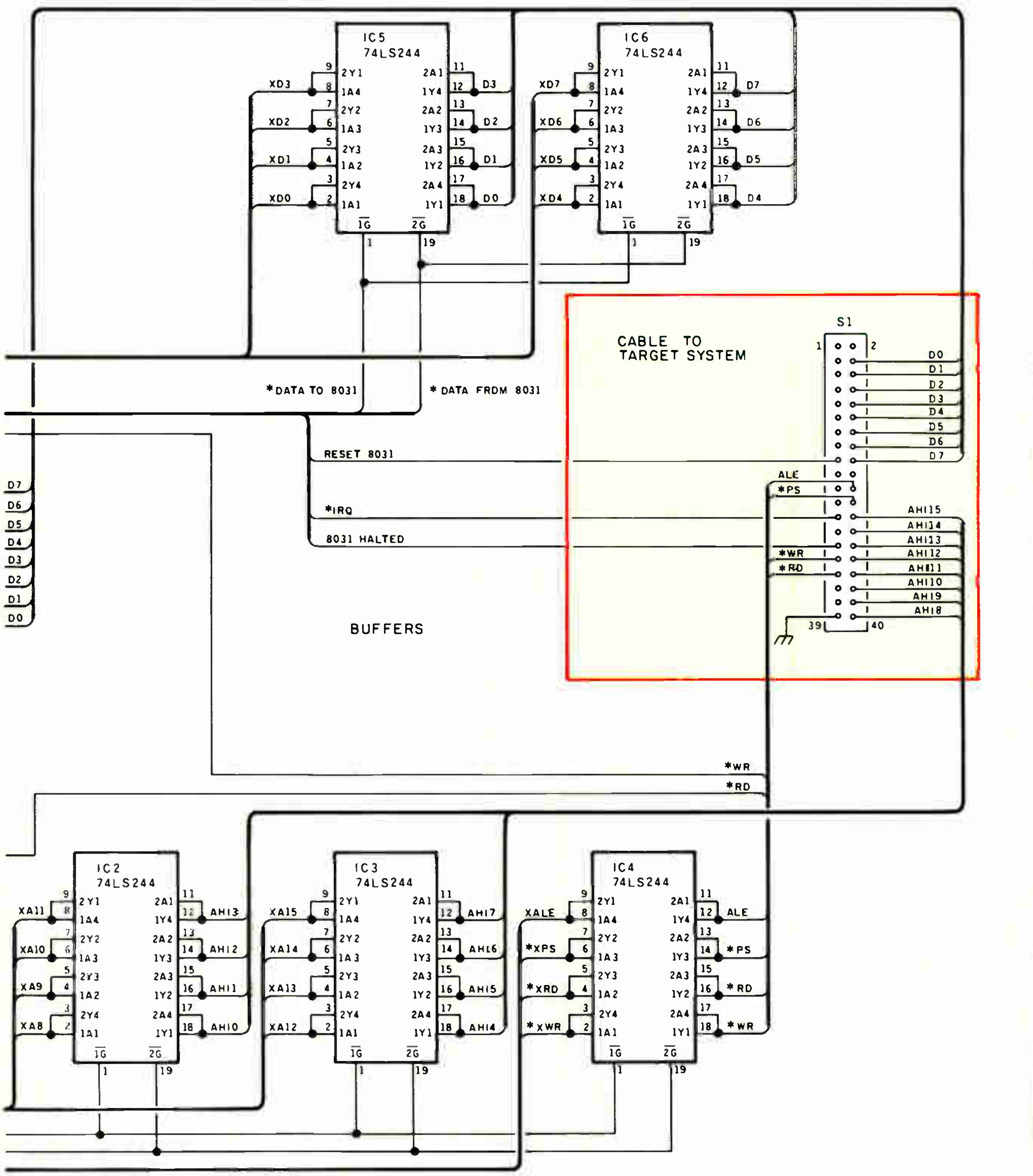


Figure 4b: *The EPROM programmer subsystem and bidirectional bus buffers.*


IC5
74LS244
IC6
74LS244
XD3
XD2
XD1
XD0
XD7
XD6
XD5
XD4
D3
D2
D1
D0
D7
D6
D5
D4
*DATA TO 8031
* DATA FROM 8031
RESET 8031
*IRQ
8031 HALTED
CABLE TO
TARGET SYSTEM
S1
ALE
*PS
*WR
*RD
AH15
AH14
AH13
AH12
AH11
AH10
AH9
AH8
BUFFERS
IC2
74LS244
IC3
74LS244
IC4
74LS244
XA11
XA10
XA9
XA8
XA15
XA14
XA13
XA12
XALE
*XPS
*XRD
*XWR
AH13
AH12
AH11
AH10
AH17
AH16
AH15
AH14

EPROM programmer. If you start writing long programs, you may want to step up to my serial EPROM programmer.

DEBUG31 Essentials

You might think that DEBUG31 on the PC is written in assembly language to handle all the bit manipulation needed to control the hardware. It turns out that it's all done in Turbo Pascal, which is a whole lot easier to read and understand. All the tricky stuff is handled by a few low-level routines.

At the highest level, DEBUG31.PAS is a simple loop that waits for function keys to be pressed. Each function key triggers a separate procedure to handle whatever is requested. Listing 1 shows the entire main loop, which is easy enough to understand.

Listing 2 shows a procedure called by the main loop (and elsewhere, too). SysReset activates the RESET 8031 line from IC9 and sets up DDT-51 hardware so that the PC has access to the 8031 through the bus buffers. When the RESET line is active, the 8031 has stopped operating and floated all its bus and control lines, so the PC can read or write any hardware on the shared data bus.

SysReset calls SetCR (set the control register IC9), SetSR (set the system register IC12), and Load8255 (interface to the 8255), which are some of the lowest-level routines in the system. Each controls a single IC connected to the printer-port data lines. The routine handles all the operations required by other code and provides a convenient set of mnemonics that are easier to remember than the actual bit locations and values.

The 8031 Kernel

The DDT-51 system depends on a small kernel of 8031 code to handle interrupts and perform functions on behalf of the PC program. This code runs only during INT1 interrupts and must adhere closely to the gentleman's agreement interface to avoid hardware collisions.

Unlike DEBUG31.PAS, KERNEL.ASM must be written in 8031 assembly language and incorporated into any 8031 program that uses the debugging features of DEBUG31, but most of it is located in the 2K-byte debug RAM located on the DDT-51 board. The normal program memory must hold only about two dozen bytes of KERNEL's code, and you can move most of that chunk to any convenient location.

Because the 8031 registers and internal RAM are not directly accessible through the DDT-51 interface, KERNEL must copy those values into the debug RAM before DEBUG31 can see them. Once they've been copied, the PC can read, display, and change them as

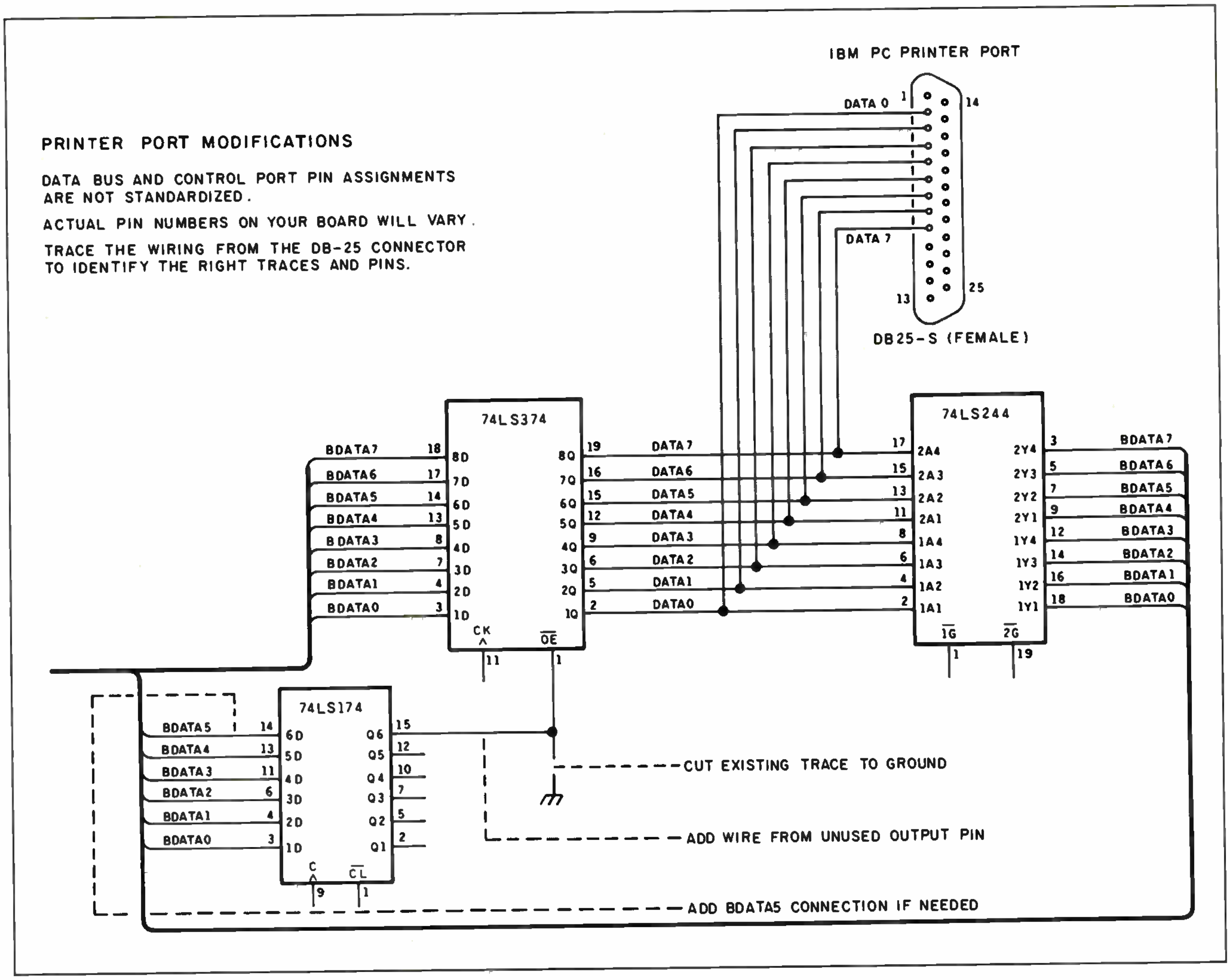


Figure 5: *How to make an IBM PC's unidirectional parallel printer port bidirectional.*

needed. KERNEL then copies the new values back into the internal locations and returns to the interrupted code.

The software handles breakpoints in a similar manner. DEBUG31 stores the breakpoint address in debug RAM and triggers an interrupt. KERNEL decodes the operation and writes an LJMP instruction at the specified address. The KERNEL breakpoint handler gets control when the 8031 executes the LJMP and copies the internal values into debug RAM.

At the heart of the interrupt-handler routine, the first order of business, as with any interrupt code, is to save all the CPU registers. Later on, these saved values will be copied into debug RAM so that DEBUG31 can reconstruct the actual state of the machine when the interrupt occurred.

If a breakpoint was active, the UndoBP routine removes the LJMP and restores the program RAM so that the next instruction is ready to go. Because an LJMP requires 3 bytes, it may have overwritten one or two instructions following the breakpoint. Regrettably, the 8031 does not have a single-byte software interrupt instruction like the 8088's special INT 3 breakpoint.

The DumpRAM routine copies the internal RAM values into debug RAM as described before, as well as extracting the registers saved on the stack. Remember that the internal RAM reflects the current registers rather than the ones used by the main program. Some internal RAM locations can't be read without introducing side effects: Reading the serial buffer will reset a pending interrupt, which would cause a malfunction in the main code.

Both KERNEL and DEBUG31 increment separate IRQ counters; KERNEL's counter is stored in debug RAM. If DEBUG31's counter differs from KERNEL's version, at least one IRQ got lost, which probably means that the 8031 program is out of control.

Because most of KERNEL is in the debug RAM, DEBUG31 can't read that RAM while the 8031 executes from it. The StepSpin routine is located in 8031 program RAM, which frees up the debug RAM for the PC. The StepSpin code sets 8031 HALTED to indicate that the debug RAM is available, then waits for the PC to raise INT1 when it's done changing the RAM. At that point, it's safe to begin executing from debug RAM again, so the code returns to SpinRet to continue.

The code following SpinRet reads the

continued

Listing 1: *The* DEBUG31.PAS *main loop.*

```
(*** setup code omitted here ***)

 REPEAT
  { Get next key }
  GetKey(key1,key2);
  { Is it an extended key? }
  IF key1 = Chr(ESC)
   THEN BEGIN
    { Which function key? }
    CASE Ord(key2) OF
     59 : ShowHelp;
     60 : SysReset;
     61 : LoadKernel;
     62 : Download;
     63 : SetBurn;
     64 : Writeln('F6 not used');
     65 : SetRegs;
     66 : SetBP;
     67 : SysStep;
     68 : BEGIN
           { Normal, no IRQ }
           SysRun(running,FALSE);
           Writeln('Use F9 to stop/step');
          END;
    ELSE;
   END;
  END;

UNTIL (key1 = Chr(ESC)) AND (key2 = Chr(0));

(*** some cleanup code omitted ***)
```

Listing 2: *The system reset procedure.*

```
{ Force reset and take control of bus }

PROCEDURE SysReset;

BEGIN

 { Ensure a reset }
 SetCR(Reset8031,ON);

 { Get control of bus }
 SetCR(IRQ,OFF);
 SetCR(CtlTo8031,ON);
 SetCR(CtlFrom8031,OFF);
 SetCR(AccessOK,ON);
 SetCR(EnableDec,ON);

 { Set up controls }
 SetSR(XRD,OFF);
 SetSR(XPSEN,OFF);
 SetSR(XALE,OFF);
 SetSR(XWR,OFF);

 { Our data and address }
 Load8255(I55Ctls,I55AoBoCi);

 { Reset IRQ counter }
 IRQctr := 0;
 PutRAMbyte(IRQctrB,$00);

 Writeln('8031 hardware is reset');

 { Indicate reset }
 state := reset;

END;
```

new run-mode byte from debug RAM and handles the request. This code also installs the new breakpoint LJMP instruction.

Finally, the StuffRAM routine copies the (possibly changed) values from debug RAM back into internal RAM. It inserts the new values for the registers into the right stack locations, so that the main program's registers can be altered by the PC. It does not restore registers with side effects (e.g., the serial transmitter buffer) for the same reason that DumpRAM didn't read from them.

After the registers are restored, the 8031 executes a RETI (return from interrupt) and the interrupted main code resumes execution, perhaps with new register values. (The complete listings for DEBUG31.PAS and KERNEL.ASM are available for downloading from the Circuit Cellar bulletin board system.)

A Middle Ground

Does working on the DDT-51 development system convert me into a software jockey? Certainly not. To maintain a high level of performance in Circuit Cellar designs at a time when the rest of the industry is moving to application-specific ICs (ASICs) and other development-intensive reduced-component custom designs, I have chosen a middle ground of using programmable microcontroller chips.

In the same way that a large board of IC logic chips is reduced functionally to an ASIC, I have lumped the controlling elements of the TTL circuit I usually use into a configurable application-specific controller that can simulate these functions. Using simple three- or four-chip microcontrollers as standard computer engines in my projects, I am now better able to concentrate on presenting applications of technology rather than providing redundant explanations of low-level logic.

The DDT-51 development tool will hopefully help other BYTE readers consider the benefits of this middle ground.

The DDT-51 development system won't handle all possible 8051 target systems, but it will give you a good start. With that in hand, we can continue with other interesting Circuit Cellar project designs.

Experimenters

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Next Month

I'll present a real-world example of multiprocessing. ■

Special thanks for the technical contributions provided for this article by Jeff Bachiochi and Ed Nisley.

Editor's Note: Steve often refers to previous Circuit Cellar articles. Most of these past articles are available in book form from BYTE Books, McGraw-Hill Book Co., P.O. Box 400, Hightstown, NJ 08250.

Ciarcia's Circuit Cellar, Volume I covers articles in BYTE from September 1977 through November 1978. *Volume II* covers December 1978 through June 1980. *Volume III* covers July 1980 through December 1981. *Volume IV* covers January 1982 through June 1983. *Volume V* covers July 1983 through December 1984. *Volume VI* covers January 1985 through June 1986.

Circuit Cellar Ink

It's virtually impossible to provide all the pertinent details of a project or cover all the designs I'd like to in the pages of BYTE. For that reason, I have started a bimonthly supplemental publication called Circuit Cellar Ink, which presents additional information on projects published in BYTE, new projects, and supplemental applications-oriented materials. For a one-year subscription (6 issues), send $14.95 to Circuit Cellar Ink, 12 Depot Square, Peterborough, NH 03458. Credit card orders can call (203) 875-2199.

There is a multiline Circuit Cellar bulletin board system (running TBBS 2.0M) that supports past and present projects in BYTE and Ink. You are invited to call and exchange ideas and comments with other Circuit Cellar supporters. The 300-/1200-/2400-bps BBS is on-line 24 hours a day at (203) 871-1988.

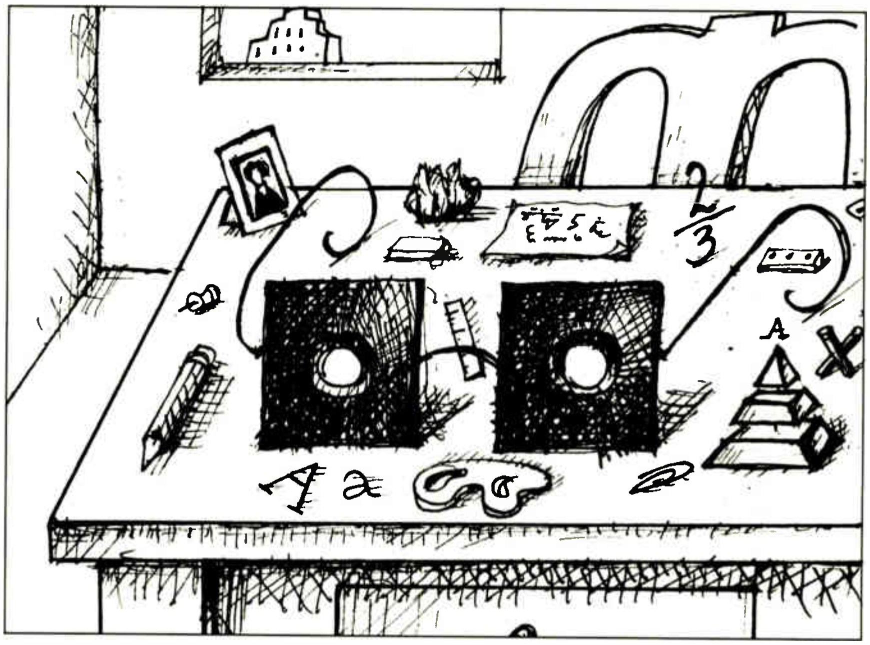
To receive information about the Circuit Cellar Ink publication for hardware designers and developers, please circle 100 on the Reader Service inquiry card at the back of the magazine.

Steve Ciarcia (pronounced "see-ARE-see-ah") is an electronics engineer and computer consultant with experience in process control, digital design, nuclear instrumentation, and product development. The author of several books on electronics, he can be reached on BIX as "sciarcia."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH 03458.

FLOATING-POINT WITHOUT A COPROCESSOR

A high-precision floating-point-emulation library for your PC



Most of the applications for floating-point calculations are obvious: scientific analysis, engineering design, financial calculations. Others, like graphics and desktop publishing (calculations involving reduction and enlargement), are less obvious. Interest in increasing floating-point throughput has grown; this is most apparent in the attention being paid to higher-performance math coprocessors—witness the inclusion of sockets for *both* the Weitek and the Intel coprocessors on many of the new 80386 machines.

For some situations, a coprocessor is the best answer for hurrying the throughput of floating-point calculations. But for many others, a coprocessor is either not cost-effective (although the prices are coming down—I'm waiting until I can get an 8087 for $50) or simply unavailable (as is the case with many laptop computers). Software designers of products dependent on floating-point operations cannot assume all targets for their products will have a floating-point coprocessor available. (Apple provides its floating-point support as part of the Standard Apple Numeric Environment [SANE], which is incorporated into the Macintosh's System file.)

I decided on this month's topic partly in response to a comment I heard at a recent seminar: A participant was designing an application and complained that he wanted to include floating-point support but could not find any real working examples. I also believe that it's instructive to investigate the inner workings of a system you take for granted. Who knows? You might improve things and design the next IEEE standard for floating-point numbers.

The package I designed performs the four basic operations: add, subtract, multiply, and divide. I'll describe these this month. I've also incorporated some basic I/O routines, which will appear next month.

The system is written in 8088 assembly language, and to test it, I provided some simple interface routines with BYTE Small-C. You should be able to modify this interface to hook into your favorite compiler. (You'll find pseudocode listings of the main routines here. The 8088 source code for the package, FLOATPAK.TXT, is available in a variety of formats. See page 3 for details.)

First, let's take a look at the format of floating-point numbers.

Know the Beast

It's important to be clear about the format of floating-point representation. Lord knows it's tough enough to be clear about base-10 floating-point numbers; base-2 floating-point is even worse.

Scientific notation provides a compact means of representing numbers when there is the possibility of wide swings in value. Simply put, even though you don't have room for lots of digits, you can still write very big *and* very small numbers. Instead of writing 1,000,000, you can write 1.0E+6; and instead of writing −.00000032, you can write −3.2E−7.

It's a mathematical shorthand. The expression −3.2E−7 means -3.2×10^{-7}. For a little terminology: −3.2 is referred to as the mantissa, and −7 is the exponent. How can we get this representation into our binary computer? Use the same idea, only make everything base 2.

Figure 1 shows the format my floating-point math package uses. FAC1_EXP stores the exponent, and FAC1_MAN holds the mantissa. Since this is all in base 2, you can express a floating-point number in scientific notation format as follows:

continued

ILLUSTRATION: MACIEK ALBRECHT © 1988

<FAC1_MAN> $\times 2^{<FAC1\_EXP>}$.

FAC1_MAN is a binary number with both integer and fractional parts. Just as the decimal mantissas above use a decimal point to separate their integer and fractional portions, binary floating-point numbers use a *binary point* to separate integer and fractional portions. Of course, this binary point is an imaginary entity; it has no real existence inside the computer—we just assume its location.

As usual, things are never really quite as simple as they appear at first glance. What I've described is a fairly accurate description of the representation—but with a couple of minor exceptions.

Minor exception number one is that FAC1_EXP is a *biased* exponent. This simply means that the value stored in FAC1_EXP is the true exponent value plus a bias. Adding a bias allows the package to represent positive and negative exponents. For example, in my package, the bias is 16384. An exponent of 0 would be represented as 16384; +12 would be 16396; and −5 would be 16379. Thus, the exponent has a range of 2^{+16383} to 2^{-16383}—something like 10^{4931} and 10^{-4931}. As a means of rapidly identifying true zero, the package recognizes FAC1_EXP equal to zero as signaling the special case that the entire number is zero. (The number 16384 isn't something I pulled out of the air. Since FAC1_EXP is 16 bits, a bias of 16384 gives us a 15-bit exponent with the high bit left over to detect exponent overflow.)

Minor exception number two revolves around the fact that the internal representation of a floating-point number (i.e., how the package sees the number when an operation is being executed) is different from that number's external representation (i.e., how calling routines see the number). Specifically, the internal representation of the number sports an additional word's worth of precision. You'll see how this—and other trickery—becomes important when I get to the floating-point output routine.

You can think of FAC1 as a *floating-point accumulator*—a floating-point register, if you will—internal to math package uses. There are actually two accumulators: FAC1 and FAC2. Each holds one of the two arguments involved in the math operation, and when the addition, subtraction, multiplication, or division is finished, FAC1 holds the result. A third storage location, FAC3_MAN, saves temporary values during the multiplication and division routines.

Now that we've gone over the blueprints, it's time to get to the construction work. As I stated earlier, we begin at the foundation.

Addition

Before you can add two floating-point numbers, you have to do something anyone who has ever added fractional numbers is familiar with: align the decimal points. Only now you're aligning the base-2 equivalent of the decimal point, and in our representation of floating-point numbers, this translates to *matching up the exponents.*

You do this by determining which number has the largest exponent and moving that number into FAC1. The other number goes into FAC2. Then you simply subtract FAC2's exponent from FAC1 and examine the result to determine how many bits to shift FAC2 to line up its binary point with FAC1.

Note that since you've guaranteed that the number in FAC2 has a smaller absolute value than FAC1, the shift will be to the right. Why? What you're doing is matching the exponents of the two numbers, and you accomplish this by adding an amount—call it *y*—to FAC2_EXP. This has the effect of multiplying the entire number by 2*y* (just as adding to the exponent of a base-10 floating-point number has the effect of multiplying by 10), so we have to offset that by shifting FAC2's mantissa to the right. (Remember that shifting a binary number right 1 bit divides that number by 2.)

If you have to shift FAC2 more than 78 bits, you can exit the routine immediately; FAC1 is so much larger than FAC2 that the addition will have no effect on the result.

Next, you examine the signs of the two numbers. If they differ, negate the mantissa of FAC2 (since you're *really* performing a subtraction). You can then go about the business of the actual addition, which looks for all intents and purposes just like addition of 80-bit integers. See listing 1 for the addition pseudocode.

If bit 79 (the highest bit) has been set as a result of the addition, then an overflow must have occurred. This can happen only if FAC1 and FAC2 had the same sign, and if that's the case you don't have to modify FAC1.

However, a subtraction may have taken place (if FAC1 and FAC2 had different signs); in this case, a 1 in bit 79 indicates that the result is a negative number in two's complement form (and that the absolute value of FAC2_MAN was greater than FAC1_MAN). You can determine this by reexamining the FAC1_SIGN and FAC2_SIGN. If they differ, you know the sign of the result is the sign of FAC2, so move FAC2_SIGN to FAC1_SIGN and negate the mantissa of FAC1 to make it positive again.

The last step is to normalize the contents of FAC1, so let's go ahead and talk about normalization. What is it, and why is it important?

Make It Normal

It would be a waste of space to write a floating-point number as 0.00003E−4; it's better to instead write it as 3.0E−9. Likewise, you wouldn't want to write 1,200,000.0E+6; use 1.2E+12 instead.

continued

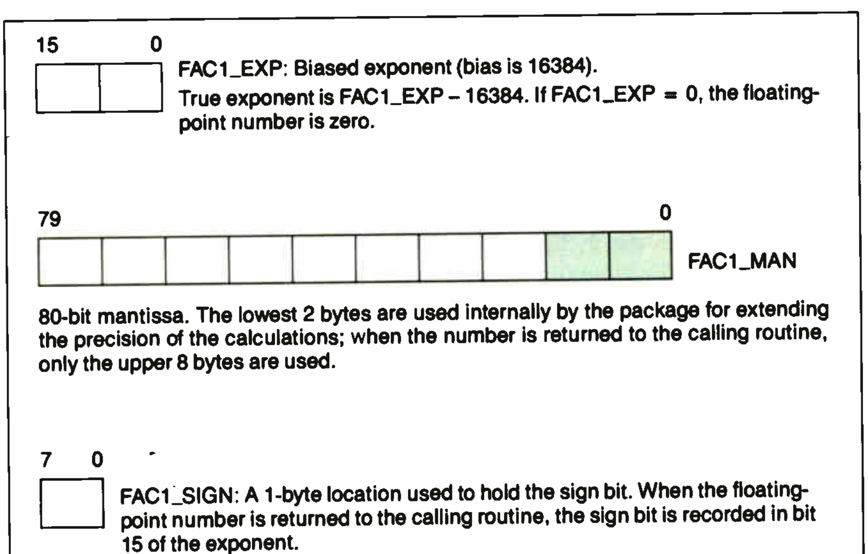


Figure 1: *Floating-point representation. Note that the internal format adds an additional word of precision.*

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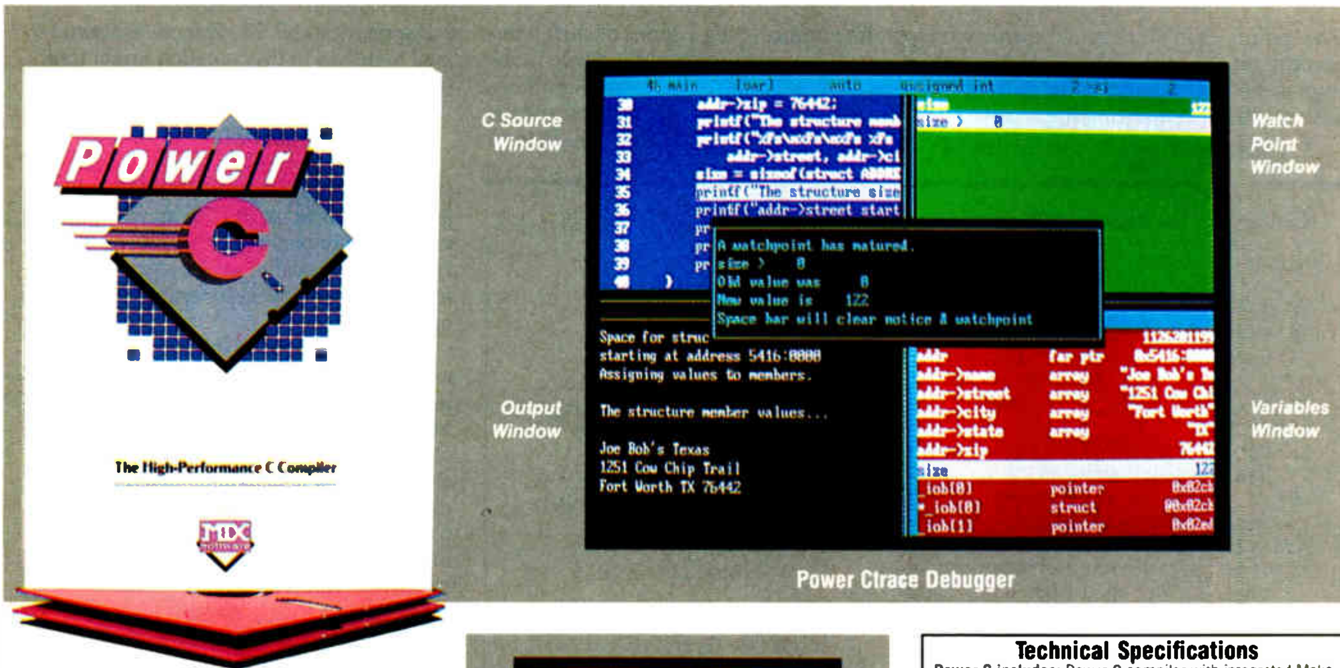

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The point: Don't consume space with zeroes; get the most significant nonzero digit near the decimal point. This process is called *normalizing* the number.

You can normalize a binary floating-point number using a series of shift operations, as shown in listing 2. Since in the base-2 system the only nonzero digit is a 1, normalization amounts to shifting the contents of the mantissa left or right until a 1 appears in bit 78. Hence, a normalized mantissa in this notation might look (in base 2) like the following:

0.1001001110010 11

(I've shown only the top 16 bits.) Notice that the topmost bit (bit 79) stays zero. Its job is to play bucket and catch any overflow bit that occurs as the package performs floating-point operations on the number.

Of course, shifting the mantissa left or right is the same as multiplying or dividing (respectively) by 2. So that the value of the floating-point number doesn't change, you must offset the effects of the shift operation by incrementing or decrementing the exponent. The rule is simple: If you shift left (a multiply), offset that by decrementing the exponent; if you shift right (a divide), offset that by incrementing the exponent.

Finally, the normalization routine has to check for exponent overflow and underflow. This will happen if, during the shifting process I just mentioned, the routine increments the exponent above the maximum allowed (overflow) or decrements it to zero (underflow). The normalization routine shown in listing 2 returns an error code if the exponent overflows or underflows. It's up to the calling routine to decide how to handle the situation.

All four of the floating-point routines exit through the normalization routine.

Listing 1: *Floating-point addition.*

```
Add FAC2 to FAC1:

FPADD:
IF FAC1_EXP < FAC2_EXP THEN
   exchange FAC1 and FAC2;
Bits_to_shift = FAC1_EXP-FAC2_EXP;
IF Bits_to_shift > 78 THEN
   RETURN;
IF FAC1_SIGN <> FAC2_SIGN THEN
   Negate FAC1_MAN;
REPEAT Bits_to_shift TIMES
   Shift FAC2_MAN right;
Add FAC2_MAN to FAC1_MAN;
IF (FAC1_SIGN<>FAC2_SIGN) AND
   (Bit 63 of FAC1_MAN = 1) THEN
      BEGIN
      Negate FAC1_MAN;
      FAC1_SIGN=FAC2_SIGN;
      END
GOTO NORM_FAC1;
```

Listing 2: *Normalizing floating-point numbers. The four primary routines exit through this code.*

```
Normalize The Number In FAC1:

NORM_FAC1:
IF FAC1_MAN=0 THEN
   FAC1_SIGN=0;
   FAC1_EXP=0;
   RETURN;
IF bit 79 of FAC1_MAN=1 THEN
   BEGIN
   Shift FAC1_MAN right 1 bit;
   FAC1_EXP=FAC1_EXP+1;
   END
WHILE bit 78 of FAC1_MAN=0
   BEGIN
   Shift FAC1_MAN left 1 bit;
   FAC1_EXP=FAC1_EXP-1;
   END
IF bit 15 of FAC1_EXP=1 THEN
   RETURN Exponent_overflow_error;
IF FAC1_EXP=0 THEN
   RETURN Exponent_underflow_error;
RETURN;
```

Listing 3: *Floating-point subtraction, based on the fact that $x-y = x+(-y)$.*

```
Subtract FAC2 from FAC1:

FPSUB:
FAC2_SIGN = FAC2_SIGN XOR 128;
GOTO FPADD;
```

Subtraction

This is tough. You invert FAC2's sign (FAC2_SIGN) and do a floating-point add (see listing 3). Next!

Multiplication

Multiplication is simpler than you probably think. If you can multiply decimal numbers, binary multiplication is a snap. Furthermore, multiplying numbers in scientific notation is not much harder. Just keep two simple rules in mind: 1) Add exponents and 2) multiply mantissas. Adding the exponents is the easy part—it's just a matter of adding two 16-bit numbers. But multiplying the mantissas—that's what we really came here for.

Think of how you learned multiplication in grade school—writing one number above the other, then proceeding across the lower number, multiplying one digit at a time, generating partial products, and adding. It's the same thing here.

Take a look at figure 2a, where two binary numbers are being multiplied. Proceeding from right to left on the lower number (the multiplier), if the digit is a 1, then write the upper number (the multiplicand) under the bar. If the digit is a 0, then write 0 under the bar. (These numbers under the bars are the partial products.) Keep going until you run out of bits in the multiplier. The rightmost digit of each partial product lines up with its generating digit in the multiplier. The result is the sum of the partial products.

You'll notice that the result can have up to twice the number of bits in the multiplier (or multiplicand, whichever has more bits). So when you go to multiply two 80-bit mantissas, the result can be up to 160 bits, the top 80 of which are all that you're really interested in. To multiply binary fractional numbers (the mantissas) so that the lower unwanted bits fall off the right end, see figure 2b.

The process is similar to the one in figure 2a, with the addition of an accumulated value. You scan the digits of the multiplier from right to left. If the digit is a 1, add the multiplicand to the accumulated value; if the digit is a 0, add a 0 to the accumulated value. Then—and this is the trick—shift the accumulated value to the right prior to the next addition. The result is the same, only we've slid the least-significant bits off to the right.

That pretty much covers the technique used by the floating-point multiplication routine (the pseudocode is shown in listing 4), except for a couple of points: First, since the routine adds *biased* exponents, it has to subtract the bias from the result (otherwise the result would be doubly biased). Second, the multiplication operation actually shifts FAC3 (which holds the accumulated value, as shown in

continued

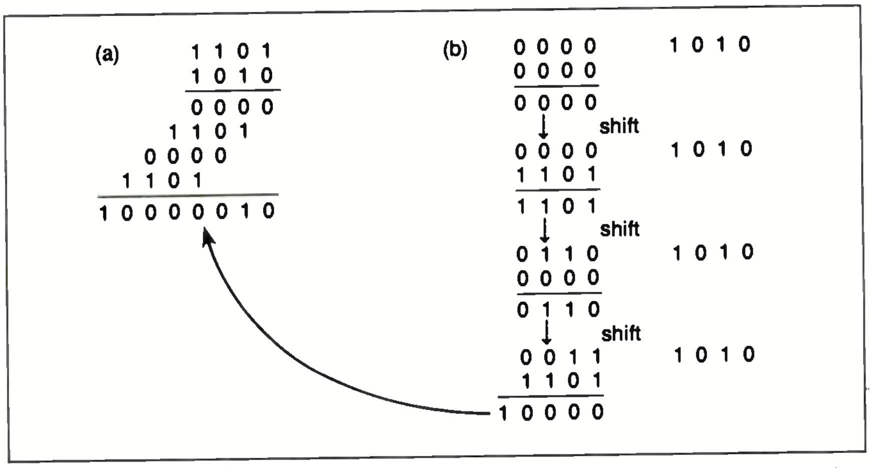

Figure 2: **(a)** *Multiplying binary integers. This should remind you of the longhand multiplication you learned on the chalkboard.* **(b)** *Multiplying binary fractions. Notice that the result is the same as in* **(a)**, *but we've shifted least-significant bits off to the right.*

Listing 4: *Floating-point multiplication.*

```
Multiply FAC1 by FAC2

FPMULT:
FAC1_SIGN = FAC1_SIGN XOR FAC2_SIGN;
FAC1_EXP = FAC1_EXP + FAC2_EXP -
        (BIAS+1);
Clear FAC3_MAN;
REPEAT 79 TIMES
  BEGIN
  Shift FAC3_MAN right;
  Shift FAC1_MAN right;
  IF carry=1 THEN
     FAC3_MAN = FAC3_MAN +
             FAC2_MAN;
  END
FAC1_MAN = FAC3_MAN;
GOTO NORM_FAC1;
```

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Listing 5: *Floating-point division.*

```
Divide FAC1 by FAC2:

FPDIV:
IF FAC2_EXP = 0 THEN
   RETURN Division_by_zero_error;
FAC1_SIGN = FAC1_SIGN XOR FAC2_SIGN;
FAC1_EXP = FAC1_EXP - FAC2_EXP + BIAS;
Clear FAC3_MAN;
FAC1_MAN = FAC1_MAN - FAC2_MAN;
REPEAT 80 TIMES
  BEGIN
   Shift FAC3_MAN left;
   Shift FAC1_MAN left;
   IF carry=1 THEN
      FAC1_MAN = FAC1_MAN +
                 FAC2_MAN;
   ELSE
      FAC1_MAN = FAC1_MAN -
                 FAC2_MAN;
      Set bit 0 of FAC3_MAN = 1;
   END IF;
  END
FAC1_MAN = FAC3_MAN;
GOTO NORM_FAC1;
```

figure 2b) to the right *before* each addition, so the result of the multiplication is FAC1 × FAC2 × 2. This reduces accuracy loss that can arise from the fact that the routine multiplies binary fractions. This loss of precision is analogous to multiplying .2 and .4, yielding .08 and wasting a digit position on the 0. The routine accounts for the additional multiplication by 2 by subtracting 1 from the exponent of the result (I sneaked this into the part where the routine subtracts the bias from the resulting exponent).

Division

This will sound ridiculously obvious, but floating-point division is a lot like the reverse of floating-point multiplication. Instead of adding exponents, you subtract them. With binary floating-point numbers in particular, instead of a series of shift-right-and-add operations applied to the mantissas, the algorithm consists of shift-left-and-subtract operations.

Again, let's concentrate on the division of binary fractions (the mantissas). The procedure is similar to integer division (a topic I won't go into in great detail, since there are many introductory texts on the subject). At the core of the routine is a loop that compares the divisor (FAC2) to the dividend (FAC1) to determine if the divisor can "go into" the dividend. If so, the routine subtracts the divisor from the dividend (creating a partial remainder), sets the 0th bit in the quotient (FAC3), and shifts everything to the left for the next operation.

You'll notice that the routine doubles up the subtraction and comparison operations: If subtracting the divisor from the dividend generates a borrow (indicating a negative result), the routine reverses the effect of the subtraction by adding the divisor back into the dividend (this is what happens when the divisor won't go into the dividend). This shift-and-subtract process (with an occasional add) is repeated for each bit of the mantissa.

Of course, the complete floating-point division routine must first check for division by zero. This is easy: Since the routines define an exponent of zero as an indicator of true zero, the FPDIV routine simply tests FAC2_EXP. If FPDIV finds that FAC2_EXP is equal to zero, the routine exits with an error condition (see listing 5).

Getting It In and Out

Next month, I'll wrap up the floating-point library with a description of the routines for loading and storing the floating-point accumulators, I/O, and some suggestions for extending the package. ■

Rick Grehan is a BYTE senior technical editor at large. He has a BS in physics and applied mathematics and an MS in computer science/mathematics from Memphis State University. He can be reached on BIX as "rick_g."

Your questions and comments are welcome. Write to: Editor, BYTE, One Phoenix Mill Lane, Peterborough, NH, 03458.

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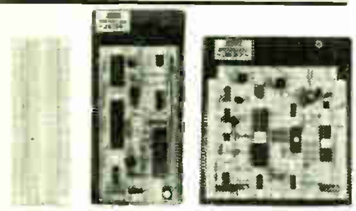

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· Award BIOS ROMs included

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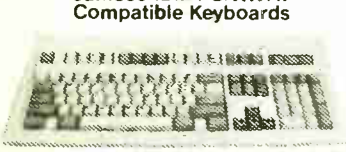

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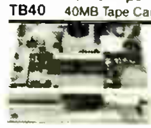

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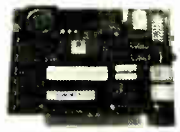

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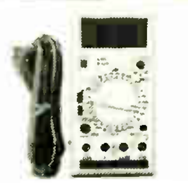

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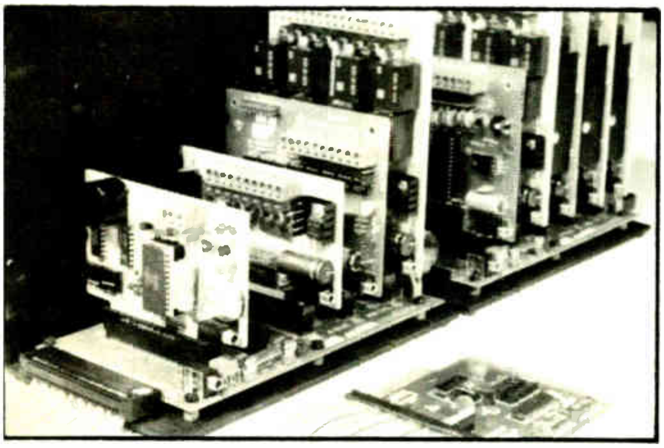

An A-BUS system with two Motherboards
A-BUS adapter (IBM) in foreground

With the A-BUS you can plug your PC (IBM, Apple, TRS-80) into a future of exciting new applications in the fields of control, monitoring, automation, sensing, robotics, etc.

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The complete set of A-BUS User's Manuals is available for $10.

About the A-BUS:

- All the A-BUS cards are very easy to use with any language that can read or write to a Port or Memory. In BASIC, use INP and OUT (or PEEK and POKE with Apples and Tandy Color Computers)
- They are all compatible with each other. You can mix and match up to 25 cards to fit your application. Card addresses are easily set with jumpers.
- A-BUS cards are shipped with power supplies (except PD-123) and detailed manuals (including schematics and programming examples)

Relay Card — RE-140: $129
Includes eight industrial relays, (3 amp contacts, SPST) individually controlled and latched. 8 LED's show status. Easy to use (OUT or POKE in BASIC). Card address is jumper selectable.

Reed Relay Card — RE-156: $99
Same features as above, but uses 8 Reed Relays to switch low level signals (20mA max). Use as a channel selector, solid state relay driver, etc.

Analog Input Card — AD-142: $129
Eight analog inputs. 0 to +5V range can be expanded to 100V by adding a resistor. 8 bit resolution (20mV). Conversion time 120us. Perfect to measure voltage, temperature, light levels, pressure, etc. Very easy to use.

12 Bit A/D Converter — AN-146: $139
This analog to digital converter is accurate to .025%. Input range is −4V to +4V. Resolution: 1 millivolt. The on board amplifier boosts signals up to 50 times to read microvolts. Conversion time is 130ms. Ideal for thermocouple, strain gauge, etc. 1 channel. (Expand to 8 channels using the RE-156 card).

Digital Input Card — IN-141: $59
The eight inputs are optically isolated, so it's safe and easy to connect any "on/off" devices, such as switches, thermostats, alarm loops, etc. to your computer. To read the eight inputs, simply use BASIC INP (or PEEK).

24 Line TTL I/O — DG-148: $65
Connect 24 input or output signals (switches or any TTL device) to your computer. The card can be set for: input, latched output, strobed output, strobed input, and/or bidirectional strobed I/O. Uses the 8255A chip.

Clock with Alarm — CL-144: $89
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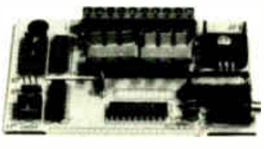
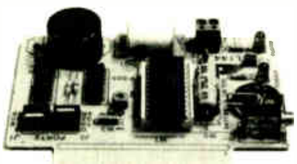
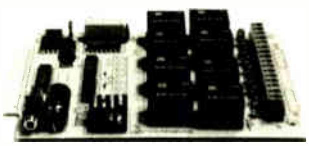


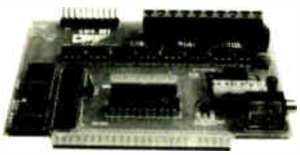
ST-143



CL-144



RE-140



IN-141

AD-142

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Remote Control Keypad Option — RC-121: $49
To control the 4 motors directly, and "teach" sequences of motions.

Power Driver Board Option — PD-123: $89
Boost controller drive to 5 amps per phase. For two motors (eight drivers).

Breakout Board Option — BB-122: $19
For easy connection of 2 motors. 3 ft. cable ends with screw terminal board.

Stepper Motor Driver — ST-143: $79
Stepper motors are the ultimate in motion control. The special package (below) includes everything you need to get familiar with them. Each card drives two stepper motors (12V, bidirectional, 4 phase, 350mA per phase).
Special Package: 2 motors (MO-103) + ST-143: **PA-181: $99**

Stepper Motors — MO-103: $15 or 4 for $39
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TRS-80 Model 102, 200 Plugs into 40 pin "system bus"	AR-136 ..$69
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TRS-80 Model I. Plugs into 40 pin I/O bus on KB or E/I	AR-131 ..$39
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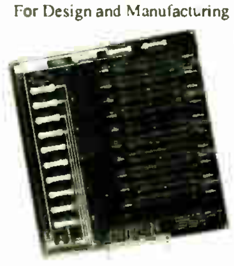

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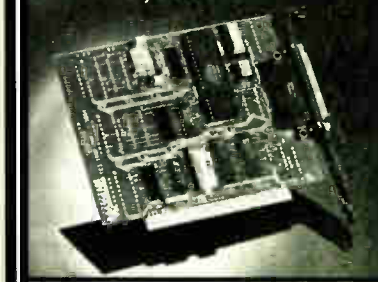

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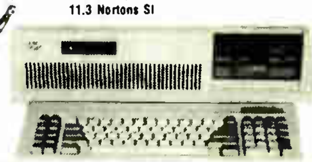

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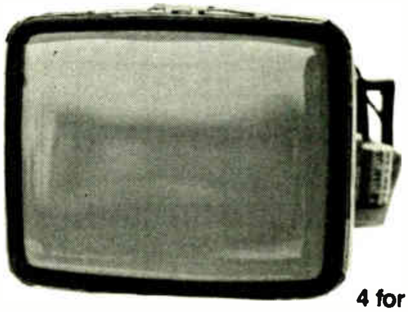

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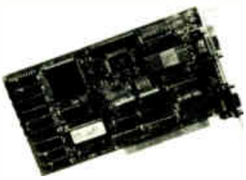

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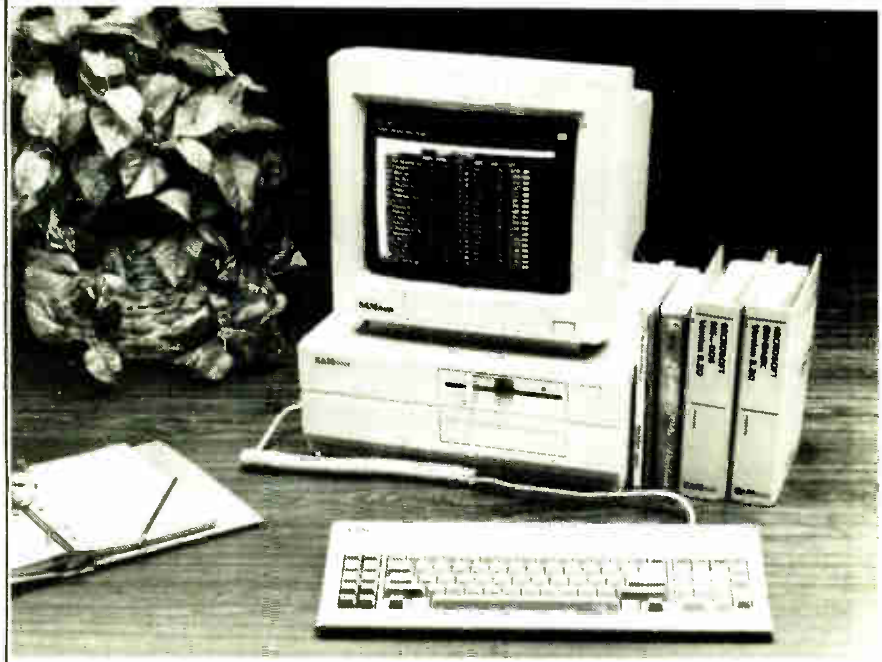

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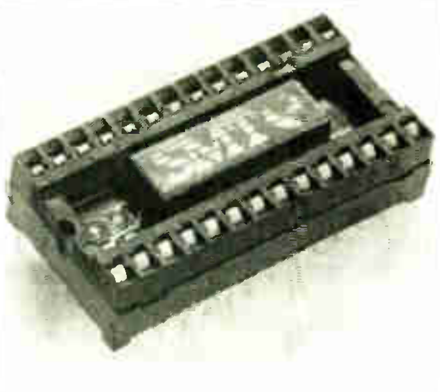

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3.000MHz	2.25	9.000MHz	2.25	22.1184MHz	2.25
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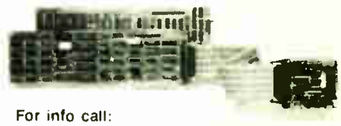

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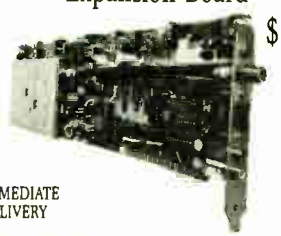

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NEC/8500 Laptop

$319 ~~$995~~

The NEC PC/8500 laptop computer incorporates a 25 line liquid crystal display and modem that plugs directly into any RJ/11 wall jack An auto log/on feature instructs the 8500 to phone the users host computer and automatically send password and log/on information The computer also includes both serial and Centronics parallel ports packaged in this six pound laptop.
This is the ideal computer for Realtors, insurance people or any individual that requires immediate access to remote information.
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6.8	15V	42	2.2	35V	19
10	15V	.45	4 7	35V	39
22	15V	99	10	35V	69

DISC

10pf	50V	05	001µf	50V	05
22	50V	.05	005	50V	.05
33	50V	05	01	50V	07
47	50V	.05	05	50V	.07
100	50V	.05	1	12V	10
220	50V	.05	1	50V	12

MONOLITHIC

.01µf	50V	.14	1µf	50V	.18
.047µf	50V	15	47µf	50V	.25

ELECTROLYTIC

RADIAL			AXIAL		
1µf	25V	14	1µf	50V	14
4.7	50V	11	10	50V	16
10	50V	11	22	16V	14
47	35V	.13	47	50V	.19
100	16V	.15	100	35V	.19
220	35V	.20	470	50V	.29
470	25V	.30	1000	16V	.29
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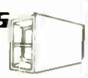

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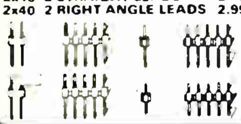

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WIREWRAP HEADER	IDHxxW	1.86	2.98	3 84	4 50	5.28	6 63
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RIBBON HEADER SOCKET	IDSxx	.63	.89	.95	1.29	1.49	1 69
RIBBON HEADER	IDMxx	---	5.50	6.25	7.00	7.50	8 50
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FOR ORDERING INSTRUCTIONS SEE D SUBMINIATURE CONNECTORS BELOW

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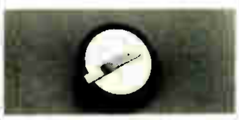

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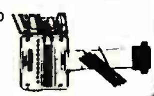

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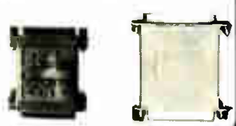

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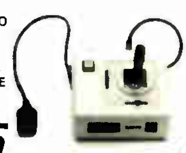

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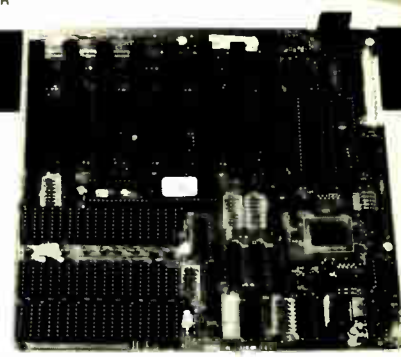

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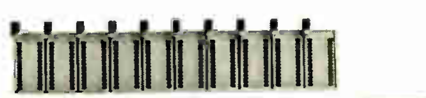

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EDITORIAL INDEX BY COMPANY

Index of companies covered in articles, columns, or news stories in this issue
Each reference is to the first page of the article or section in which the company name appears

COMING UP IN BYTE

PRODUCTS IN PERSPECTIVE:

October will see the continuation of our new column format. This includes special pieces devoted to business applications, the Macintosh, computer communications, OS/2, and hands-on hardware and software construction projects. And don't forget Computing at Chaos Manor and Applications Plus.

A whole new class of 80386 systems can give you the performance of an 80386 for a lot less money than the high-end systems. These clones don't push for that extra bit of performance and don't offer a lot of frills. But the trade-off is an attractive price—around $3000. October's Product Focus will compare a dozen of these clones.

System reviews: Next month, we'll give the 20-MHz 80386-based System 310 from Dell Computer a full going-over. Another review examines three portables: the Amstrad PPC640, the Epson Equity LT, and the USA Micro Laser Compact XT.

A hardware review examines five low-end scanners for the Macintosh.

Software reviews: Given the current interest in object-oriented development, you may want to take a look at our review of C-TALK from CNS. C-TALK adds object-oriented extensions to a number of C implementations. In another review, we'll look at a diagnostic facility for C on MS-DOS computers called PC-Lint from Gimpel Software. Also in for scrutiny will be Borland's Turbo Prolog 2.0.

Application reviews include D, the Data Language, a fast database manager for MS-DOS computers from CalTex; EGA Paint 2005 from RIX SoftWorks; and Borland's high-powered word processor for MS-DOS systems, Sprint.

IN DEPTH:

HyperCard and hypertext embody similar techniques. Each is a tool for linking disparate facts together, even if those facts are not all initially contained in the same place. Our In-Depth section will take a look at some outstanding "hyper" examples and explain the technology behind the linkages.

FEATURES:

Mark Waller will continue his discussion on microcomputer power with an article on power backup systems. Waller, an authority on electrical power management, will provide practical advice for buying the best system for your needs. Additionally, Peter Wayner will present a piece on a structured writing program.

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READER SERVICE

To get further information on the products advertised in BYTE, fill out the reader service card by circling the numbers on the card that correspond to the inquiry number listed with the advertiser. This index is provided as an additional service by the publisher, who assumes no liability for errors or omissions.

* Correspond directly with company

Index to Advertisers by Product Category

READER SERVICE

Advertising Supplement included with this issue:
CMO (U.S. and Canada Subscribers)

* Correspond directly with company.

BACK ISSUES FOR SALE

	1985	1986	1987	1988
Jan.	$6.00			$6.00
Feb.	$6.00	$6.00	$6.00	
March	$6.00		$6.00	$6.00
April	$6.00		$6.00	
May	$6.00		$6.00	$6.00
June	$6.00	$6.00	$6.00	$6.00
July		$6.00	$6.00	$6.00
Aug.	$6.00	$6.00	$6.00	$6.00
Sept.	$6.00	$6.00	$6.00	
Oct.	$6.00	$6.00		
Nov.	$6.00			
Dec.	$6.00	$6.00		

SPECIAL ISSUES and INDEX	
BYTE '83–'84 INDEX	$2.00
BYTE 1985 INDEX	$2.50
BYTE 1986 INDEX	$2.00
BYTE 1987 INDEX	$2.50
1985 INSIDE THE IBM PCs	$4.75
1986 INSIDE THE IBM PCs	$5.00
APPLICATIONS SOFTWARE TODAY SPECIAL	$4.00

Circle and send requests with payments to:

BYTE Back Issues
One Phoenix Mill Lane
Peterborough, NH 03458
(603) 924-9281

☐ Check enclosed *Payments from foreign countries must be made in US funds payable at a US bank.*

☐ VISA ☐ MasterCard

CARD # ______________________ EXP. DATE ______________

SIGNATURE ______________________________________

The above prices include postage in the US. Please add $ .50 per copy for Canada and Mexico; and $2.00 per copy to foreign countries (surface delivery). Please allow 4 weeks for domestic delivery and 12 weeks for foreign delivery.

European customers please refer to Back Issue order form in International Advertising section of book.

NAME ______________________________________

ADDRESS ______________________________________

CITY ______________________ STATE ____________ ZIP ____________

TIPS

SUBSCRIBERS ONLY!*

Use BYTE's Telephone Inquiry Processing System

Using TIPS can bring product information as much as 10 days earlier.

SEND FOR YOUR SUBSCRIBER I.D. CARD

1) If you are a new subscriber or have lost your I.D. card, circle #1 on the Reader Service Card; **attach mailer label**. We will immediately send your personal TIPS subscriber card.

GET PREPARED

2) Write your Subscriber Number, as printed on your Subscriber I.D. Card, in boxes in Step 5 below. (Do not add 0's to fill in blank boxes)

3) Write numbers for information desired in boxes in Step 7b below. (Do not add 0's to fill in blank boxes.)

CALL TIPS

4) Now, on a Touch-Tone telephone dial: (413) 442-2668 and wait for voice commands.

ENTER YOUR SUBSCRIBER AND ISSUE NUMBERS

5) When TIPS says: "Enter Subscriber Number"
(Enter by pushing the numbers and symbols [# or * enclosed in the boxes] on telephone pad ignoring blank boxes)
Enter ☐☐☐☐☐☐☐☐☐☐ [#] [#]

6) When TIPS says "Enter magazine code & issue code"
Enter [1] [#] [9] [8] [#] [#]

ENTER YOUR INQUIRIES

7a) When TIPS says "Enter (next) Inquiry Number"
Enter one inquiry selection from below (ignore blank boxes)

b) Repeat 7a as needed (maximum 17 inquiry numbers)

1. ☐☐☐ [#] [#] 6. ☐☐☐ [#] [#] 10. ☐☐☐ [#] [#] 14. ☐☐☐ [#] [#]
2. ☐☐☐ [#] [#] 7. ☐☐☐ [#] [#] 11. ☐☐☐ [#] [#] 15. ☐☐☐ [#] [#]
3. ☐☐☐ [#] [#] 8. ☐☐☐ [#] [#] 12. ☐☐☐ [#] [#] 16. ☐☐☐ [#] [#]
4. ☐☐☐ [#] [#] 9. ☐☐☐ [#] [#] 13. ☐☐☐ [#] [#] 17. ☐☐☐ [#] [#]
5. ☐☐☐ [#] [#]

END SESSION

8) End session by entering [*] [*] [9] [1] [#] [#]

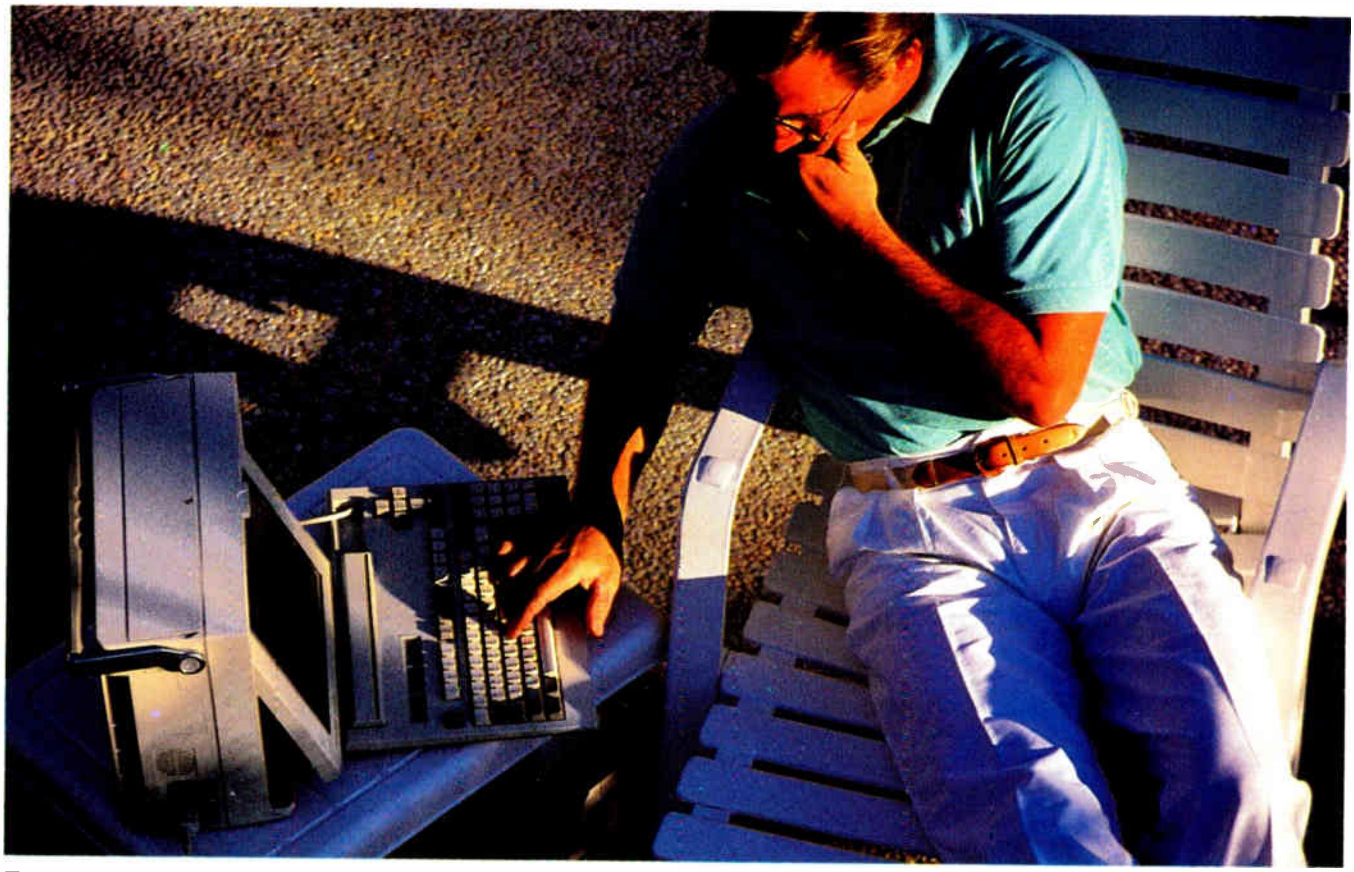
9) Hang up after hearing final message
If you are a subscriber and need assistance, call (603) 924-9281.

Available 24 Hours, 7 Days a Week

If you are not a subscriber fill out the subscription card found in this issue or, call BYTE Circulation 800-423-8912.

***Domestic and Canadian Subscribers Only!**

THE DESKTOP COMPUTER FOR PEOPLE WHOSE MINDS ARE AT WORK EVEN WHEN THEIR BODIES AREN'T.



Presenting the PowerMate™ Portable. Desktop power to go.™

If you happen to be one of those rare individuals whose minds don't punch out at five o'clock, we have some good news for you.

It's called the PowerMate Portable. And thanks to some workaholic engineers at NEC, this nifty little dynamo is everything a desktop computer is.

Plus it's portable. Which means you can use it anywhere. At work. At home. Or on the road. It boggles the mind.

And speaking of mind boggling, check out what's under the hood: Intel 80286™ technology, full-size internal AT-compatible expansion slots, an optional internal modem, 20 or 40 MB hard disk and EGA resolution on a backlit LCD display. Call 1-800-343-4418 and find out more about PowerMate Portable from NEC. The quick pick-me-up for the "Thank Goodness it's Monday" crowd.

Take it to the limit.

NEC

For the name of the dealer nearest you, call 1-800-343-4418. In Canada, call 1-800-387-4313. NEC Information Systems, Dept. 1610, 1414 Massachusetts Ave., Boxborough, MA 01719.

C&C Computers and Communications

Tandy Computers: Because there is no better value.™

The New Tandy® 5000 MC

Our most powerful 386™ based computer . . . made in America.

The new Tandy 5000 MC Professional System is strictly business, from the look of its 256,000-color VGA graphics to the tactile feel of its keyboard.

Inside is pure performance, from the 80386 processor operating at 20 MHz to the fast memory with cache that provides RAM-fast access to your data.

The 5000 MC comes with a built-in 1.44MB 3½" floppy drive. There's room inside for a second 3½" drive (or hard drive) and two 5¼" floppy, hard or tape drives. Choose from ST-506 or ESDI—and SCSI support is coming.

Expand the memory to 16MB using two dedicated expansion slots, and you can still add five IBM® Micro Channel compatible expansion adapters.

And the 5000 MC is a natural as the hub of a multiuser system or as a file server in a 3Com® office workgroup.

A Tandy 5000 MC with an 84MB hard disk drive is only $6999. Check out the new alternative in personal computing.

- 20 MHz Intel® 80386 microprocessor
- 2MB RAM, expandable to 16MB
- Intel 82385 Memory Cache controller
- Built-in VGA graphics
- Five IBM Micro Channel™ expansion slots, plus two dedicated memory slots
- 80387 coprocessor socket
- Supports MS-DOS®, MS® OS/2 and multiuser SCO® XENIX® operating systems

Radio Shack® COMPUTER CENTERS
A DIVISION OF TANDY CORPORATION

Price applies at Radio Shack Computer Centers and participating stores and dealers. Monitor sold separately. Intel/Reg. TM and 386/TM Intel Corp. IBM/Reg. TM and Micro Channel/TM IBM Corp. MS, MS-DOS and XENIX/Reg. TM Microsoft Corp. SCO/Reg. TM The Santa Cruz Operation. 3Com/Reg. TM 3Com Corp.

Circle 231 on Reader Service Card