

# Mini-MicroSystems

A CAHNERS PUBLICATION

FEBRUARY 1983

VCRs for disk backup  
Floppy market overview

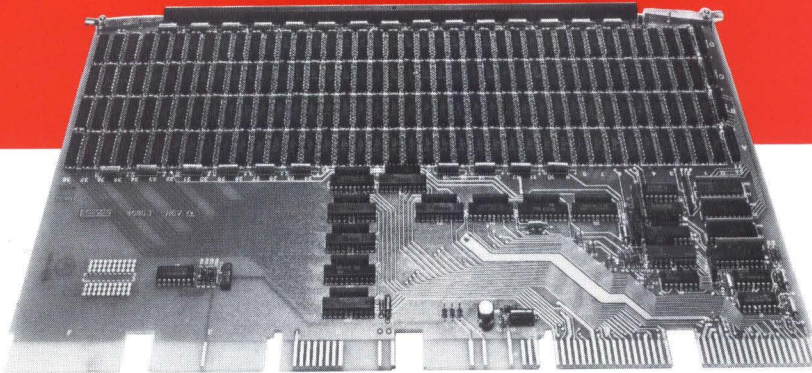
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5¼-inch Winchester stores 140 Mb



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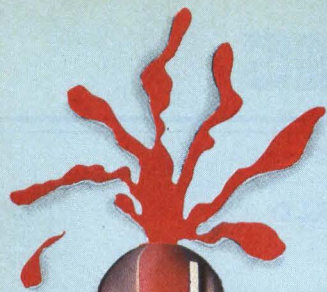
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DEC Mini	Dataram ADD-IN	Board Size	Maximum Capacity
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LSI-11	DR-215	dual	256 KB
LSI-11	DR-213	quad	1.0 MB
PDP®-11	DR-114S	hex	256 KB
PDP-11	DR-114SP	hex	256 KB
PDP-11	DR-214	hex	1.0 MB
PDP-11	DR-144	hex	256 KB
PDP-11	DR-244	hex	1.0 MB
VAX®-11/750	DR-175	hex	256 KB
PDP-11/70			
VAX-11/750	DR-275	hex	1.0 MB
VAX-11/730			
VAX-11/780	DR-178	extended hex	512 KB
VAX-11/780	DR-278	extended hex	2.0 MB
DECSYSTEM 2020®	DR-120	extended hex	256 KB

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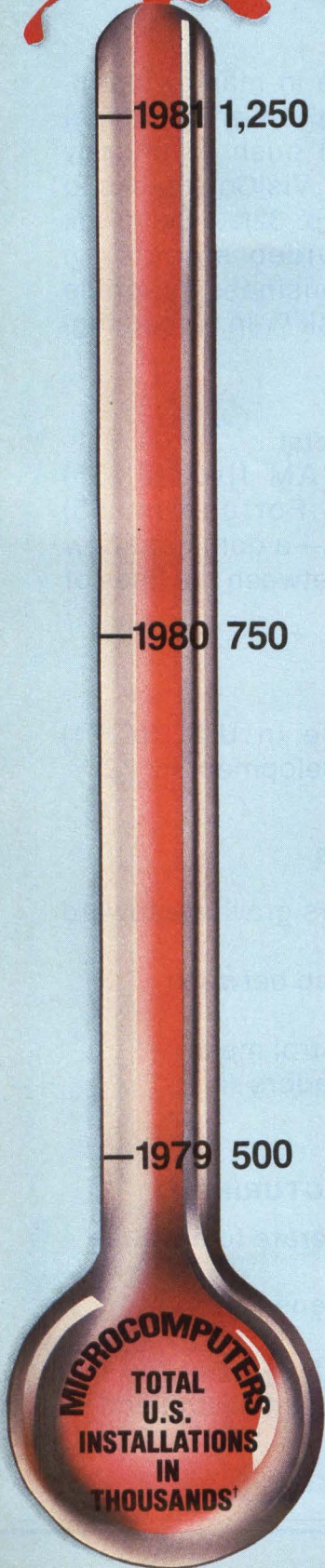
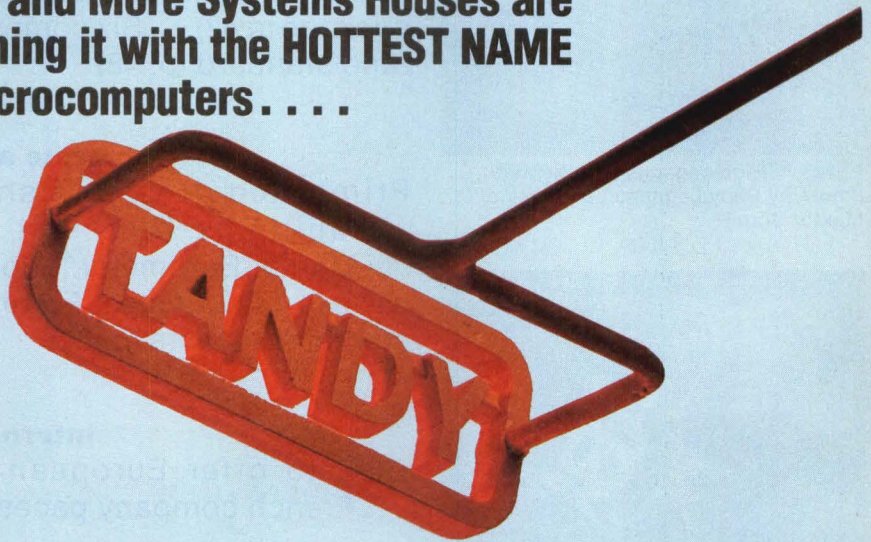
Dataram also provides core ADD-INS, core and semiconductor ADD-ONS, memory system units, memory management, and a wide range of memory-related accessories for DEC users.





# MICRO FEVER

**More and More Systems Houses are Catching it with the HOTTEST NAME in Microcomputers . . . .**



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**Tandy Contract Marketing Sales**

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\*Focus Research, West Hartford, Connecticut as commissioned by Time Magazine.

†Source: Mini/Micro Systems Magazine Estimates

**CIRCLE NO. 1 ON INQUIRY CARD**



# Mini-Micro Systems

## MINI-MICRO WORLD

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Apple bets on proprietary software in market bid (p. 17)...Qume takes on TeleVideo in low-end terminal market (p. 21)...Amlyn, Drivotech push minifloppy capacities above 3M bytes (p. 26)...VisiCorp seeks to set standard with Visi<sup>ON</sup> package (p. 32)...Seiko ink sheet color printer processes video signals (p. 41)...High hopes for IBM PC business graphics package (p.42)...Six companies back 1/4-in. streaming-tape standard (p. 48)

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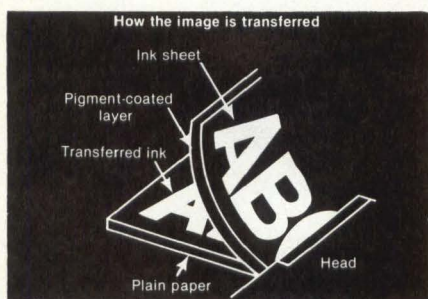
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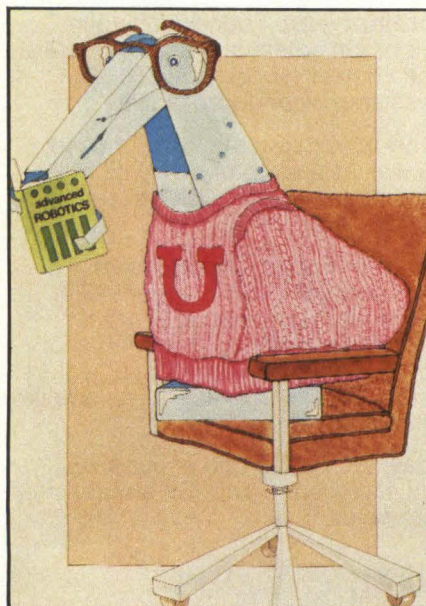
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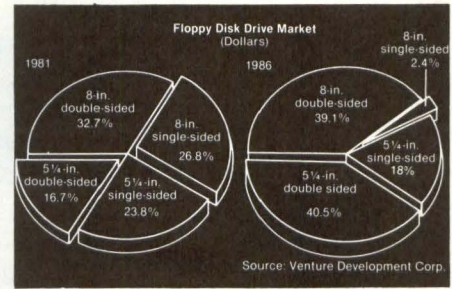
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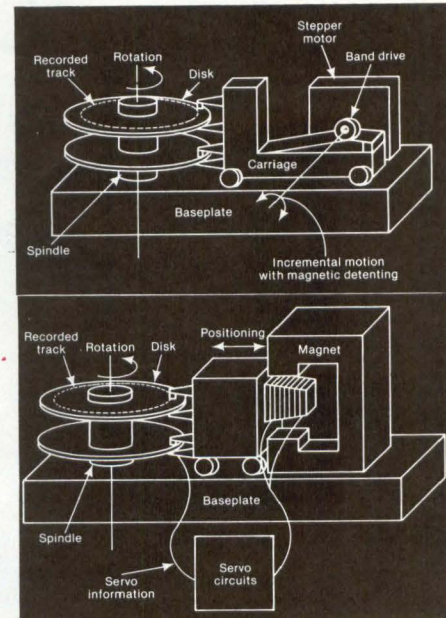
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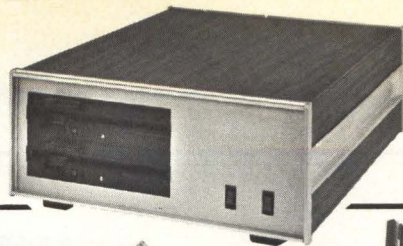


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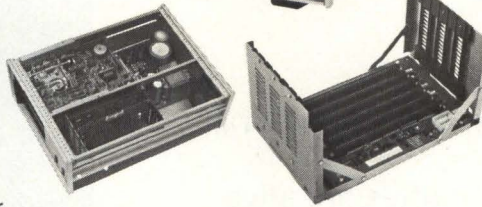




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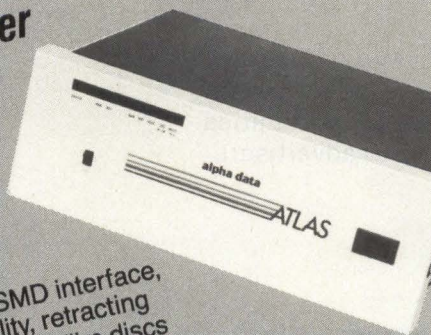
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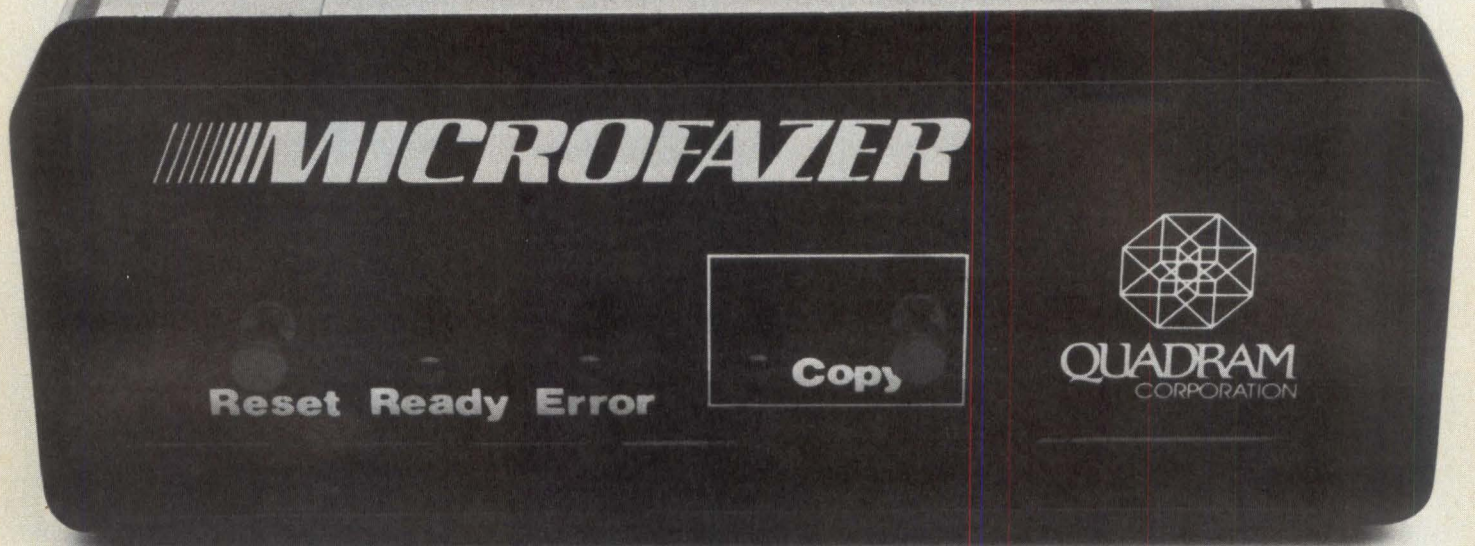
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*Electronics & Electrical Products*

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**No waiting.** Now with Microfazer by Quadram there is no more waiting.

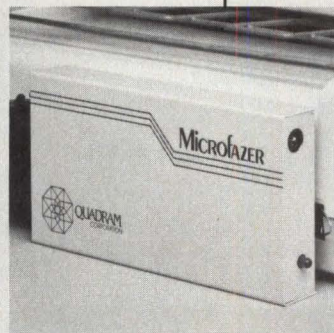
Microfazers are inexpensive universal printer buffers which any computer user cannot afford to be without. Any computer—any printer (or plotter!), whether parallel or serial. Microfazer receives information from the computer at ultra high speeds causing the computer to think the printer is printing just as fast as the computer can send. Microfazer holds the information until your printer can handle it, and then sends it on.



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need your information repeated, for whatever reason, it's always right there—inside Microfazer.

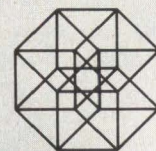
**Microfazer™ stack.** Microfazer can be stacked with popular modems or other peripherals. Some models can plug directly onto the back of your printer. Install it in less than 60 seconds, and choose the amount of buffer



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CORPORATION

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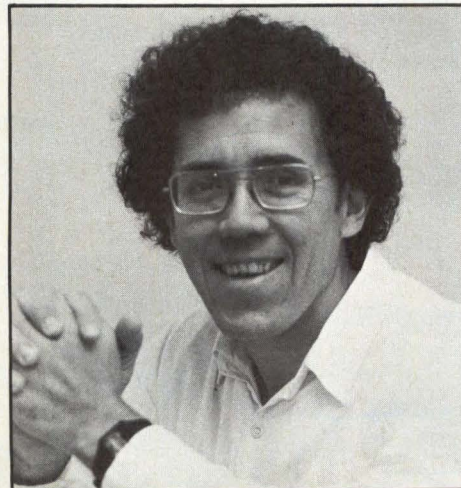
## Fine tuning an organization



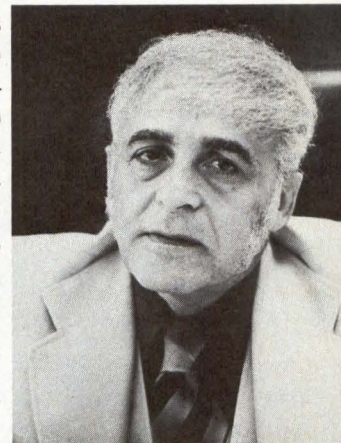
Frann



Glazer



Bright



Any organization that has grown as fast as the editorial staff of *Mini-Micro Systems* has in the last few years—from five full-time editors in early 1979 to 18 today—needs fine tuning to adjust to a changing industry and audience. We're doing that fine tuning. Last month, we introduced you to George Bond, managing editor; Bob Sehr, a San Jose correspondent; and Linda Bachmann, an associate editor in Boston. Three other editors take a bow this month: Steve Frann, Sarah Glazer and David Bright.

All three work in the Boston headquarters, but each has a different assignment. Steve Frann, our new products editor for the past several issues, brings a varied background to that section, which always scores very high in readership studies. He has a B.S. in humanities and science from the Massachusetts Institute of Technology, where he majored in a self-developed program that combined elements of cultural anthropology, linguistics, political science and science writing.

Steve was new products editor for *80 Micro* magazine before coming to us, a role that involved writing, copy editing and magazine layout. He's also served internships at *Technology Review* magazine (science writing) and WGBH-TV in Boston.

Sarah Glazer's task is to concentrate on trends, technologies and corporate strategies so that she can contribute in-depth, staff-written articles to The Interpreter and Systems in Manufacturing sections. The latter is a section we've devoted to exploration of the increasingly important role of computers in factory applications.

Before joining *Mini-Micro Systems*, Sarah was managing editor of *Telematics*, a magazine covering the telecommunications and data-communications fields. She also contributed to *International Fiber Optics and Communications*, a sister publication to *Telematics*. Sarah has served as editor of the *Record*, a technical magazine for the industrial property sector of the insurance industry, and has been a technical editor in General Electric Co.'s aircraft engine division in Lynn, Mass.

Sarah earned a B.A. from Harvard College, where she majored in English.

David Bright is serving in a newly created staff position—reporter/news assistant. In that capacity, he will report, write and edit stories for the Mini-Micro World section directed by Lori Valigra, senior editor for news. David is a 1982 graduate from the University of Massachusetts/Boston, with a major in English. He comes to us from a Boston area supply company, where he was a computer operator and director of VisiCalc and DigiCalc training.

S. Henry Sacks  
Vice President/Publisher



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# Breakpoints

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## **NEW SYSTEMS, REPRICING, MARK HP LOW-PRICE STRATEGY**

Hewlett-Packard Co., as part of what it terms an assault on the market for lower priced business computer systems, will introduce the 3000 Series 39 this month. The 39 offers the same performance as the 40SX, which it supersedes, at prices as much as 20 percent lower. Prices of packaged systems range from \$33,900 to \$45,200. Prices of mid-range 3000 Series 40 and 44 models have been reduced 15 to 17 percent, and add-on memory prices have been reduced 15 to 26 percent. HP also offers 17 percent lower prices on a typical HP 250 model 20 small-business computer. A new model 25 with 256K bytes of memory, 9.7M bytes of disk memory, a 1.2M-byte floppy disk drive, a console and a printer is list-priced at \$17,000. Software developments added recently by HP include an HPMENU for 3000 systems programs, graphics software for the 250 models and larger volume discounts on some application software.

## **XEROX PC STRATEGY TARGETS MAJOR ACCOUNTS**

After its admittedly weak first stab at the personal computer market, Xerox Corp. has refined its strategy for the revamped 820-II. Now the system is being pushed through Xerox's major accounts marketing force as an entry-level managerial workstation. Xerox officials say sales into major accounts in this market have doubled from month to month since the introduction of the 820-II last summer. To advance the 820 as a workstation for managers and other office personnel, Xerox is expected to announce a direct Ethernet connection early this month. Previously, the 820 could connect only to the local-area network via a communications server. In addition, Xerox officials say they will have an integrated package similar to Visicorp's Visi<sup>on</sup> by the time that product is shipped with IBM systems this summer. The addition of such software could make the 820 a kind of poor-man's Star workstation and possibly an alternative to Apple Computer Inc.'s Lisa.

## **TANDY ADDS ALTERNATE MODEL II, MODEL 16 OPERATING SYSTEMS**

After relying exclusively on its proprietary TRS-DOS operating system, Tandy Corp. is augmenting its personal computer line with industry-standard operating systems. The company last month conceded to peer pressure in the low-end market and added Digital Research's CP/M + operating system as a \$250 option for its model II line. On the high-end dual-processor Z80/MC68000 model 16, the company has added its long-awaited, multi-user UNIX operating system, which is Microsoft's XENIX instead of the anticipated UNOS version from Charles River Data Systems. The XENIX package is free to model 16 customers in a run-time version and is priced at \$750 as a development system with the C language. Other languages such as COBOL and BASIC are offered on the run-time version, as are Microsoft's Multiplan and accounting packages. Tandy also plans to offer FORTRAN and Pascal this spring. For small-business system OEMs, the company has added RM-COS.

## **FAULT-TOLERANT DPS 6 EXPECTED FROM HONEYWELL**

By mid-year, Honeywell Information Systems is expected to launch a highly resilient hardware/software package for DPS 6 minicomputer transaction-processing networks. Marilyn Maleckas, manager of marketing support for the DPS 6, notes that several divisions within Honeywell are installing the resilient system. They include the company's Automatic Response Centers that handle urgent customer problems. She identifies industrial control and on-line order entry as promising applications. Software for the resilient system comprises an enhancement to the TPS 6 transaction-processing system, which, in turn runs under the GCOS 6 operating system. Essential hardware includes two DPS 6 minicomputers, a high-speed line linking their buses and a unit for switching terminal communications lines between the processors.

## **TABOR MICROFLOPPY DEBUTS IN FORTHCOMING SOROC SYSTEM**

Soroc Corp., Anaheim, Calif., will become one of the first manufacturers to market a desk-top system using the Tabor 3¼-in., 500K-byte floppy disk drive. Soroc will use the



# Breakpoints

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microfloppy in its Excecline series due out late this month. Soroc expects to retail its small-footprint system at less than \$2000, including bundled software. Under a \$12-million contract with Tabor, Soroc will initially use single-sided floppies and then double-sided floppies as they become available. The system may also be enhanced in the near future with a SyQuest 3.9-in. fixed/removable cartridge or a Seagate 3½-in. Winchester drive (MMS, January, p. 15), depending on availability.

## **NCC MOVES TO LAS VEGAS IN 1984**

In the face of a threat by more than 200 exhibitors, representing more than 100,000 sq. ft. of exhibit space, to pull out of the National Computer Conference, show sponsor the American Federation of Information Processing Societies has shifted the location of the 1984 show from Houston to Las Vegas. Exhibitors had complained about poor and scattered facilities as well as intolerable heat and humidity at last year's show. After this year's show in Anaheim, NCC will be rotated for the next four years between Las Vegas and Chicago. The two cities represent the only sites large enough to accommodate the show, says Larry Jennings, manager of exhibit operations at AFIPS.

## **INTEL MAY ADOPT CAP-CPP X.25 BOARD**

Packet-switching applications involving the X.25 protocol are the target for a board-based package being prepared for Intel Corp. systems by software house CAP-CPP Ltd., Reading, England. Intel's Software Distribution and Support Operation, Santa Clara, is evaluating the product with a view toward selling and supporting it or just recommending it. SDSO's strategic marketing manager, Peter Chess, offers no additional comments. Peter Weston, CAP-CPP industrial systems manager, hopes that Intel will adopt the product but notes that it will be made available in the U.S. through the offices of CAP-CPP Inc., New York. The X.25 software will run on a PC board configured around the Intel 8088 processor and will be sold like a disk controller, says Weston. He explains that it will interface with the Intel Multibus and will enable the host Intel CPU to communicate over an X.25 network. The CPU could be an 8086, an iAPX 186 or 286 or an 8-bit processor.

## **START-UP TO OFFER LOW-END FAULT-TOLERANT SYSTEM**

Tolerant Transaction Systems, Inc., San Jose, has been formed to market a low-end fault-tolerant computer. The system, expected to be introduced in the last quarter of this year, will be based on National Semiconductor Corp.'s recently introduced NS16000 chip, and will be aimed at the OEM market. The company has obtained an undisclosed amount of venture capital from Adler & Co., New York, and is looking for a "benefactor"—a large company such as Burroughs Corp. or NCR Corp. that would like to enter the fault-tolerant market without the expense of in-house development.

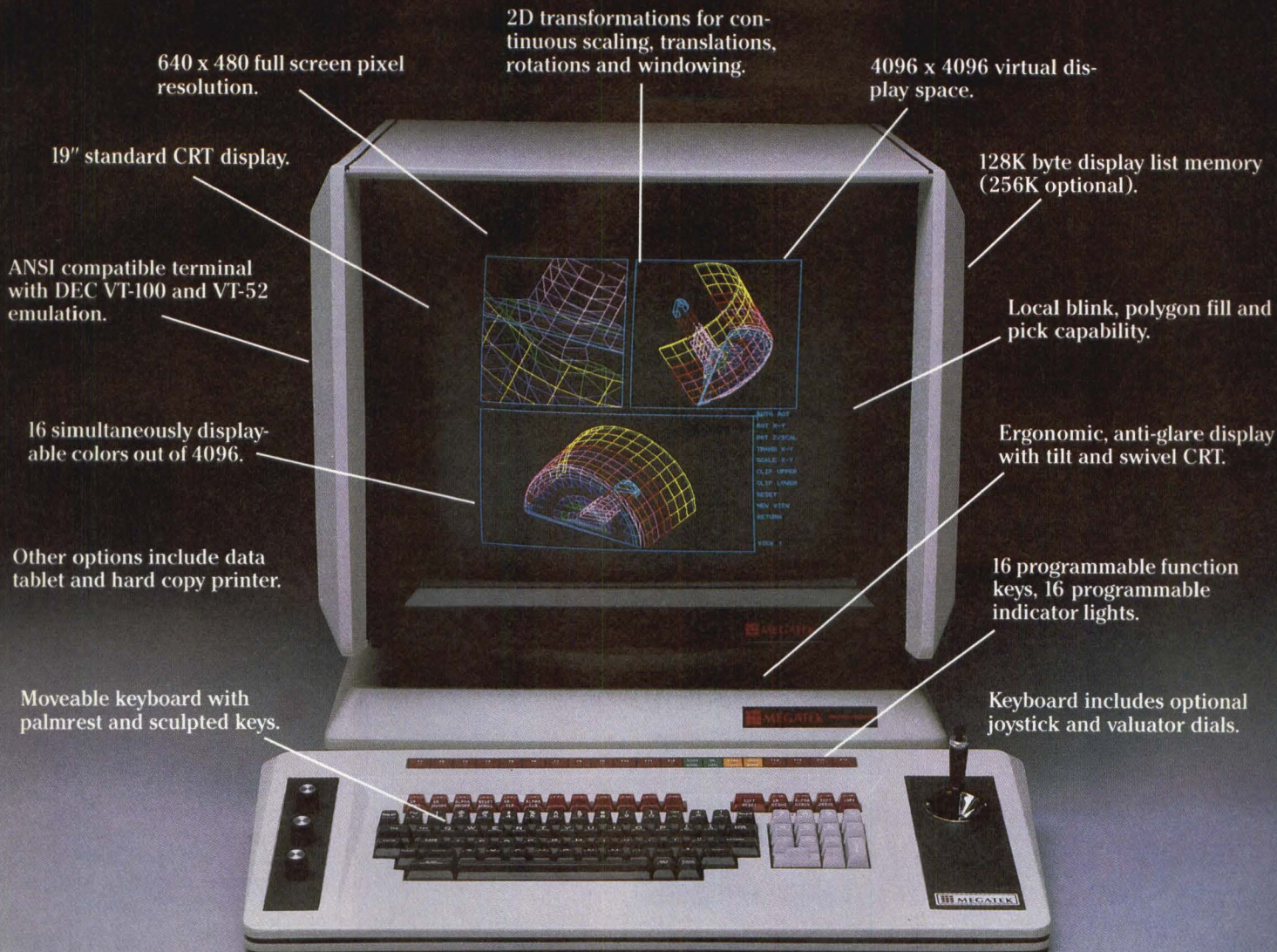
## **SOFTWARE HELPS RPG II PROGRAM MIGRATION FROM IBM SYSTEM /34 TO PRIME MINIS**

The Escape/34 software package, due for shipment mid-month, is said to allow IBM Series/34 users to move RPG II programs easily and inexpensively to Prime Computer Inc.'s 32-bit minicomputers. Available from Database Systems Corp., Phoenix, Ariz., which develops software exclusively for Prime products, Escape/34 employs a menu-driven screen utility to help users operate an application after it is moved. Escape/34's RPG II compiler accepts System/34 RPG II code for recompilation. RPG II application programs can then be run on Prime machines. The product is priced at \$10,000.

## **UTILITY ALLOWS FILE TRANSFERS AMONG MINICOMPUTERS AND MICROCOMPUTERS**

A file-transfer utility using an SDLC-like protocol is said to allow a wide range of minicomputers and microcomputers to send and accept each other's files across standard dial-up telephones, satellite links, local-area networks, packet-switched networks and direct cable connections. Called Blast, for blocked asynchronous transmission, the utility is priced at \$250 to \$900, depending on CPU size. The product from Communications





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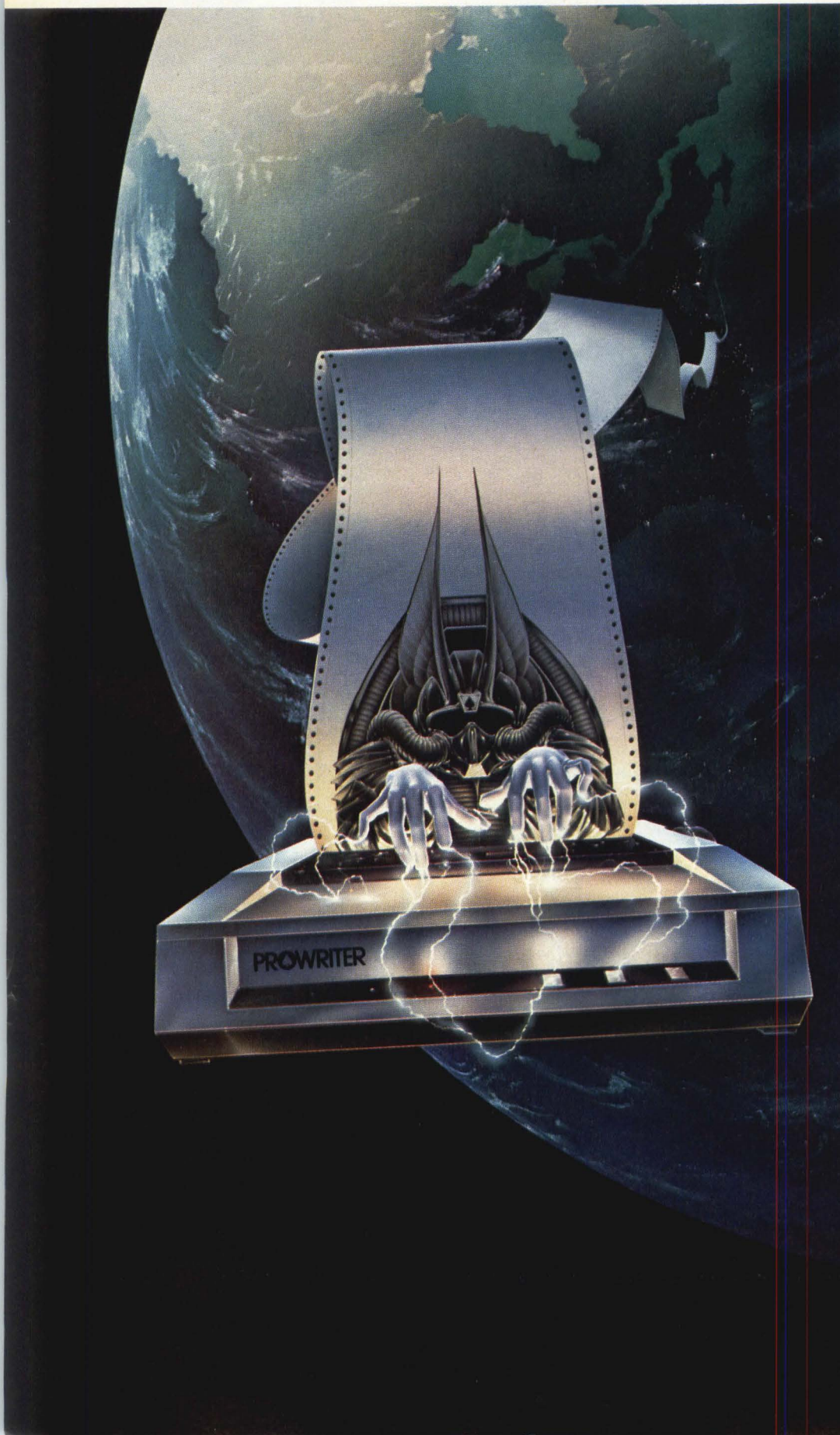
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# Breakpoints

Research Group Inc., Baton Rouge, La., was expected to be announced late last month for Data General Corp., Digital Equipment Corp. VAX, Apple Computer Inc., IBM Corp. PC and CP/M- and MP/M-based computers. The Blast products use a high-level full-duplex sliding window protocol that is said to allow error-free data transfer.

## **TRIDATA PROTOCOL CONVERTER TO LINK VARIOUS SMALL SYSTEMS**

Tridata Corp., Mountain View, Calif., this month is expected to release Netway, a protocol converter designed to link a variety of dissimilar minicomputers, microcomputers and mainframes using more than six protocols. The protocols include those for IBM SNA/SDLC and 2780/3780, Burroughs poll/select, X.25 and one from Control Data Corp. Tridata, which has marketed intelligent modems, says Netway will go far beyond protocol conversion to function as a multiplexer, a data concentrator and a packetizer as well. The Z80-based Netway 100 board will handle the data conversion at the system node level, using instructions down-loaded from the dual Z80 Netway 200 host. A base price of \$250 per connection is projected. Tridata will cater to OEMs with a protocol development language for custom needs and is leaving a slot in the 200 for add-ins.

## **MEMOREX JOINS 5¼-IN. RIGID DISK DRIVE MARKET**

Memorex Corp. has made a first move into the explosive 5¼-in. rigid disk drive market by announcing a joint R&D and manufacturing license agreement with DMA Corp. Under the agreement, Memorex will immediately manufacture DMA's Micro Magnum fixed/removable 10M- to 15M-byte, 5¼-in. cartridges. For its part, DMA will share in R&D of a 5¼-in. Winchester with Memorex and will get a manufacturing license for a 5¼-in. fixed Winchester. As part of the deal, Memorex also obtained a minority interest in DMA.

## **TOKEN-PASSING LAN PRODUCTS SAID TO MEET IEEE-802 STANDARDS**

Token/Net, a local-area network interface system operating on CATV-compatible broadband cable, is expected to be unveiled next month at Interface '83 by Concord Data Systems, Waltham, Mass. The system uses a 5M-bps RF modem with token passing and a bus topology. Token/Net is said to comply fully with IEEE 802 LAN standards. The products are slated for June or July availability at a price of less than \$1000 per port.

## **TECHFILES: A quick look at industry developments**

**Micro files: Callan Data Systems has signaled its intention to pursue the federal government market.** Last month, the company added an Ada package supplied by Computer Science Corp., Irvine, Calif., and signed up Falls Church, Va., General Services Administration contractor Terminals Unlimited for a \$1.8-million order. In addition to the Ada package for its MC68000-based UNIX system, Callan has purchased a \$595 word-processing package and a program-oriented text editor that will be bundled with its Unistar system.... **Commodore Business Machines is the latest vendor to add its entry to a flurry of portable computer announcements.** The company has announced a monochromatic display portable unit with prices starting at \$995 and a color version with prices starting at \$1495. But Commodore's big news is a deal with Zilog Inc. that will give Commodore access to Zilog's Z8000 16-bit microprocessor design, which is expected to emerge in Commodore high-end products as early as this year's Hanover Fair.... Meanwhile, **Colby Computer**, Oakland, Calif., has developed a solution to the IBM "compatibility problem" among portables. Colby is marketing an \$895 kit that enables a nontechnical person to remove an IBM PC from its case and convert it into a portable, including the 9-in. standard display. The procedure is expected to take only 20 to 40 min. using a screwdriver and has reportedly raised the possibility of gaining some large OEM and other major orders among customers who want to avoid the compatibility issue. For another \$135, Colby will offer a kit that will make the desk-top IBM chassis a five-slot expansion box.... In another part of the IBM PC forest, **Sritek Inc.**, Columbus, Ohio, is offering Z80, 8086, 80286, MC68000 and National 16032 boards for the IBM box. Each



# Breakpoints

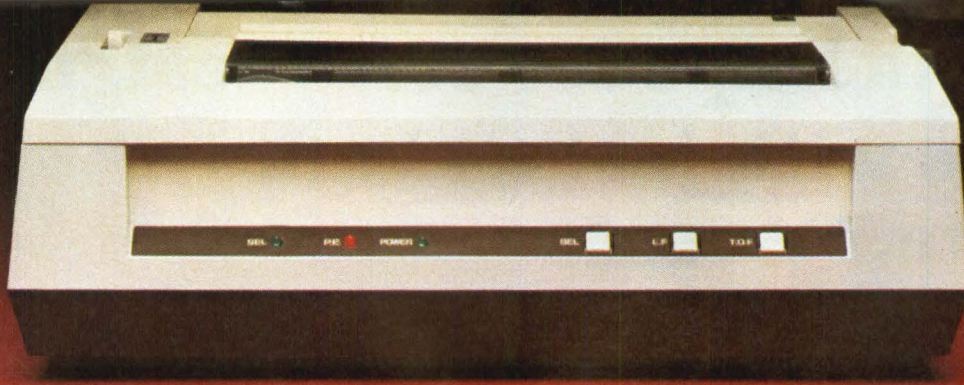
processor can be attached to a 0.5M-byte card, and is expected to be available with XENIX or another UNIX implementation....**IXO Inc.**, Culver City, Calif., is delaying announcement of a networking product using an IBM PC as a host computer because of a change in the company's presidency. Jeffrey Bachman, formerly vice president and chief financial officer, replaces Jeffrey Rochlis, who left to form an entertainment software start-up....Under its Digital Classified Software program, **Digital Equipment Corp.** is selling and supporting COBOL compilers and programming tools developed for its microcomputer products by Micro Focus, Santa Clara. The compilers and tools will be available for Robin and DECMate II machines under CP/M and for the Rainbow 100 under CP/M-86.

**Communications lines: Ungermann-Bass** has agreed in principle to acquire **Amdax Corp.**, Bohemia, N.Y. The acquisition of Amdax strengthens Ungermann-Bass's position in the broadband CATV market—the installed base of Amdax broadband modems is greater than 10,000. Research at the Amdax facility in Boca Raton, Fla., on high-speed mainframe-to-mainframe communications makes the entry of Ungermann-Bass into the SNA market likely late this year....Meanwhile, in Ungermann-Bass's own R&D labs in Santa Clara., work is nearing completion on a lower priced, smaller version of the company's general-purpose Net/One communications system, based on the LAN chip set it developed jointly with Fujitsu.

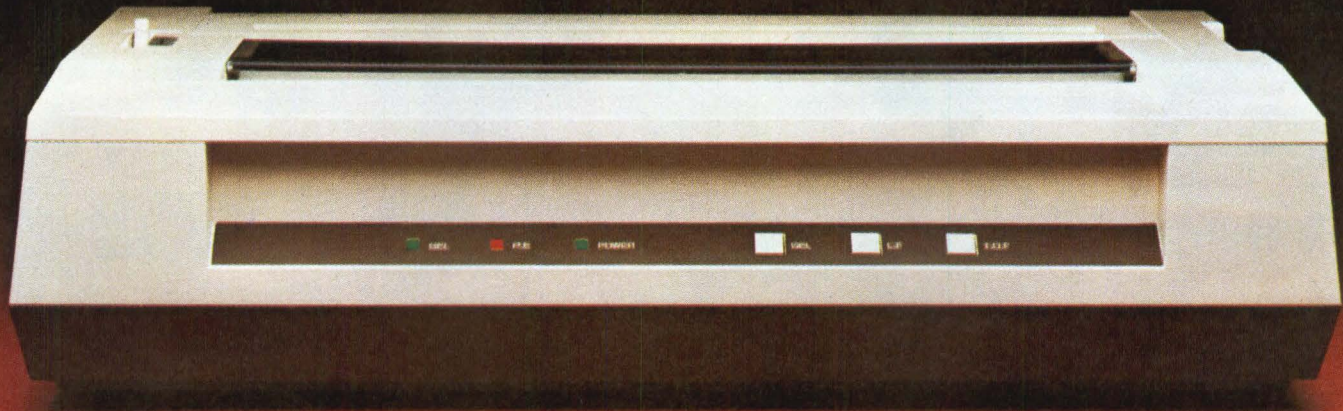
**Random disk files:** Media appears to be the message being received in the Silicon Valley venture-capital community as at least three media start-ups have sprung up in the last two months. **Grenex Corp.** received a third of its funding from Seagate Technology and the rest from venture capitalists. The Sunnyvale, Calif., firm will specialize in vertical recording media and expects to have a product in early 1984. It is headed by former Seagate chemical engineer Earl Blevis....**Akashic Memories** was formed in December by John Scott, formerly general manager of Apple Computer Inc.'s Disk Drive division. Akashic will concentrate on thin-film media, in the hope of filling anticipated heavy demand in a market now dominated by Ampex Corp....**Trion Corp.**, Santa Clara, Calif., is still in the formative stages, with principals expected to emerge this month from Verbatim Corp. and Dysan Corp. The start-up will concentrate on 5¼- and 8-in. floppy disks and is expected to offer new packaging and wider distribution. A company spokesman says Trion will attempt to repeal the pseudo-scientific image of floppy disks by distributing them through drugstores and discount outlets....**In just three and one-half months, Hewlett-Packard Co.'s personal computer division has sold nearly 10,000 of its Series 70 systems, incorporating the Sony 3½-in. floppy.** A source high in the personal computer division says 3½-in. floppies already comprise most of the floppy disk systems that HP sells....Perhaps in deference to HP's demands, **Sony Corp.** will continue to manufacture its first-generation 3½-in. floppy. Meanwhile, Sony has agreed to manufacture a second generation of 3½-in. floppies with automatic shutters and other features prepared to the standard sought by a U.S. industry committee including Shugart Associates and Verbatim.

**Terminal files:** Introductions of low-cost color ASCII terminals from **Applied Digital Data Systems** and **Wyse Technology** have fueled speculation about whether other independent terminal vendors will introduce color units. **Hazeltine Corp.**, for example, is believed to have a 640 × 480 dot resolution graphics terminal running in-house based on Intel Corp.'s 82720 color video controller chip, but rumors about Hazeltine wanting to sell its terminal division make the product's introduction uncertain....**Zentec Corp.** is readying a medium-resolution graphics terminal for the OEM that should premiere at NCC, with a list price of less than \$7000....But that price may not be low enough if the rumor of a **Tektronix Inc.** graphics terminal, code-named Unicorn and priced at less than \$5000, proves true....Meanwhile, Berkeley, Calif. start-up **Cubic Systems**, which offers the \$9870 CS-3 graphics system with 512 × 512 dot resolution that performs 3D object manipulations locally, is close to introducing a less expensive product with similar capabilities based on the IBM PC.





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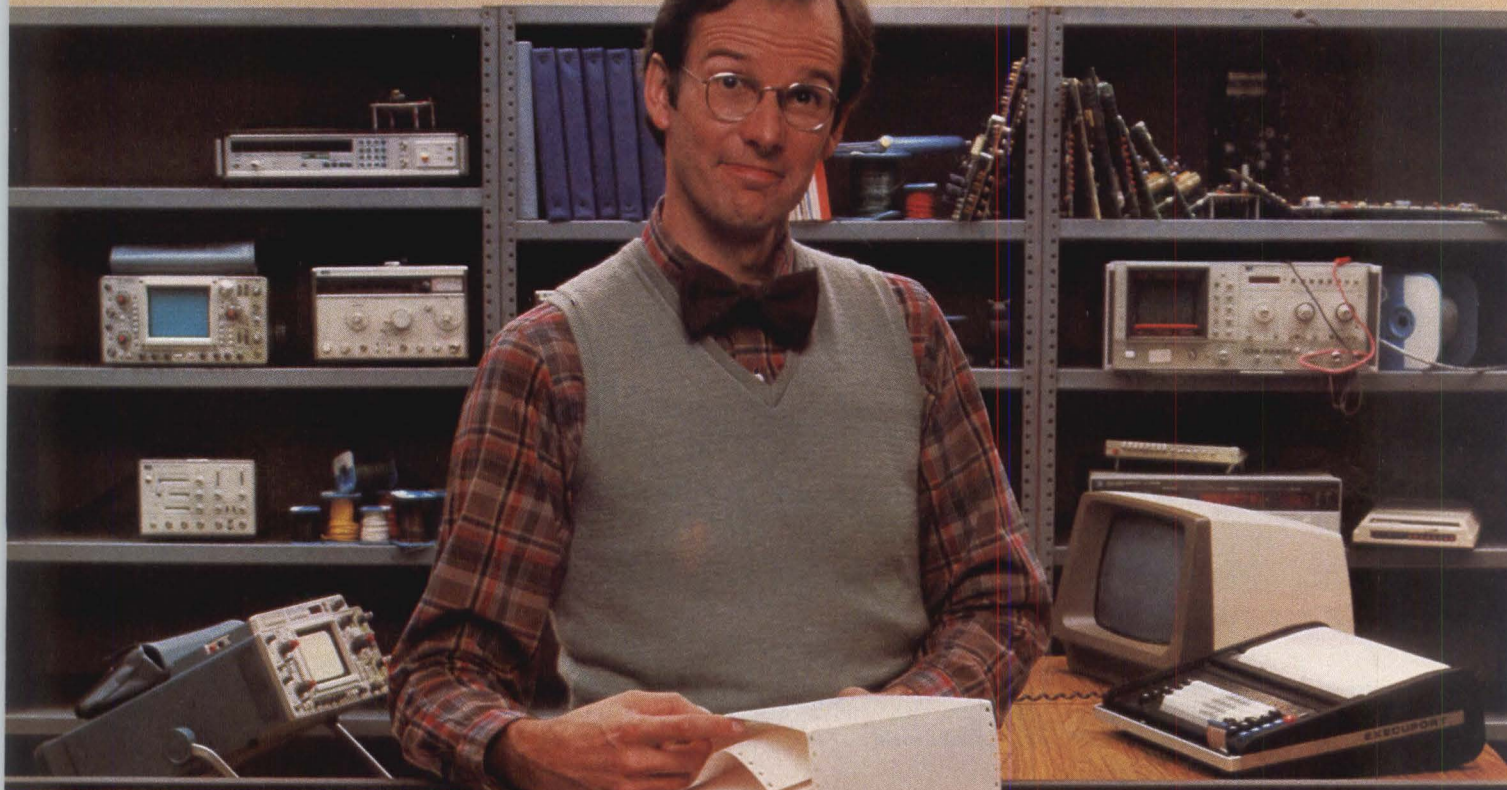
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# Mini-Micro World

NEWS



**Barry Smith, Apple's product marketing manager for Lisa software, says the bundled \$9995 Lisa MC68000-based microcomputer required added memory and disk space to run a complement of six proprietary application packages. The price also includes 1M byte of main memory, two built-in minifloppy drives, a Seagate 5M-byte, 5¼-in. Winchester disk drive, a keyboard with calculator keypad, a 12-in., black-and-white bit-mapped display, a mouse data-entry device, two serial ports and one parallel port, the Lisa operating system and five application packages. (Photo by Mort Thomas)**

## Apple bets on proprietary software in its bid for office systems market

Apple Computer, Inc., last month became the latest vendor attempting to bring office automation to the desks of office professionals and middle managers with the introduction of its long-anticipated Lisa system. Based on a Motorola MC68000, the system is offered in a tightly bundled \$9995 package that includes a proprietary UNIX-like operating system and six proprietary application packages.

With an optional Apple local-area-networking scheme, Lisa appears to be aimed squarely at the major account office-automation territory that Xerox Corp. staked out almost two years ago with its Star 8010

workstation/Ethernet combination.

The basic Lisa system is built around a 5-MHZ, 16-bit MC68000 microprocessor with 1M byte of main memory implemented in 64K-bit RAMs. It includes two built-in Apple minifloppy disk drives (see "Apple to manufacture disk drives," p. 18), a Seagate 5M-byte, 5¼-in. Winchester disk, a typewriter keyboard with calculator keypad, a 12-in. black-and-white, bit-mapped display, a mouse, two serial ports and one parallel port. The \$9995 package also includes the Lisa operating system, LisaCalc, LisaWrite, LisaGraph, LisaDraw, LisaList and LisaProj-

ect application packages that are, respectively, spread-sheet analysis, word-processing, business-graphics, diagram-drawing, database-management and project-management packages.

The company originally had planned to market the system in a \$6995 version with 512K bytes of main memory, a keyboard, a display, dual floppy disks and the operating system, but shortly before introduction, marketing management decided to offer the bundled \$9995 version instead. The added memory and disk space are necessary to run the full complement of Lisa software efficiently,



says Barry Smith, Apple product marketing manager for Lisa software. The \$9995 version, with the added memory, rigid disk and application programs (each of which was to have been separately priced at \$300 to \$500), represents \$13,000 to \$14,000 worth of hardware and software, he claims.

The Lisa system is the first product of Apple's two-year-old, 70-employee Personal Office Systems division, headed by former software vice president John Couch. The Lisa project, initiated four years ago, represents a major corporate commitment to enter the high-stakes office-automation market against not only Xerox Corp., but also Wang Laboratories, Inc., and IBM Corp., among others.

However, Apple has also taken steps to retain its position in the traditional personal-computer market, in which its new office-automation rivals have already invaded Apple turf with their personal computers. With the Lisa introduction, the company announced a re-engineered version of its mainstay, the Apple II (see "E stands for extended life," p. 20).

Lisa, which stands for locally integrated software architecture, embodies many of the user interface principles that Xerox's Office Products division pioneered with its \$16,500 8010 Star workstation. Both systems use a proprietary operating environment that is tied to the system hardware. Both use multiple windows on a high-resolution display to replicate papers on an executive's desk, and both rely on an electromechanical mouse device to point and select data or functions represented by symbols on the screen.

One of the key differences, and one that Apple president Mike Markkula cites as among "the most significant" aspects of the Lisa program, is a third-party software

program. Unlike Star, which is restricted to Xerox applications, Lisa is expected to have an array of third-party applications that will be developed using a Lisa tool kit. Price for the Pascal-based tool kit has not been set, but Smith says he expects it will be available to software developers in the fourth quarter of this year. For other applications that Smith calls "classic high-end personal-computing packages," Apple offers developers and end users a choice of BASIC, Pascal or COBOL packages that have been tentatively priced at around \$1000. Smith says FORTRAN will also be

added.

While Smith says the Lisa software system will remain "married" to the Lisa hardware package, he indicates that the company is looking at other operating systems to coexist with Lisa's. "In addition to our own operating environment, we want to bring up CP/M, and we're moving on UNIX," he says. The company's own Apple DOS and SOS operating systems proved too expensive to adapt as emulation packages on Lisa, he says.

The Lisa operating system is written mainly in Pascal, as are the applications. About 2 percent of the

## APPLE TO MANUFACTURE DISK DRIVES

Apple Computer, Inc., a pioneer in personal computers, is one of the first personal computer companies to design and manufacture its own disk drives. Even Apple's newest and most serious rival, IBM Corp., buys drives for its Personal Computer from Tandon Corp., a high-volume, low-cost supplier.

The new drives will be offered with the Apple III, as well as the new generation of Apple microcomputers.

Apple previously bought its drives from Alps Electronics of Japan and added electronics and heads from its head manufacturing plant in Newbury Park, Calif. The new generation of higher capacity drives—UniFile and DuoFile—will be completely manufactured at the Southern California facility. Alps will continue to supply its drives for the Apple II and will become a second source for the new generation of Apple drives.

Software and controller modifications would be required to make UniFile and DuoFile compatible with the Apple II, says Barry Yarkoni, marketing manager for Apple's Peripheral Systems Division. "Those modifications are not in the works, but that's not to say it isn't planned in the future," he says.

UniFile is a single drive unit with an unformatted capacity of 871.4 bytes, or four times the capacity of the current generation of Apple drives.



DuoFile contains two drives, for a total unformatted capacity of 1.6M bytes. To achieve that capacity, Apple will buy media from Verbatim Corp., 3M Co. and others. Apple's new drives will operate at 62.5 tpi, up from 48 tpi on the current generation of Apple drives. Apple did not go to 96 tpi for reliability reasons, Yarkoni says. "We don't believe—and our media suppliers certainly don't believe—that 96-tpi densities will provide enough data integrity for our users," he says.

The foremost consideration in the media is to the sensitivities of personal computer users, Apple officials say. Even though the Apple III and the new generation of Apples are aimed at the business market, many of the new users have not been trained in the proper care and feeding



operating system is written in assembly language, and most of that is dedicated to the graphics kernel so that Lisa can have quick graphics processing without the expense of a graphics co-processor, Smith says. He adds that Apple looked at UNIX as Lisa's operating system, but decided too many alterations would be required to attain Lisa's rapid inter-process communications and file protection.

In the near term, Apple is concentrating its efforts on selling the system through select members of its dealer network and a national accounts sales force that is expected

### ETHERNET TO BE OFFERED ON APPLE II AND III

3com Corp. has signed a multimillion-dollar contract with Apple Computer, Inc., to provide Ethernet local networking products for the Apple II and III. Ethernet has been adopted as a standard by more than 40 U.S. and foreign companies, the European Computer Manufacturers Association and the Institute of Electrical and Electronics Engineers. Bill Krause, 3com president, predicts a shift to networked personal computers in the next five years as a cost-effective replacement for time-shared minicomputers. Shipment of Ethernet prototypes to Apple were scheduled to begin last month. The contract covers 3com shipments to Apple through June, 1986.

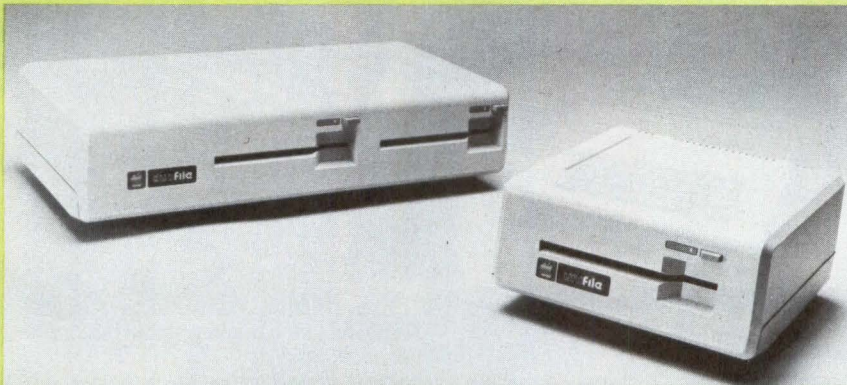
to reach 100 representatives—double the current level—when Lisa is shipped in late spring. About 150 dealers had previewed the system by the end of last year,

Smith says, and Apple anticipates that 15 to 20 percent of the company's 1400 domestic retail outlets will qualify to handle the new system. Dealers that qualify must demonstrate the ability to provide training and on-site support as well as the financial strength to carry a more expensive product. Other computer dealers that have found previous Apple products not sophisticated enough for their markets may sign with Apple for Lisa, Smith says.

Beyond 1983, however, the company sees "OEMs as a really big potential outlet for this product," Smith points out. Both hardware and software OEMs will be signed to address vertical market niches by 1984, he predicts. In the meantime, Apple will concentrate on selling the tightly bundled Lisa package to end users.

As in Star and the recently introduced Visi<sup>On</sup> package from VisiCorp (MMS, February, p. 00), the application programs and documents created are presented as multiple, overlapping windows on the screen. Using the mouse to point and select, a user can bring a "page" to the top of the screen and shrink or expand the size of the window. The bit-mapped screen addresses 720 pixels vertically and 364 pixels horizontally.

The Apple networking scheme uses coaxial cable, which will be sold in pre-cut lengths for easy installation. Smith says the company



Apple Computer has redesigned its disk drives for the Apple III and its new generation of business computers both inside and out (right). The new design stresses ergonomics on the outside and data integrity on the inside. The first generation of minifloppies will continue to be manufactured for Apple by Alps Electronics of Japan for use on the Apple II.

of media. "Most media is made to withstand the extremes of room temperature. We have gone beyond that to allow the media to withstand temperature ranges as high as 140°," Yarkoni says.

He adds that users often move flexible media from place to place. For example, they store it in a cool place such as a briefcase in a car trunk and then take it indoors. The result is often damaged media, Yarkoni says. Use of the head-disk assembly also reduces media wear because heads are located at opposite ends and sides of the diskette, unlike a standard double-sided assembly, which posi-

tions the heads on the same end and thereby increases pressure on the media.

The drive has eight electronically controlled motor speeds, which vary from track to track to use each track to its fullest bit density. Outside tracks previously could not achieve the same density as inside tracks because of the ways the heads were moved over the diskette.

Both drives will be available in the second quarter of this year. UniFile lists at less than \$1000 each, and DuoFile lists at less than \$1700.

—Robert A. Sehr



# Mini-Micro World

NEWS

decided on a proprietary network instead of Ethernet or other commercially available networks to assure easy installation. Apple Net is a 1M-bit-per-sec. baseband system that uses carrier-sense, multiple-access with collision detection techniques similar to and, Smith says, "very compatible" with the Xerox Ethernet scheme. He says an Ethernet interface is under development. Apple Net has a practical limitation of 128 nodes, but is

optimized for work groups in the four- to 20-node range, he adds.

He says Apple Net connections—using one of three available card slots in the Lisa cabinet—are expected to retail for \$500 per terminal. The principal applications for the network are peripheral sharing and data exchange. Apple Net is expected to support Apple II and III connections as well, but plans for those products are not complete.

For communicating with corporate data-processing installations, Apple offers LisaTerm at introduction. Priced in the \$300 to \$500 range, the package emulates standard Teletype and Digital Equipment Corp. VT52 and VT100 protocols. Packages for IBM 2780/3780, 3270 bisynchronous and 3270 SNA protocols are expected to follow within a year.

—Geoff Lewis

## AT APPLE, E STANDS FOR EXTENDED LIFE

Apple Computer, Inc., is hoping to keep its mainstay Apple II line in high-volume production through the mid-1980s, and possibly beyond, with a re-engineered version of the original machine. The Apple II, which came to the market five years ago and helped take personal computing from a hobbyist base to a worldwide business market, has reached the end of its manufacturing cycle in terms of cost reductions, Apple officials say.

Its replacement, the Apple IIe, is introduced in a \$1395 configuration that includes 64K bytes of memory, upper- and lower-case characters, a full ASCII keyboard and a system disk. The price is only slightly higher than street prices for the 48K-byte Apple II+ version it replaces, which is limited to an upper-case display.

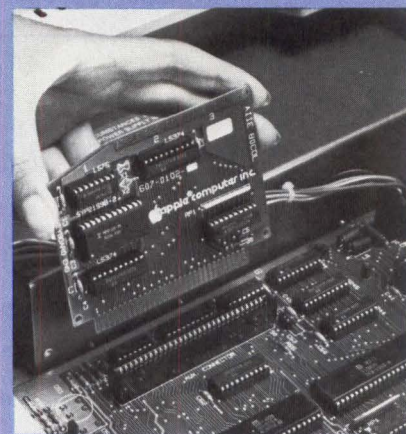
However, although both products use the 8-bit 6502 microprocessor, the IIe is more than a straightforward replacement for the aging II, product manager George Johnson notes. Not only does it offer an advance in packaging—the IIe is based on a single printed-circuit board with 31 integrated circuits that replaces the II's three-board, 109-IC design—but it also positions Apple to battle more aggressively in the growing market for unsophisticated users and international customers, Johnson says. He points out that the unsophisticated user segment now accounts for 75 percent of all personal computer purchases. That user, which Apple research defines as the well-educated consumer with an annual income of \$35,000 and a desire to become a



The Apple IIe is Apple's attempt to extend the life of its popular Apple II.

computer literate, will be the main focus for Apple IIe and competitive products. Apple feels that a fully configured system package selling for around \$2000 will appeal to this market and has configured a \$1995 IIe with a CPU, one disk drive, a monitor, a monitor stand and an 80-column card. To address the international market better, Apple has included the full ASCII keyboard and has designed a switch for the back of the system box that will activate a choice of 15 ROM-based foreign-language character sets.

More significant for Apple is the IIe's design, which allows easy manufacture and further cost reductions. The IIe is also designed to be twice as reliable as its predecessor, says Apple engineer Walt Broedner. The CPU board can eventually be manufactured in Singapore using auto-insertion machines, robot stampings.



A special video display slot in the Apple IIe accepts a new low-cost 80-column card. Apple will market an additional card providing 80 columns and 64K of RAM. Apple redesigned the main logic board for the Apple IIe, using one printed-circuit board with 31 ICs instead of 109 ICs on the three-board Apple II. Both products are based on the 8-bit 6502 microprocessor.

Other improvements in the IIe address both the needs of the naive user and frequently cited shortcomings of the II. While the basic system is still restricted to 40 columns, a new 80-column card includes the 64K-byte memory expansion, taking the system to a new maximum memory of 128K bytes. That card is list-priced at \$295, while the 80-column card without the memory expansion is \$125. The 80-column card also includes controls for high-resolution (560 × 192) graphics. For the first time, users can combine a text window with graphics on the same screen. —Geoff Lewis



# Qume takes on TeleVideo in low-end terminal market

Most independent CRT terminal manufacturers sweated blood when TeleVideo, Inc., slashed out a leading market share, and it may be time to sweat again. This year, it's Qume Corp.'s turn. The San Jose manufacturer this month is springing volume shipments of its first ASCII video display units into distribution channels that are already fiercely competitive. Qume plans to fight its way into the ranks of the top five independent VDT vendors within a year. This will require carving up some well-established competition in a low-growth market, and convincing dealers its products offer a significant price/performance advantage.

The new VDTs are being built to Qume's design and quality-control criteria in Taiwan under exclusive contract, with quality assurance supervised by Qume's recently established Taiwan subsidiary. The first entry is the QVT102, a unit that is list-priced at \$695, with such ergonomic features as a detachable, low-profile keyboard, a non-glare tilt and swivel display in standard green or optional amber phosphor and 9 x 12 character cell resolution with true lower-case descenders. Qume compares the features of the QVT102 to the \$695 list-price offerings of the four highest volume VDT manufacturers—TeleVideo, Lear Siegler Inc., Applied Digital Data Systems and Hazeltine Corp.—all of which the QVT102 emulates via a menu-driven setup mode, to illustrate what director of marketing Keith Rapp claims is unparalleled price/performance.

But what chance does Qume have in such a competitive market, which is marked by eroding margins? Sources close to both Qume and the Taiwan electronics industry confirm



**Qume's new terminal line, all members of which are housed in the above casing of the QVT102, is said to offer better price/performance than competing low-end CRT's. Qume hopes to become one of the leaders in that fiercely competitive market.**

that Qume will have sufficient margin to support the QVT102, given an estimated price to Qume of \$250 for the QVT102. And although

TeleVideo vice president of marketing Steve Tatum thinks the window for gaining large market share with superior price/performance has closed, he says a company that has sufficient margins, makes the right marketing moves and brings to the contest a reputation for timely delivery of quality products could do exactly what Qume intends to in the ASCII terminal market.

It will take more than one model, however. Qume plans first shipments in February of the smooth-scrolling QVT108, which emulates the TeleVideo 925/950 code structure and features 11 function keys, six direct editing keys and two pages of memory for \$895. A third terminal sharing the common family housing is a Digital Equipment Corp. VT100/132 emulator dubbed the QVT103. Although the specification on the ANSI X3.64-compatible 103 is not firm, Qume hopes to include memory expansion to four pages and several open slots. But achieving that may be tough, says Rapp, because at a list price of \$895, the unit is already several hundred

QVT-102 Comparison chart of standard features	Qume QVT 102	Televideo 910	LSI ADM 5	ADDS Viewpoint	Hazeltine 1500
Display character size	7 x 9	7 x 8	5 x 9	5 x 8	7 x 8
25th status line	Yes	No	No	No	No
Menu set-up	Yes	No	No	No	No
Line drawing set	Yes	No	No	No	No
Detachable keyboard	Yes	No	No	Yes	No
Low-profile keyboard	Yes	No	No	No	No
Separate programmable function keys	4	0	0	0	0
Switching power supply	Yes	No	No	No	No
Screen tilt	Yes	No	No	Yes	No
Screen rotate	Yes	No	No	No	No
Line block transfer mode	Yes	No	No	No	No
Page block transfer mode	Yes	No	No	No	No
Unprotected block transfer	Yes	No	No	No	No
Screen-saver time out	Yes	No	No	No	No
Insert/delete line	Yes	No	No	No	Yes
Insert/delete character	Yes	No	No	No	No
Clear unprotected	Yes	No	No	No	Yes
Forward/Backward tab	Yes	Yes	No	No	Yes
Column tab positions	80	80	0	0	0
Print key	Yes	Yes	No	No	No
Programmable answerback	Yes	No	No	No	No

Source: Qume Corp.



# YOU CAN'T CO YOU'VE GOT NO

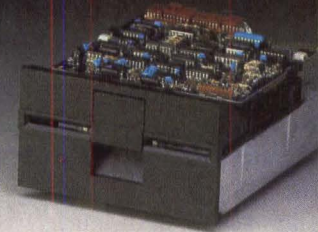
That's quite a claim. How can we make it? Quite simply, because no one else is trying to do what we've set out to do.

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\$200 or \$300 'home' system with meaningful capacity—not just a game or toy—most households will be able to afford one. Then we will see a real mass market.

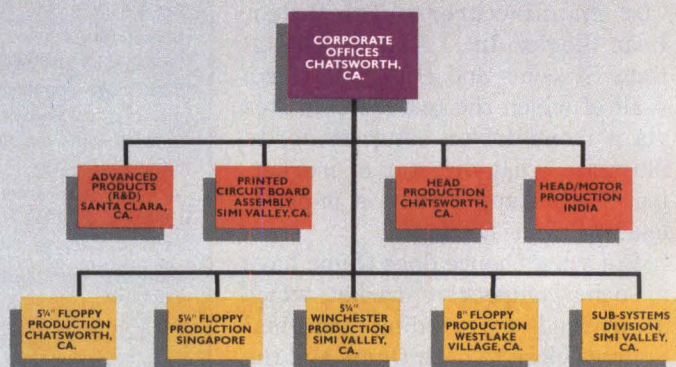
"At the upper end, if we can give small business and personal computers 10 to 50 times their current memory/storage capabilities at a practical cost, we will enlarge the market for more sophisticated desktop systems, and of course, our own market as well!"

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keeping their individual priorities distinct to further increase productivity and, ultimately, throughput.

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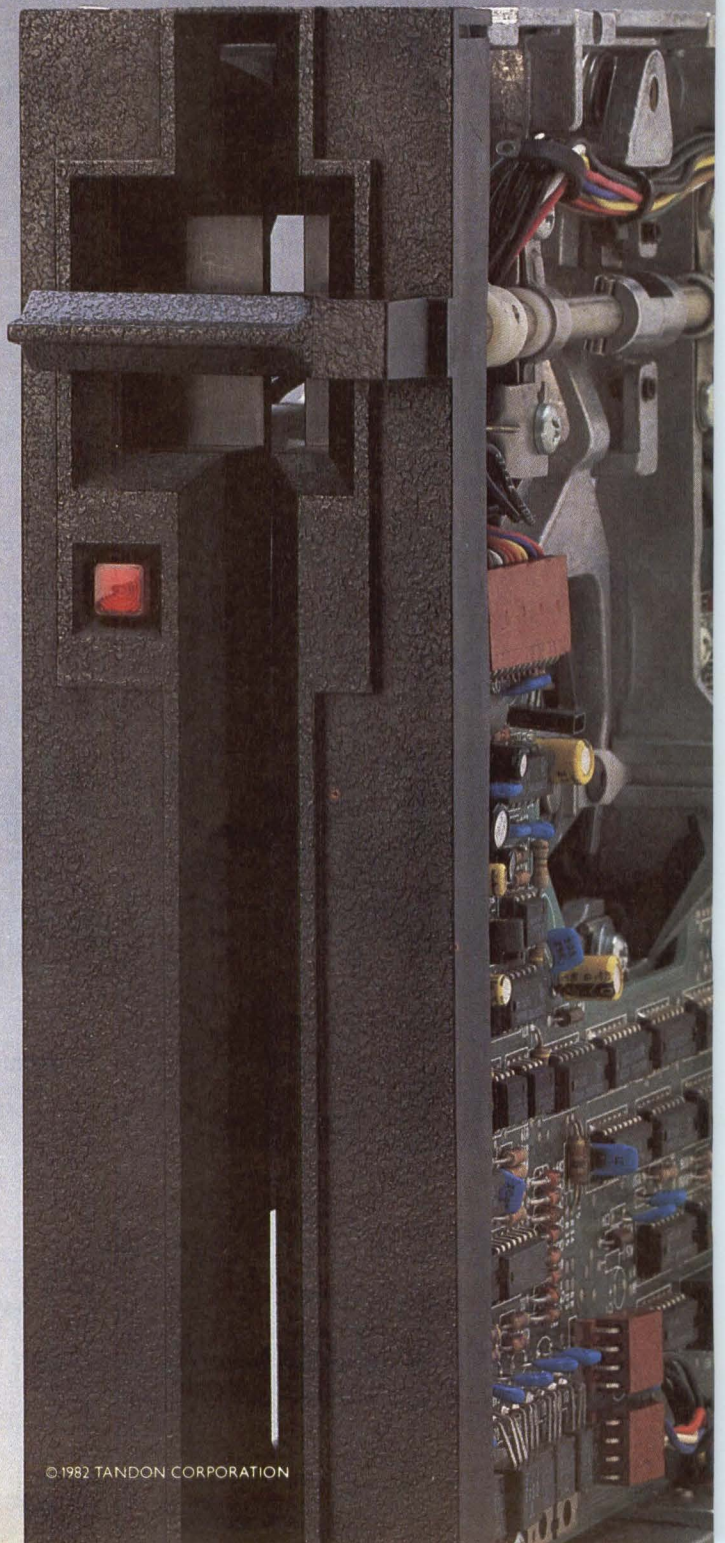
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# Mini-Micro World

NEWS

dollars less than any other ANSI-compatible terminal on the market.

Rapp says Qume has strong backing from parent ITT Corp. for its ambitious and expensive plans, which include matching the advertising budgets of the competition from the outset. The corporation is willing to take the risk, Rapp says, because top management carefully examined TeleVideo's aggressive distribution strategy that helped catapult TeleVideo from ground zero to the top of the independent VDT heap in less than two years and convinced top management they could succeed. Rapp looks to TeleVideo as the model rather than to the OEM emphasis that led to Qume's success in printers. He expects an 80:20 mix of distribution and OEM sales, but the company

needs a number of high-volume distributors to achieve it.

"We are as serious as a heart attack about satisfying the demands of the distribution channels," he says. David M. Aronowitz, program manager of electronic office services for market research firm Gnostic Concepts, Menlo Park, Calif., says that kind of emphasis will be necessary if Qume is to succeed.

"Most of the major distribution channels for terminals are saturated," says Aronowitz, "and the dealers have tremendous brand loyalty. Qume is going to have a tough time gaining the necessary shelf space unless dealers perceive a significant price/performance advantage."

Although confident on that score, Rapp concedes it will take time.

"We don't expect distributors to trip over themselves tossing current brands out the door to bring us in," he says. "But flexible terms on initial shipments will make it painless to try the product." Rapp declines to spell out those terms.

Qume will ask distributors to handle the entire line of VDTs, but allow them to swap slow-moving for fast-moving products twice a year. Distributors will get price protection in the form of product credits, equal to the difference between the old and new price at quantity of stock on hand, if competitive pressure or lower costs dictate list-price reductions by Qume. Rapp also pledges to avoid pitting Qume distributors against each other by guaranteeing territories.

Another major selling point for

## PLUG-IN MODULES KEY IN QUME'S LATEST PRINTER OFFERING

In line with Qume Corp.'s intention to become a one-stop shopping center for computer peripherals, the San Jose, Calif., manufacturer also plans to become the plug-in printer house for the word-processing and desk-top computer industry. The first two members of the company's new letter-quality daisy-wheel printer family, the Sprint 11/40 and 11/55 Plus, showed up at Comdex '82 in Las Vegas.

The Sprint 11s get their "plus" from an interchangeable communications module, designated the Qume connection, that plugs into the back of a CRT. This provides compatibility to perform word-processing application software used on microcomputers from such companies as IBM Corp., Hewlett-Packard Co., Xerox Corp., Commodore Business Machines, Inc., Tandy and North Star Computers, Inc. "We specifically targeted the rapid desk-top computer market when we designed the communications module," says Lee Cannon, Qume's director of printer marketing. Three interfaces—an RS232C, a Centronics parallel and and IEEE-488 (HP-IB)—will interface with 95 to 99 percent of



Qume's Sprint Plus daisy-wheel printers include the "Qume connection," an interchangeable communications module that plugs into the back of a CRT to make the printers compatible with a number of microcomputers running word-processing software.

Qume's target systems, he explains. Future uses for the printers are word-processing, scientific, engineering, financial and multilanguage applications.

Based on an Intel 8085 8-bit

microprocessor, the Sprint 11/40 Plus and 11/55 Plus feature print speeds of 40 and 55 cps, respectively, MTBF rates of 5500 hours at 25-PERCENT DUTY CYCLES AND 63- to 65-dba acoustic noise levels. The fully formed character printers use Qume's standard 96-character print wheels. The company's future plans, however, call for higher speed Sprint 11 family members with 130-character print wheels. The 11/40 and 11/55 print 132-, 158- and 197-character lines at 10, 12 and 15 cpi, respectively.

The Sprints use a Qume continuous-loop, fabric ribbon enhancement designated the Multistrike IV cartridge. A bidirectional forms tractor and a single-bin sheet feeder are also available for paper handling. The printers handle paper as wide as 15 in.

The list price of each communications module is approximately \$100, and the retail price of the printer is \$1776. OEM discounts are available. Qume will market the devices through its traditional distributors, dealers and OEMs, says Cannon. Deliveries have begun.

—Nancy Love





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the new terminals, says Rapp, is Qume's new policy of one-year guarantees for its entire product line. Six months of the guarantee goes to the distributor, and six months to the end user, although distributors can pass along the remaining portion of their guarantee if the product moves in less than six months. "The competition offers 90 days," Rapp says.

Lear Siegler, Inc., director of marketing Catherine Raftery confirms the 90-day norm, but dis-

counts the impact of extending the warranty because, she says, "Today's terminals are pretty reliable." George Chao, president of San Francisco terminal importer Liberty Electronics, agrees. The mortality curve for VDTs is greatest up front, he says, and a guarantee beyond 90 days is just fluff.

But Gnostic's Aronowitz says the one-year guarantee will help Qume gain market share, especially if the company isn't touchy about customers breaking the seal. "If they

certify that the addition of particular endorsed graphics and modem boards won't blow the warranty, dealers will be attracted by the chance for add-on sales," he says. Rapp says Qume policy is not set in this area, but hints that dealers' desire for add-on sales will be satisfied by forthcoming options.

Qume plans extension of its new terminal line by the end of the year, adding such features as a full-page, display, bit-mapped graphics and possibly color. —Kevin Strehlo

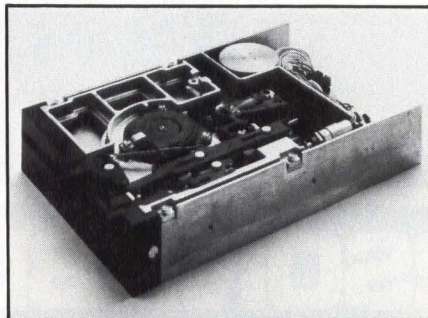
## Amlyn, DriveTec push minifloppy capacities to more than 3M bytes

The 5¼-in. minifloppy, which helped launch a revolution in desk-top computer systems, has been relegated to limited backup roles because of limited capacities.

Until Amlyn Corp. last year developed an 8M-byte minifloppy drive, using five 1.6M-byte platters, minifloppies were limited to at best 1M byte.

Now, however, Amlyn and DriveTec Inc.—both San Jose start-ups—have begun a new era in minifloppies with drives yielding 3.2M and 3.3M bytes, respectively. In addition to the start-ups, established floppy manufacturers such as Shugart Associates, which developed the minifloppy in 1979, are believed to be developing a 5M-byte floppy on a single platter that may be available by this year's National Computer Conference.

Sophisticated operating systems such as UNIX and OASIS take up almost all the disk capacity of this generation of minifloppies, leading system integrators to specify a minimum 5¼-in. Winchester in desk-top systems. Users of desk-top systems, however, are believed to prefer removable floppies.



DriveTec Inc. has packaged its 3.3M-byte minifloppy in a half-height design, allowing a double-drive 6.6M-byte capacity in the same space as that typically used by a regular minifloppy.

Until recently, track densities on the minifloppies were limited by technology to 96 tpi, consequently limiting capacity. "It's the age-old game of the disk-drive industry," says Jim Snow, vice president of marketing for Amlyn, referring to the natural tendency of disk-drive manufacturers of any-sized products to put more capacity in a smaller space. "If these (minifloppies) didn't do that, it would be an industry first."

Amlyn has been shipping its original drives since last April, and has now retooled the 8M-byte drive to a single-platter arrangement

that, like the original drive, uses coated media. The drive has a track density of 170 tpi and a recording density of 9500 bpi. The drive is available in both single- and double-sided versions, achieving 1.6M- and 3.2M-byte capacities, respectively. The 1.6M-byte version is dubbed the 1850, and the 3.2M-byte version is the 1860.

The Amlyn drive's 170 tpi is achieved through a servo track configuration. In contrast, the DriveTec version uses a proprietary servo to achieve its 192-tpi density, which translates into 3.3M-byte capacity on the double-sided, half-height drive.

The DriveTec 320 drive features a two-stepper-head actuator, allowing one stepper to be used to make large movements of the gum-ball-shaped head and a second stepper for more precise movements. The result is that heads can move at the precision of 200 µin., with less pressure on the 50-µin. media.

Media for the DriveTec drive is manufactured by Dysan Corp., Maxell Corp. of America, BASF

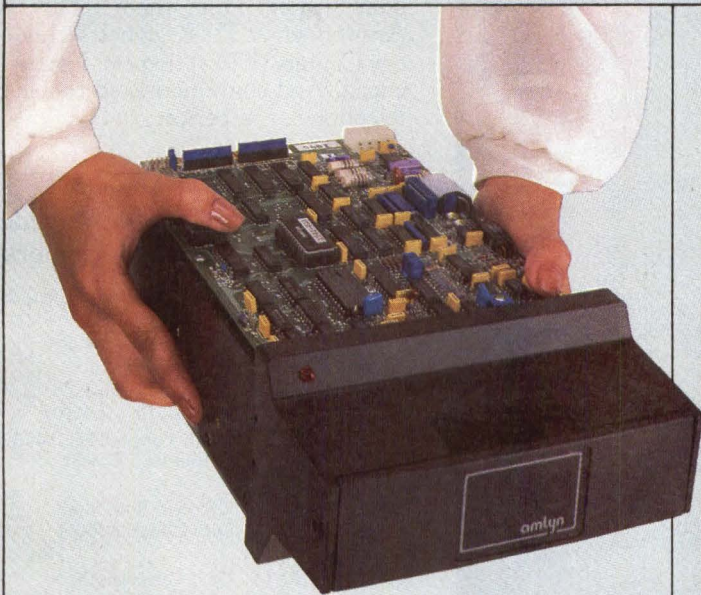
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# THE 8MBYTE FLOPPY SURPRISE

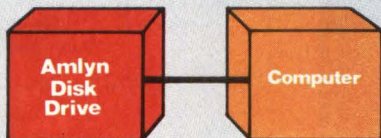
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## Dynamic On-Line Operation

Amlyn drives provide 8 MBytes in the same space as a standard mini-floppy. Amlyn has combined the capacity of Winchester drives with the advantage of removable media.



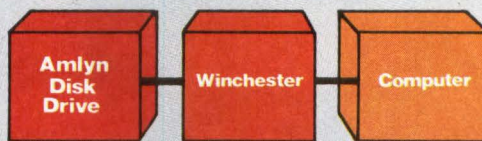
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## Removable Media

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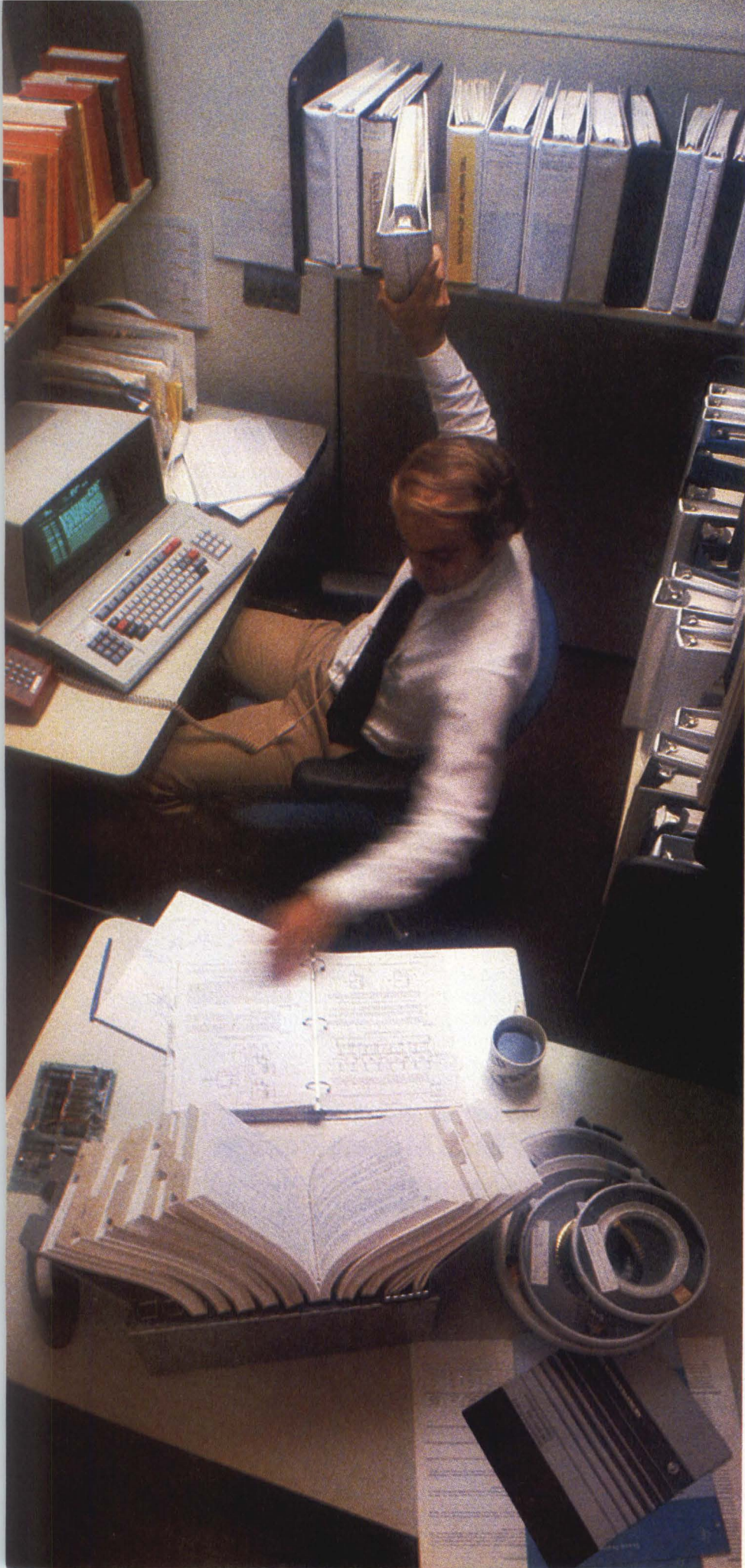


## Standard and Flush Mount Design

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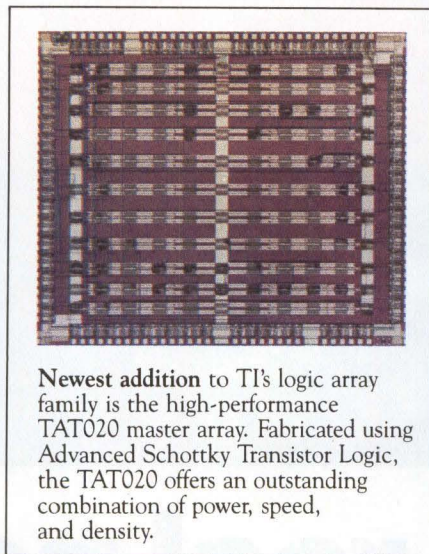
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Array	Gates**	Technology†	Gate Delay	Gate Power	I/O Signals
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TAL004*	400	LPS	5.0 ns	1.25 mW	42
TAT004	400	STL	2.5 ns	600 $\mu$ W	76
TAT008	800	STL	2.5 ns	600 $\mu$ W	104
TAT010	1000	ASTL	1.0 ns	300 $\mu$ W	88
TAT020	2000	ASTL	1.0 ns	300 $\mu$ W	120

\*TAL Series Arrays are manually routed by you and schematically verified by TI with your software HDL model prior to prototyping.

\*\*Usable gates

†LPS — Low-power Schottky

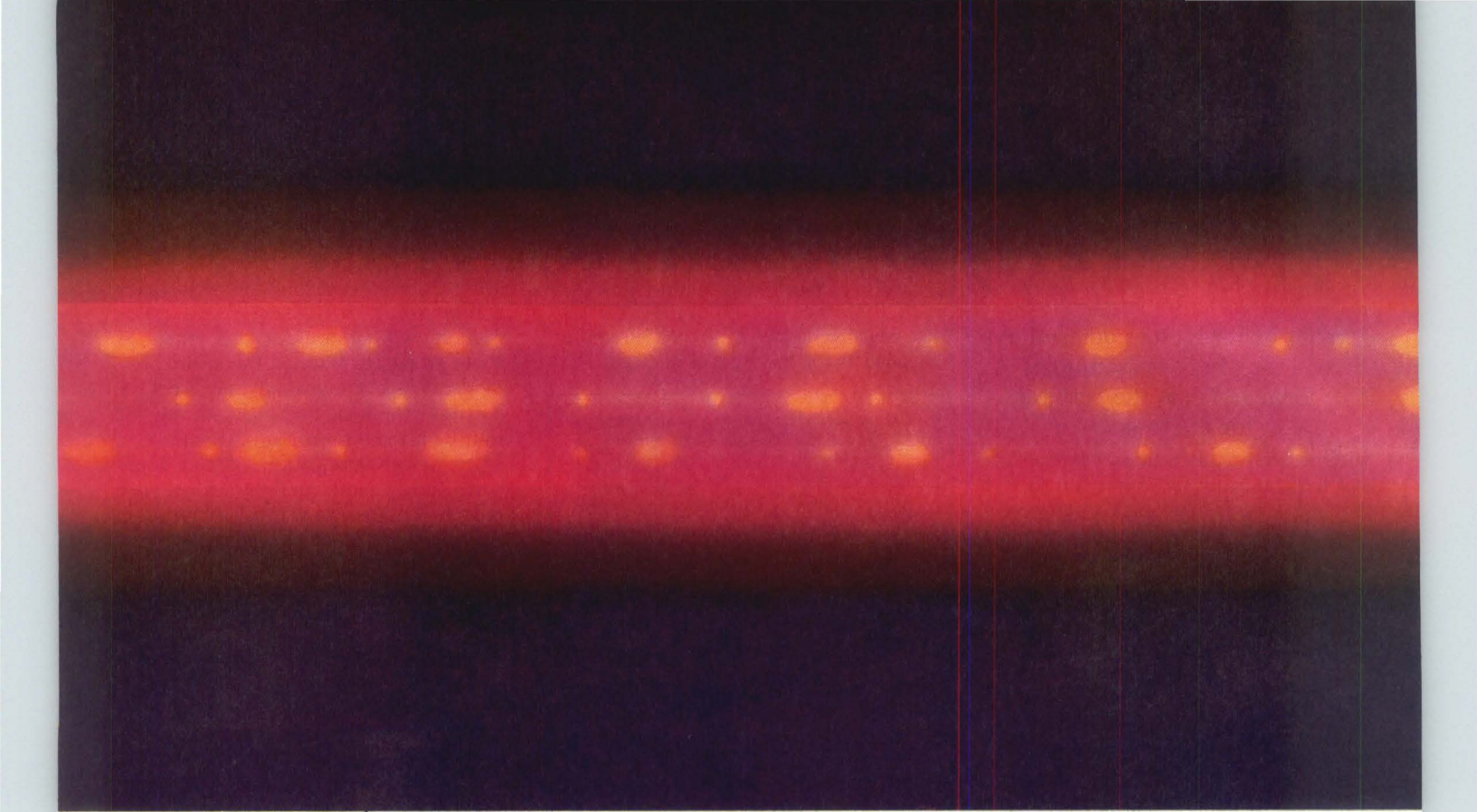
†STL — Schottky Transistor Logic

†ASTL — Advanced Schottky Transistor Logic

MIL versions of all these logic arrays are available from Texas Instruments.

CIRCLE NO. 18 ON INQUIRY CARD



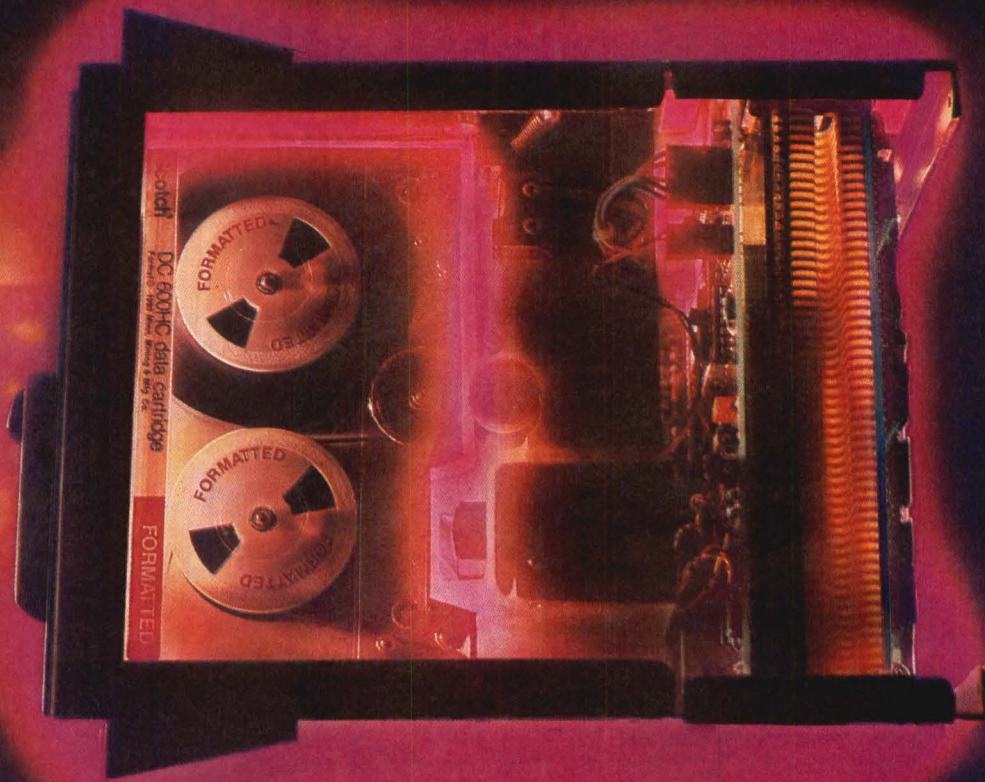


**It takes real nerve  
to compare our  
1/4" back-up system  
with 1/2" drives.**

**It also takes  
67 megabytes.**

---





## HCD-75: so much for so little.

Presenting the only 1/4" cartridge back-up system that'll go head to head with 1/2-inchers in the critical 30-70 Mbyte range.

The reason is simple. The 3M Brand HCD-75 Data Cartridge Drive System gives you 67 Mbyte per cartridge formatted. No other cartridge drive gives you so much capacity.

There's nothing medium about the medium, either. Each Scotch® DC 600HC cartridge is pre-recorded with permanent forward/reverse-reading block keys. They give you block-addressable storage. You get compact recording on all 16 tracks, with a density of 10,000 frpi, without rewinds.

The HCD-75 system, including drive and controller, is about one-fifth the size of a 1/2" tape drive. You don't have to put back-up and I/O plans on the back burner because of size constraints.

## Interchange for the better.

Cartridges interchange quickly and

easily. Tape-to-head alignment is ensured by a special sub-routine. It automatically aligns the read-write head and stepper motor controller to the tape edge each and every time the operator puts a cartridge in the system.

There's brain to this back-up, too. First, all its functions are handled through its controller. And second, there's minimal host involvement, so host time can be freed up for more critical functions.

## All the reliability without high cost.

You can run one HCD-75 drive off the controller, or two, or three, or four. You still get all the reliability of the high-priced drives. The HCD-75 runs self-test routines to ensure proper operation. It gives you sophisticated error messages when faults are detected.

Advanced error-detection/correction routines keep working to deliver extremely low error rates. The micro-processor controls the drive functions; so potentiometer adjustments are a thing of the past.

## Back-ups without back orders.

The whole shooting match—drive, controller, preformatted Scotch DC 600HC cartridges—is ready for immediate delivery. One at a time or in production quantities—you name it. (Also ask about 3M's proven family of 8" Winchester compact disk drives.) Haven't you waited long enough for a reasonable, reliable, truly high-capacity alternative to 1/2" drives?

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**3M hears you ...**

CIRCLE NO. 19 ON INQUIRY CARD

# 3M



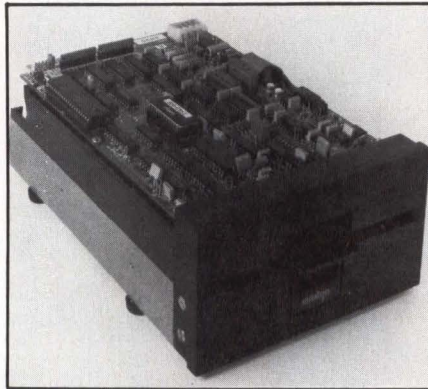
*Continues from page 26*

Systems Corp., Brown Disk Manufacturing Co. and others. The Amlyn media is manufactured by Dysan, Brown Disk and Verbatim Corp. DriveTec officials contend that their drive can also read data from the Amlyn drive. The Amlyn drive can read media from any standard 5¼-in. drive.

Compatibility will be key to the acceptance of the drives. Both Amlyn and DriveTec are searching for manufacturers willing to second-source their drives. Amlyn has signed French media manufacturer Rohne Poulac to second-source its drive in Europe and is signing a second source in the U.S. Amlyn was expected to name a domestic second source in the first quarter of this year.

DriveTec too is in discussions for a second-source agreement, which it puts as top priority in its post-introduction marketing strategy.

Independent disk-drive authority Jim Porter cites the need for both companies to establish second-source agreements quickly. He recalls the major role played by Texas Instruments Inc. in its decision to second-source Seagate Technology Corp.'s 5¼-in. Winchester. That decision affected the early acceptance of the pioneer technology. "The acceptance for these



**Amlyn will ship a half-height version of its high-capacity 3.2M-byte floppy drive this year.**

drives will be there," Porter says, "but it will be slow at first until the technology is endorsed by others in the industry."

Although the most obvious role for the new drives is as backup for the new generation of higher capacity 5¼-in. Winchesters, both DriveTec and Amlyn contend that this will not be the primary role. "We don't expect to position ourselves in the Winchester backup marketplace—although we naturally aren't going to turn down that business," says DriveTec marketing director Vlad Langer. "We expect our drives to go into the newest generation of desk-top systems."

Many of these new systems will require operating systems such as UNIX or OASIS, which demand large

disk space, Langer contends. Even 8-in. floppy drives have a maximum capacity of 1M byte, he notes.

Amlyn's Snow agrees, noting floppy drives are still far from their peak capacity. Media availability, especially the thin-film media being used, has been the stumbling block to increasing floppy capacity, Snow says. With the new media available in volume, new technology is likely to increase floppy capacity by as much as 3 or 4 times over current drives.

Snow says there are likely to be several more manufacturers of high-capacity floppies joining DriveTec and his company by the end of 1983.

Evaluation units of the Amlyn drive were to be shipped this quarter, with volume shipments due to begin in the second quarter of 1983. The 1.6M-byte Amlyn 1850 is priced at \$300 in OEM quantities of 1000, and the 3.2M-byte Amlyn 1860 is priced at \$370 in OEM quantities of 1000.

The DriveTec product, the first for the year-old start-up founded by Shugart Associates co-founder Herbert E. Thompson, will be shipped to evaluation sites in the first quarter, with production volumes slated to begin in the second quarter. The DriveTec 320 is priced at \$325 in OEM quantities of 500.

—Robert A. Sehr

## VisiCorp seeks to set standard with Visi<sup>On</sup> applications-environment package

VisiCorp, the San Jose, Calif., software publisher that skyrocketed to a top position in the retail microcomputer software business with the VisiCalc spread-sheet package, is trying its hand at marketing a homegrown product for OEM customers that it hopes will set standards for the next generation of

personal productivity tools. The product, Visi<sup>On</sup>, is labeled an "applications environment" and is basically a user interface to present applications in a consistent, easily learned format.

Aimed at the largely untapped executive workstation portion of the market, Visi<sup>On</sup> resembles the Xerox

Star and other products developed at Xerox's Palo Alto Research Center, where Visi<sup>On</sup> had its inspiration, say VisiCorp officials.

Like Star, Visi<sup>On</sup> replicates the way an executive deals with sheets of paper on his desk: each application program or document is represented on the screen by a





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CIRCLE NO. 21 ON INQUIRY CARD



# Mini-Micro World

NEWS

window that appears to overlap the "page" beneath it. Like Star, Visi<sup>On</sup> uses a mouse pointing device to invoke commands and select data. Unlike Xerox's icons, Visi<sup>On</sup> uses written English commands displayed on the bottom of the screen.

The most striking contrast to its Xerox model, however, is Visi<sup>On</sup>'s marketing program. Instead of being tied to one machine or operating system, Visi<sup>On</sup> is expected to be converted for use on a wide variety of operating systems and machines. "We truly believe that Visi<sup>On</sup> will become the next standard in personal-computer software. Certainly it will be the standard product under which applications will run," says VisiCorp vice president C. Gerald Diamond.

To promote Visi<sup>On</sup> as a standard, Diamond says, the company will be putting new emphasis on OEM arrangements with leading personal-computer manufacturers and will encourage independent software suppliers to adapt their applications for use in the Visi<sup>On</sup> environment.

The first target systems for Visi<sup>On</sup> are IBM Corp.'s Personal Computer and Digital Equipment Corp.'s Professional 350 personal computers. The IBM implementation is scheduled for release this summer and requires a 256K-byte main memory and 620K bytes of disk. Diamond says Visi<sup>On</sup>, combined with the operating system, occupies 100K bytes of main memory. The DEC version's introduction is not scheduled yet.

Diamond claims that transporting the product to a particular computer or an operating system will not be a major task for OEMs. VisiCorp will sell its OEMs licenses for the lowest layer of the Visi<sup>On</sup> package, Visi-Host, which Diamond describes as the interface between Visi<sup>On</sup> and the operating system. Visi<sup>On</sup> can be customized at this level for using target system attributes without



Multiple windows with separate applications can be viewed simultaneously on the same screen with VisiCorp's Visi<sup>On</sup> package. The product is shown on IBM's Personal Computer, which will be the first system to support the product. The "mouse" at right connects to a standard RS232 port and is used to point to functions and data on the screen.

diminishing the system's portability, he adds.

Diamond declines to specify an OEM license price for the package, but expects the end-user price to be consistent with prices for personal computer operating systems. Industry analysts and VisiCorp competitors expect it to have an end-user price of about \$500. Diamond also declines to specify licensing fees for third-party software vendors. He says part of the marketing plan is for VisiCorp to supply some key application packages and for independent vendors to supply Visi<sup>On</sup> versions of their applications.

Files created from VisiCorp programs are said to be upwardly compatible with Visi<sup>On</sup>. The programs, however, are not expected to be integrated with the new product. VisiCorp customers will be given purchase credit toward the price of Visi<sup>On</sup>.

Brian Fischer, vice president of

operations at VisiCorp competitor Context Management Systems, says he is unsure how desirable it will be for independent software suppliers to adapt their products for Visi<sup>On</sup>. "Without any question, VisiCorp is to be congratulated for bringing this type of product into the personal-computer market. It's very, very sexy, but the question is how long will it take to rewrite applications for it, and how much will it cost?" Diamond declines to give prices for the licenses independent software houses would require, but says costs will not be a barrier to making Visi<sup>On</sup> a standard.

Diamond maintains Visi<sup>On</sup> is not comparable to other products, and denies the product was previewed some seven to 10 months before availability as a preemptive marketing move. However, as industry analysts and competitors observed the product at introduction, many

*Continues on page 41*



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CIRCLE NO. 22 ON INQUIRY CARD



NCR

• Disk

• Communications

• Fault

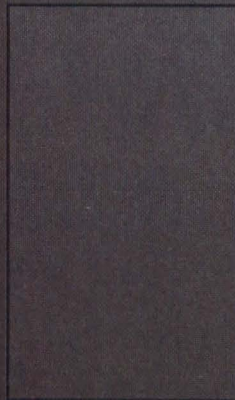
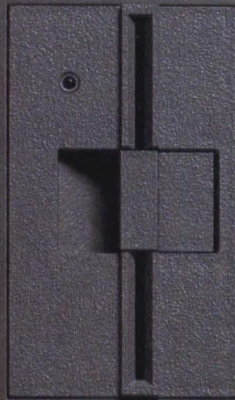
• Battery

•

On



Off





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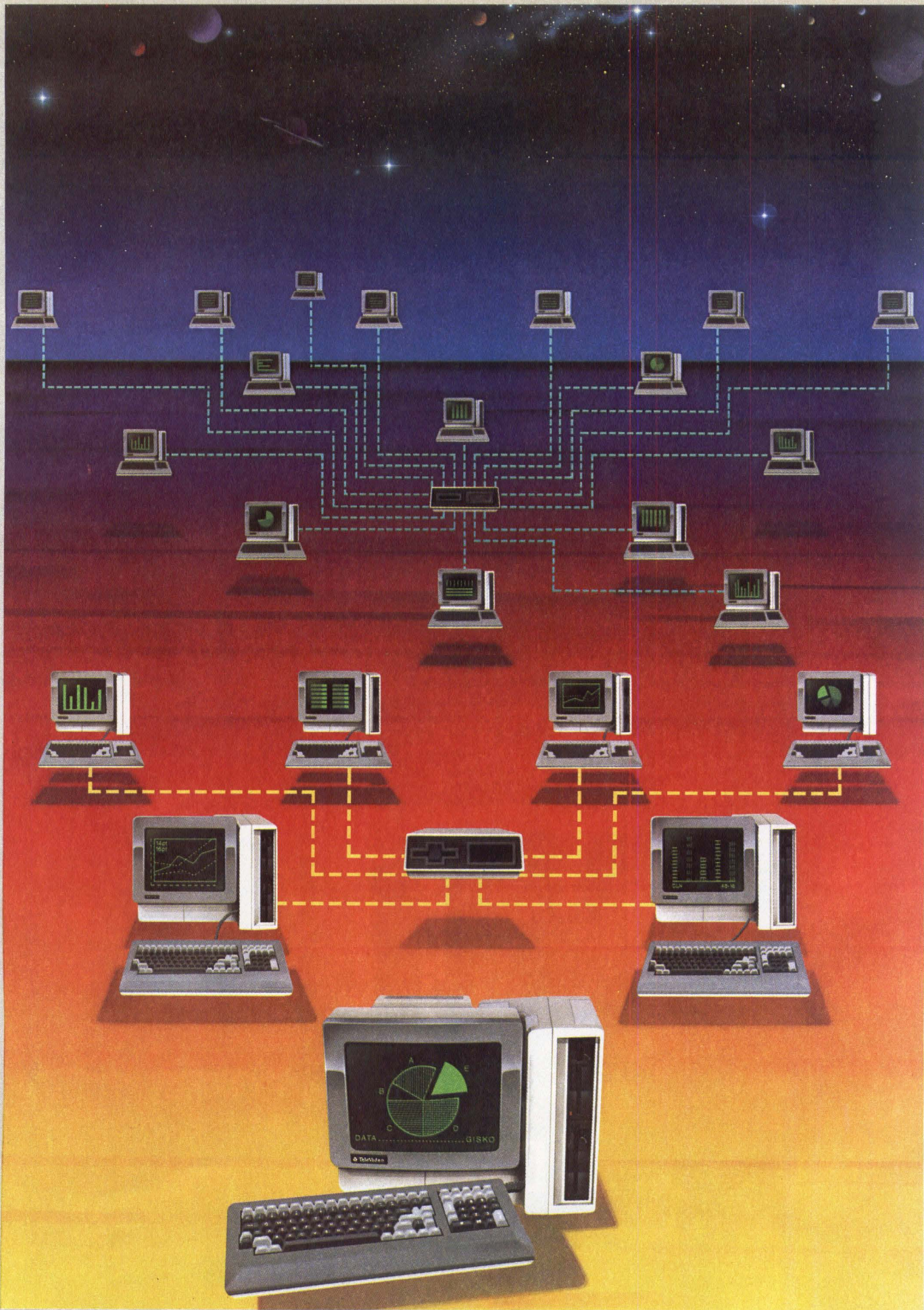
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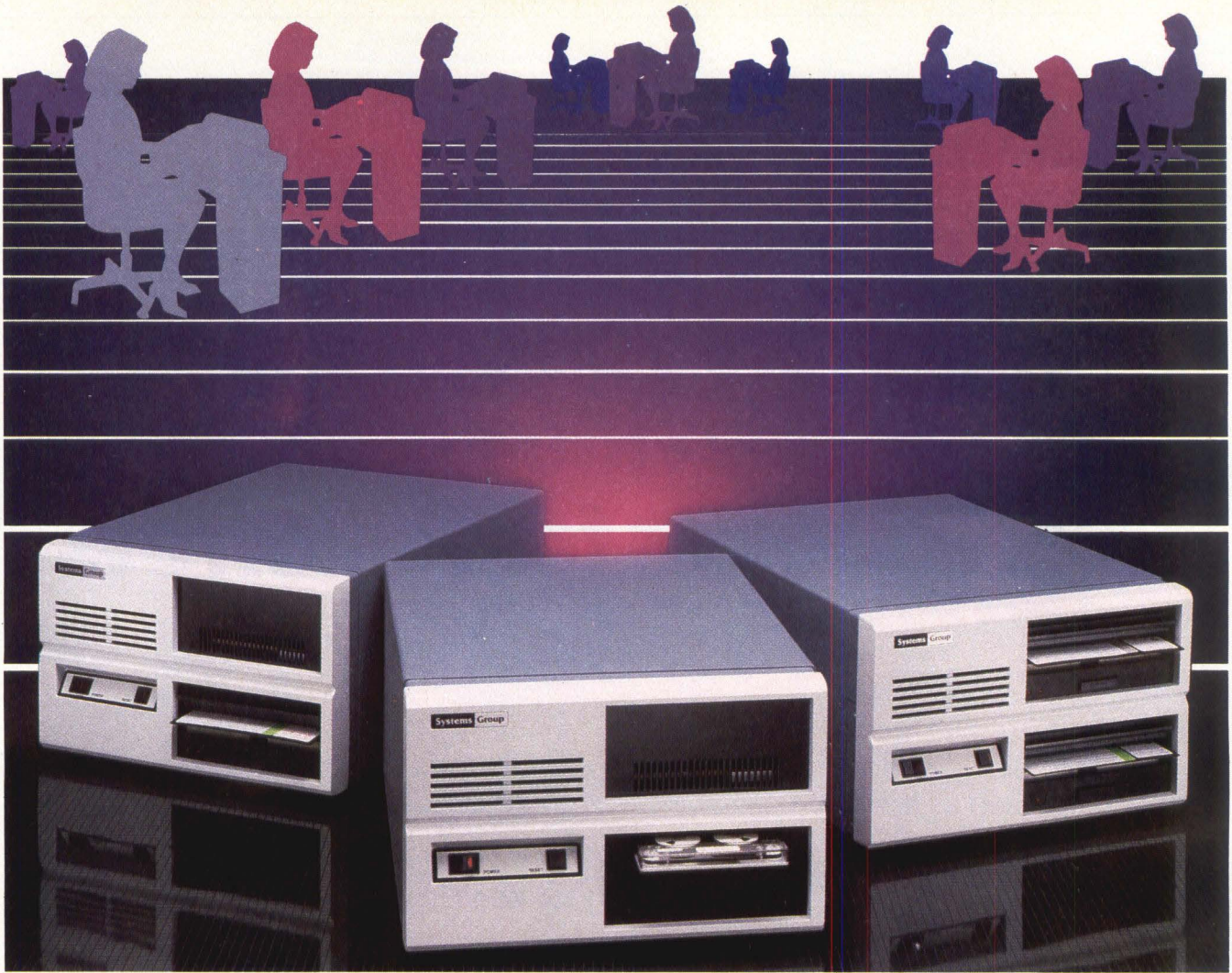
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*Continues from page 34*

compared it to some recently introduced "integrated" personal computer packages on one hand, and to Apple Computer, Inc.'s new Lisa computer on the other. Diamond points out that existing integrated packages are "closed-ended" and will not support a growing number of applications, as Visi<sup>On</sup> is expected to do.

Context Management's MBA product combines spread sheet, word processing, database management, graphics and telecommunications. Fischer says that, while VisiCorp has provided a consistent, simple interface, it has overlooked a more pressing need in the market: integrating information from one application to another and automatically updating information through several applications. That capability is supported on MBA, which has been installed on some 1500 IBM PCs in its first five months on the market. It is also available on Lotus Development Corp.'s 1-2-3 (MMS, December, 1982, p. 21). Unlike Lotus, however, MBA simultaneously supports as many as four screen windows, so that a user can change data in the spread sheet and watch how it will affect a graph on the same screen, Fischer says. He claims it appears from early information that Visi<sup>On</sup> would require updating of each application on the screen separately.

VisiCorp customer support manager Laura Burnham agrees that users would have to invoke a transfer command to use the same data in multiple windows.

As for VisiCorp's ability to set standards, industry analyst Esther Dyson of Rosen Research says, "They've got a great opportunity to be the standard. Look at what they've done with VisiCalc, and you'll see they've got a pretty good chance." However, she points out,

VisiCorp will not be alone in offering a standard applications

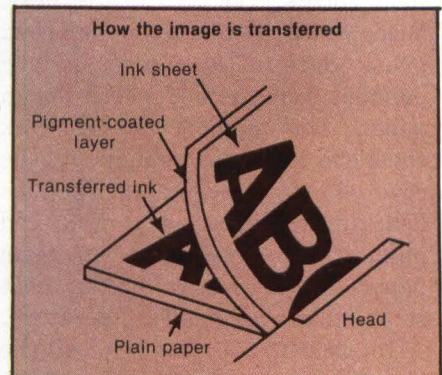
environment for professional personal computer users. —Geoff Lewis

## Seiko printer processes video signals, offers 8-color output

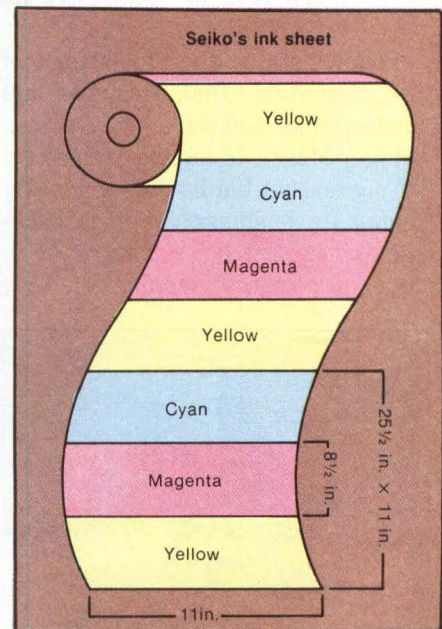
Japan's renowned Seiko group has brought a bevy of products to the U.S., including Epson printers and computers. A recent entrant flaunts the conglomerate's graphics expertise. Seiko Instruments USA, Inc., Santa Clara, Calif., has introduced the D-Scan 5201 copier/printer that processes video display signals into medium-level plotter resolution, eight-color output on plain paper at less than 25¢ per page. D-Scan uses a scheme called ink sheet, a combination of thermal transfer technology and treated color sheets of paper.

The product produces true screen copy, and is focused on raster graphics applications, says Andrew Wei, manager of graphics devices and systems. D-Scan supports RS170 and RS343 links to one terminal. Wei says Seiko will customize its product for other users. Late this year, Seiko will be able to multiplex as many as four terminals for use with the product, but must develop a multiplexer to handle the differing clock rates of those terminals. A Centronics interface is also offered. Price is \$13,000 in single-unit quantities, and OEM discounts are available.

D-Scan uses a 150-nib thermal print head to achieve an output of 150 × 150 dpi resolution. To produce color copy, the RGB video signal from the terminal goes to a Z80A microprocessor in the copier/printer. The Z80A controls an analog-to-digital converter, which decodes the signal in ½ sec., and moves the signal to the 1280 × 1024 pixel buffer video memory, which



The plain paper and ink sheet are run between the thermal print head and the platen in three passes to pick up yellow, magenta and cyan pigments from the underside of the ink sheet. At the same time, the nibs on the print head heat up and transfer the image to plain paper.



Consecutive page-sized bands of yellow, magenta and cyan contain a rugged pigment that Seiko says is fade-resistant.

holds one screen of information. Copying the signal for printing is



# Mini-Micro World

NEWS

done from the buffer under control of the Z80A.

To produce physical copy, an ink sheet passes over the stationary print head. An ink sheet consists of recurring sheets of pigments of yellow, cyan and magenta measuring  $8\frac{1}{2} \times 11$  in. The sheets come in a segmented roll of 300 sets of three color sheets. The nibs in the print head, which are aligned in one row, press dots of the appropriate pigment from the ink sheet to plain paper. The pigments on the ink sheet are contained in pigment cells covered by a wax medium. The nibs heat up to liquefy the wax and pigments for placement on plain paper. D-Scan has a built-in heat sensor to control head temperature.

To pick up all three colors, the plain paper is aligned around the platen with the first ink band, which

allows the head to transfer the cyan dots. The plain paper retracts to align itself with the second sheet of color, magenta. The process then repeats for the yellow band, requiring less than 1 min. in all.

D-Scan can print eight saturated colors: cyan, magenta, yellow, red, blue, green, black and white. The pigments used, claims Seiko, are fade resistant, unlike the dyes used in ink-jet printers, the technology that competes most closely with thermal. As a result, the output achieved is more permanent and durable, and is easy to mark for editing. The company compares pigment versus dye to oil-type versus water color paints used by artists.

Wei says the ink sheets used in the D-Scan are not a technological breakthrough, but the method of

controlling them is. Because the plain paper must make three passes to achieve the primary colors, high-precision motors and temperature control of the head is mandatory. Because the paper goes back and forth to pick up the dots, the dots must register exactly, so the company integrated a special stepper motor.

D-Scan's integrated video memory stores graphic data while printing copies. An optional multi-copy function key is also available, which allows 99 multiple copies to be produced. Per-copy cost of less than 25¢ includes the cost of both ink sheet and plain paper. The copier accepts plain paper rolls cut into standard-sized sheets. Prototypes are scheduled for this month, with shipments to begin in March and April.

## High hopes for IBM PC graphics package

Following in the footsteps of Software Arts, Inc., Business and Professional Software, Inc., Cambridge, Mass., is hoping to make a strong market bid by independently selling its business graphics package for the IBM PC. Software Arts, developer of the popular VisiCalc

program marketed by VisiCorp, took a similar tack in marketing its new product, TK!Solver (MMS, August, 1982, p. 44). BPS's first product, Apple II Business Graphics (and subsequently Apple III Business Graphics), was marketed by Apple Computer, Inc.

Called BPS Business Graphics, the software, which runs under PC DOS and p-System, can be used with more than 40 output devices. It retails for \$350. In comparison, competitive packages VisiTrend and VisiPlot sell for \$300, and Lotus's integrated 1-2-3 is priced at \$495.

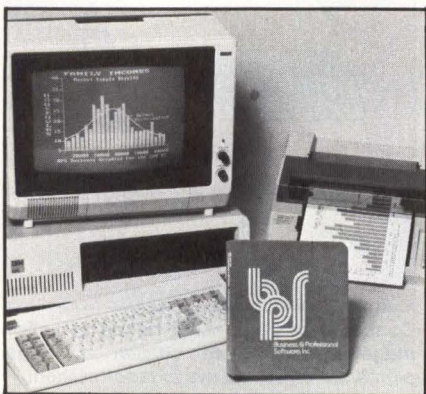
BPS officials are encouraged by optimistic market studies on the future of business graphics and personal computers, and by the success of its packages for the Apple II and III. The programs were introduced in January and April,

1982, respectively, and 7941 units had been sold by September.

The Yankee Group, a Boston market research firm, predicts IBM Corp. will own a 19.2-percent share of the desk-top computer market by 1986. That represents nearly 4 million PCs. The firm expects the business graphics hardware market to jump from \$359 million in 1981 to \$3.3 billion by 1985. More than \$1.8 billion of that will be in desk-top computers. Major manufacturers such as IBM and Digital Equipment Corp. will account for \$1.2 billion, according to the Yankee Group.

With BPS Business Graphics, PC users can create standard graphic formats—lines, horizontal and vertical bars, multiple bars (as many as four sets), pie charts, areas, points, any combinations of those on the same axes and horizontal and vertical grid lines. The system can display as many as six colors.

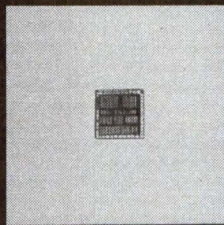
Data are extracted from VisiCalc and SuperCalc spread sheets and PC DOS and p-System files, or are



Business and Professional Software, Inc.'s BPS Business Graphics for the IBM PC can be used with more than 40 output devices.



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Hewlett-Packard  
announced the world's  
densest single chip  
32-bit CPU.**





**Today, this 450,000-transistor  
of the HP 9000 family that gives**

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**...in a \$20K box**



**...a \$50K  
multi-user  
system**



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Our tiny 1/4" square CPU contains 450,000 transistors. So there's nothing small about the 32-bit power it gives our new HP 9000 family of technical computers. Even our \$20K model gives you the performance of a mainframe computer costing up to four times as much.

And now you can have all this power in a configuration that really fits your application. The densities of the CPU and surrounding 'super chips' allow you the choice of a rack-mountable box; an integrated workstation; and a mini-cabinet suitable for a variety of single and multi-user applications.

Of course, the benefits of one-micron geometry don't stop there. This new technology has also let us develop a multi-CPU architecture that offers you three levels of processing power. Each configuration described above can take one, two or three CPUs. So you can almost double or triple the computer's capacity without adding to its size. Whether you order it that way or add the extra power later, it's transparent to the user.

## 32-bits, every bit of it.

The HP 9000 family has 32-bit internal and external data paths, 32- and 64-bit math (IEEE floating point format), and virtual memory addressing of up to 500 Mbytes.

And it is fast! The system will handle a million instructions per second. The 18 MHz clock permits the execution of a micro-instruction every 55 nanoseconds. The I/O rate can reach 6 Mbytes per second for every I/O slot. And the memory cycle time is a light-quick 110 nanoseconds.

There's also lots of program space, with up to 2.5 Mbytes of main memory. A flexible disc drive and optional 10

Mbyte Winchester are built right into the integrated workstation.

Each memory board has a Memory Controller Chip that provides automatic error detection/correction, memory mapping and 'healing'. Every time you power up, this chip actually maps out single-bit memory error locations, and assigns a back-up memory location in place of the old one—without slowing the access time or reducing memory capacity.

We've also made the CPU more efficient by assigning many of its time-consuming tasks to our Input/Output Processors. And to give you even more speed, the HP 9000 has a backplane bandwidth of 36 Mbytes/second. That's enough to support all three CPUs, each backed up by its own IOP. You can imagine the effect that has on throughput!

## All the benefits of a UNIX® operating system. And then some.

Our HP-UX is an enhanced version of this increasingly popular operating system. It supports FORTRAN 77, Pascal and C language. And lets you take advantage of the many programs and utilities already available for UNIX. In addition, HP-UX offers significant extensions like 3-D graphics, virtual memory, IMAGE Data Base Management, a variety of data communication products and enhanced file capability.

The integrated HP 9000 workstation also supports our highly evolved, high-performance Enhanced BASIC, augmented by 3-D graphics. Its run-time compile feature provides the friendliness and interactive capabilities of an interpreter with the speed of a compiler.

## Powerful networking made easy.

Even our stand-alone models won't have to work alone. Each can be part of a network of powerful, dedicated, interactive workstations. They'll support several different networking options, including Ethernet™ And in late 1983, LANs based on the industry-standard IEEE-802. So you can share peripherals and data files locally.

With HP's broad range of peripherals and instruments to choose from, it isn't hard to build precisely the system you need. Once your HP 9000s are up and running, we can make sure they stay that way. Our service is good enough to be rated Number One in Datapro surveys for the past two years.

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To get a close look at the way our new computer has changed the 32-bit world, phone your nearest HP office listed in the White Pages. Ask a Technical Computer Specialist to give you a hands-on demonstration. Or write for complete information to Pete Hamilton, Dept. 08149, Hewlett-Packard, 3404 East Harmony Road, Fort Collins, CO 80525.

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CIRCLE NO. 26 ON INQUIRY CARD



# Mini-Micro World

NEWS

entered directly from the keyboard. Moving averages, curve fitting and exponential smoothing can be performed.

Business Graphics differs from integrated packages such as Lotus's 1-2-3 in that it concentrates on graphics. David Solomont, president of BPS, insists that by

concentrating on graphics, BPS will become the best in its niche. Lotus's 1-2-3 has spread-sheet capabilities, database management and word processing as well as graphics. It does not automatically offer the statistical functions, such as moving average and standard deviation, that the BPS package does—a 1-2-3

user can only conceptualize such functions by inserting the appropriate formulas.

A major feature of the BPS package is its device independence. Some of the more than 40 output devices supported by the system include Houston Instrument's DMP-3 and Hewlett-Packard Co.'s HP7220 plotters, several Diablo Systems, Inc., printers and Integral Data Systems' Prism dot-matrix printer.

The BPS software is designed to run eventually under several operating systems. Solomont says the package will run under Digital Research, Inc.'s CP/M and OASIS operating systems in the future.

Written in Pascal, Business Graphics requires at least 128K bytes of memory, an IBM graphics card and any standard monitor. The system resides in 100K bytes of dynamically allocated memory.

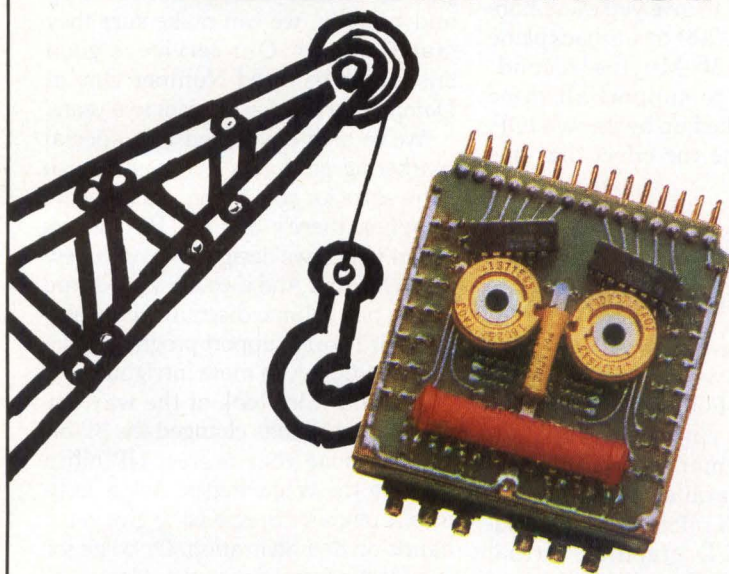
The \$350 price tag includes a backup disk, a tutorial manual with 70 sample charts and telephone support. Update disks will become available as the system interfaces with more plotters and printers. Marketing, scheduled to begin last month, is through ComputerLand and independent dealers carrying the IBM PC.

BPS had 1982 sales of \$400,000 and has received \$300,000 in venture capital from Eastech Associates, Boston, for new-product development. It has also established a \$400,000 credit line with Arlington Trust Co., Lawrence, Mass., for general operations. Solomont says the company hopes to go public or get acquired this year.

He believes 80 percent of the graphics supply is for sophisticated presentation applications, which he says account for only 20 percent of the demand. The other 80 percent of the demand, he claims, is for low-cost, analytical business graphics for desk-top computers.

—David A. Bright

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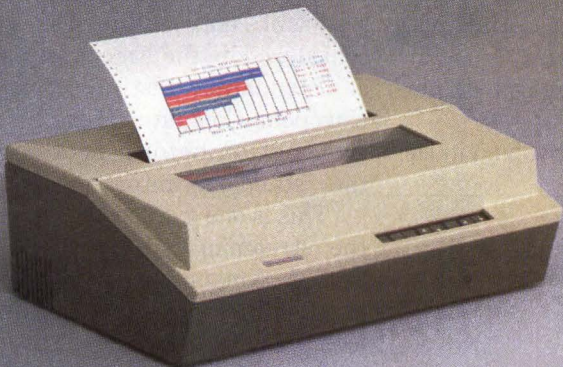
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CIRCLE NO. 27 ON INQUIRY CARD



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We made our terminals support everything from business applications to demanding CAD/CAM. We also made them upgradeable so you could change the amount of color graphics you need.

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We designed our letter quality color VectorPrinter™ like a printer/plotter, using 8 colors and a fast 300 cps print speed.

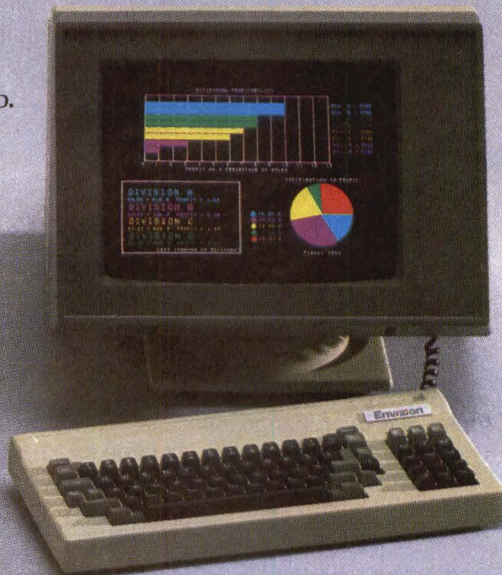
Finally, we put each and every product through intensive 100% reliability testing. And if that wasn't enough, we also made them affordable\*.

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\*Envision 210 Color Terminal: \$2,750  
Envision 220 Color Graphics Terminal: \$4,950  
Envision 230 Advanced Color Graphics Terminal: \$6,950  
Envision 420 Color Printer: \$3,950  
Envision 430 Color VectorPrinter: \$4,950

*OEM pricing available*

VectorPrinter is a trademark of Envision Technology Inc.

CIRCLE NO. 28 ON INQUIRY CARD



## Six companies back standard for 1/4-in. streaming tape

Manufacturers of 1/4-in. streaming-tape cartridges, hastened by market pressure for 5 1/4-in. rigid disk drive backup, have settled on a standard. The standard covers

format and interface and was developed by the Working Group for Quarter-Inch Cartridge Drive Compatibility (QIC).

The six companies involved in the

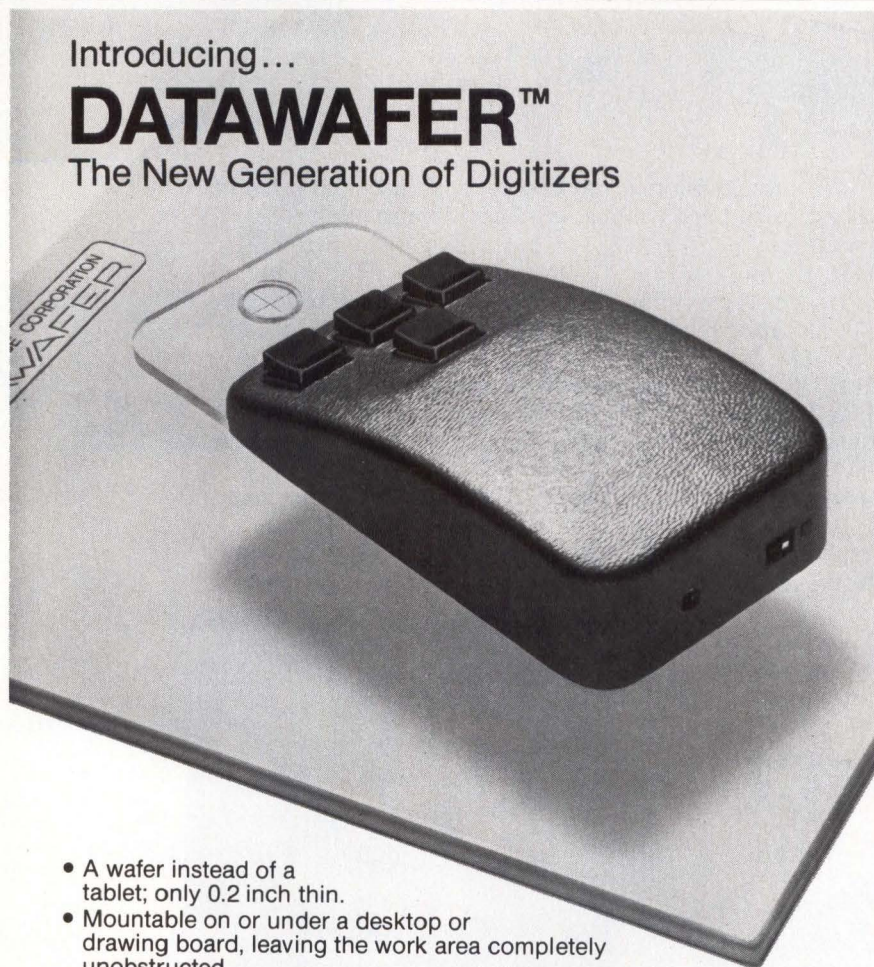
group—Archive Corp., Cipher Data Products Inc., Data Electronics Inc., Irwin/Olivetti, Inc., Qantex Division of North Atlantic Industries Inc. and Tandberg Data A/S—will not even wait to be considered by the American National Standards Institute and the European Computer Manufacturers Association before incorporating the standard into products.

"This is one giant step forward for the streaming-tape market," says Tom Makmann, vice president of marketing for Archive, whose format—with some modifications—was adopted as the new QIC-24 standard. "The need for a standard has been established by the marketplace, and this was a swift response to that need."

The committee unanimously adopted the Archive format with four- and nine-track formats, but with the modification of an address identifier for each written block and a track reference burst on track zero between the beginning of tape and the load point.

The committee rejected the only other format in the running, proposed by Control Data Corp., which did not meet the requirements of the committee members, says Bob Oakley, marketing manager for DEI. CDC is not a formal member of the group.

The committee was formed at last spring's National Computer Conference in Houston, and two months later, it decided on a QIC-02 standard interface for streaming tapes. The format decision was announced at the November Comdex show. "This decision by the member companies should stimulate much greater market demand for 1/4-in. streamers as companion devices for 5 1/4-in. rigid disk drives above the 10M-byte capacity level," says independent consultant Ray Freeman Jr., president of Freeman Associates, Santa Barbara, Calif. Freeman mediated at the committee discussions. —Robert A. Sehr



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CIRCLE NO. 29 ON INQUIRY CARD



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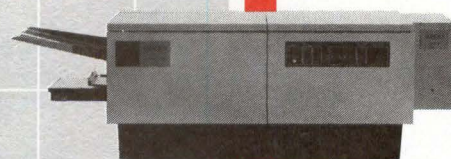
$$\psi(P) = \frac{1}{4\pi} \oint_S \left( \psi \nabla \frac{e^{ikr}}{r} - \frac{e^{ikr}}{r} \nabla \psi \right) \cdot \mathbf{n} da$$


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CIRCLE NO. 30 ON INQUIRY CARD



*No. 2 in a series:*

# Should I from my

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## **What immediate help is there to get me started?**

The Answermen at TI's strategically located Regional Technology Centers (RTCs). Expert and knowledgeable, they are ready now to answer your preliminary questions over the telephone, and to help you determine the feasibility of TI logic arrays.

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The RTC Answermen can also describe how TI's design automation system, with its series of checks and balances, minimizes errors and redesign. And they will explain the software tools available to ease and speed the design procedure.

◀ **At the ready:** The RTC Answermen in TI's Regional Technology Centers are equipped to provide virtually instantaneous information about TI logic arrays and a host of other TI semiconductor products. The RTCs are your most accessible entry point to TI's unmatched combination of product depth, design knowledge, and development tools that can result in the most cost-effective TI semiconductor solution for you.



# Ask the RTC Answermen at Texas Instruments

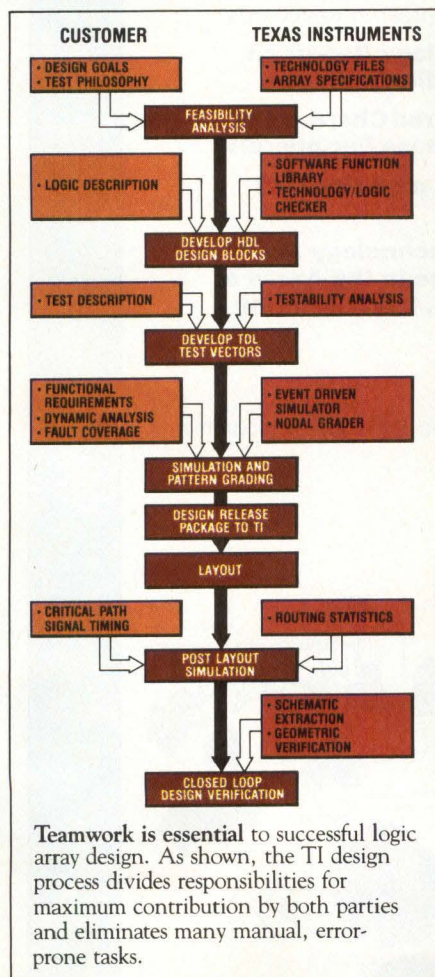
## expect extensive design help logic array supplier?

### What design training is available?

A five-day, design-level seminar is conducted regularly at the RTCs. This course will familiarize you with the techniques and capabilities of TI's design languages and automated software system.

During the course, you will learn TI's Hardware Description Language (HDL) and Test Description Language (TDL). They are used to define complex logic functions in a generalized format for compilation into a data base transferable into TI's design automation system.

The course also covers other tools available to you, including advanced simulation, design testability, design verification, and test-pattern grading.



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Array	Gates**	Technology†	Gate Delay	Gate Power	I/O Signals	Commercial/Military
TAL002*	280	LPS	5.0 ns	1.25 mW	29	C
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TAT004	400	STL	2.5 ns	600 μW	76	C/M
TAT008	800	STL	2.5 ns	600 μW	104	C/M
TAT010	1000	ASTL	1.0 ns	300 μW	88	C
TAT020	2000	ASTL	1.0 ns	300 μW	120	C/M
STL700	560	STL	3.0 ns	300 μW	61	M
SBP96700	1120	‡L	11/15 ns	100 μW	96	M
SBP96600	2120	‡L	11/15 ns	100 μW	140	M

\*TAL Series Arrays are manually routed by you and schematically verified by TI with your software HDL model prior to prototyping.

\*\*Usable gates

†LPS — Low-power Schottky

‡L — Integrated Injection Logic

†STL — Schottky Transistor Logic

†ASTL — Advanced Schottky Transistor Logic

When circumstances warrant, we'll conduct the seminar at your plant.

If you want to study on your own, appropriate documentation may be obtained from TI. This consists of a detailed Logic Array Designers Manual, data sheets of logic array characteristics, information packets on library-accessible, predesigned software functions, and related technology application notes.

### Where can I get actual design assistance?

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Each RTC has the facilities which you can use to describe your logic and prepare the HDL and TDL data base. If you prefer, the RTC will contract to do this work for you.

### How readily can I access the design tools?

Everything at TI is done to make the design process as simple and as fast as

possible. Access to TI's efficient design-automated system can be by terminals at the RTCs; by dial-up communication links from your plant, tied directly to TI's worldwide computing network. And by the Transportable Design Utility (TDU). The TDU allows you to perform your design work — utilizing the TI design software — at your own pace and on your in-house hardware.

The TDU, written in Pascal, includes the HDL compiler/syntax checker, TDL compiler, an interconnect rule checker, a design testability analyzer, and an event-driven logic simulator.

### When should I start my design?

There's no better time than now. The RTC Answermen are standing by their Hot Line telephones (see listing opposite page) to answer your technical questions and assist you in taking advantage of the time and money savings inherent in TI's logic array design automation system. Or visit the RTC nearest you, or call your local TI sales engineer.



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**Where Is the IBM Compatible Equipment?**

**The Market for DEC Compatible Equipment**

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If your abstract is selected, instructions on paper presentation will be sent to you at the time of program's announcement.

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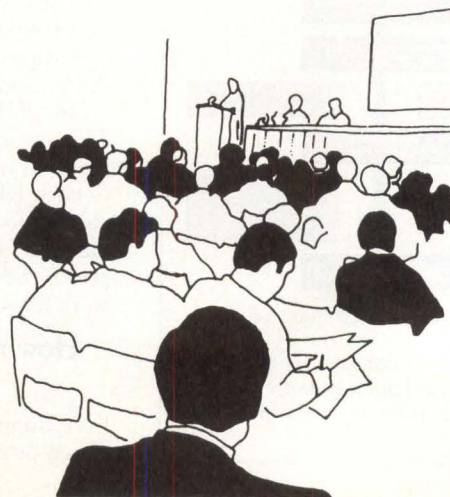
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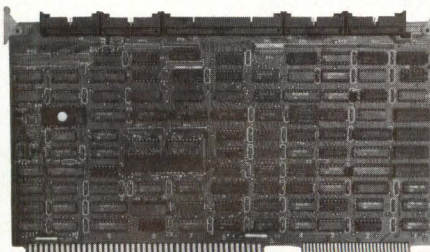
niques and are designed to work together for system optimization. For Multibus users, this means low bus usage, non-interleaved disk operation and true high-speed streaming with no repositioning. All three work with any 16, 20 or 24 bit address Multibus system.

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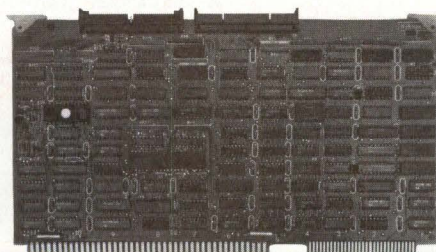
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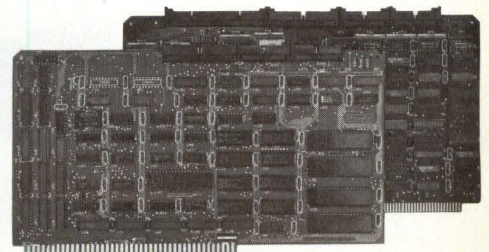
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Xylogics 450 Multibus Disk Peripheral Controller.



Xylogics 472 Multibus Tape Peripheral Controller.



Xylogics 440 Multibus Disk Peripheral Controller.

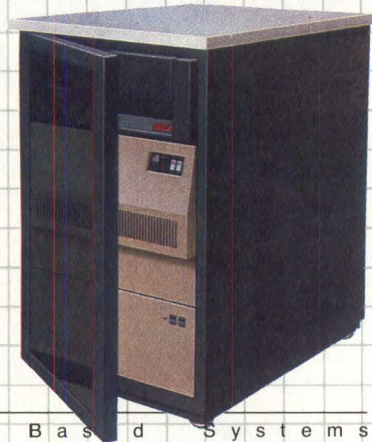
CIRCLE NO. 32 ON INQUIRY CARD



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# Mini-Micro World

CORPORATE AND FINANCIAL

## Prime acquires British CAD/CAM firm, other British companies ready to change hands

Prime Computer, Inc., has substantially strengthened its position in the CAD/CAM market with the acquisition of Compeda, a British-government-backed company that markets commercial and industrial software products.

The most noteworthy product is Plant Design Management System, a powerful design package that can be hosted by Prime machines. The package permits 3D modeling of pipelines and such complex plants as nuclear power stations. U.S. users include engineering construction company C.E. Lummus, a subsidiary of Combustion Engineering Inc., Windsor, Conn.

The terms of the acquisition leave the property rights of PDMS with the British government's Department of Industry, which funds PDMS developer the Computer Aided Design Center, Cambridge, England.

Compeda will operate as an autonomous unit within Prime, maintaining its headquarters in Stevenage, England. A Prime spokeswoman says Compeda's four U.S. offices in Paramus, N.J., Menlo Park, Calif., Schaumburg, Ill., and Houston will be merged with Prime's sales offices.

Computervision Corp. also bid for Compeda, but its offer was rejected because of disagreement over the rights to PDMS. Computervision is acquiring another British CAD/CAM company, Cambridge Interactive Systems. CIS developed the Medusa modeling system, which is sold through Prime (MMS, November, 1982, p. 148) and Applied Graphics Systems, Rotterdam, the Netherlands, which sells Medusa in continental Europe.

Computervision cannot immediately sell Medusa in the U.S.—under an existing agreement, Prime has exclusive U.S. rights to the product through 1985. (Prime acknowledges that Computervision will be able to sell Medusa after 1985.) However, there is some uncertainty about whether Medusa will be mounted on Computervision hardware sold in Europe or whether CIS will continue to sell Medusa indefinitely on other vendors' hardware. Prime machines are now the most common Medusa hosts. CIS marketing director Grispin Gray hopes that CIS will continue to operate independently of Computervision after the acquisition.

As part of its policy of selling publicly owned companies, the British government also plans to sell the Computer Aided Design Center this year. Apart from PDMS, the CAD Center product line also includes Graphical Numerical Control, which is sold in the U.S. by Cadlink, Inc., Troy, Mich. CAD Center financial controller Brian Pickton says the government hopes to sell to several joint owners, making it unlikely that a controlling interest will be sold to any one purchaser. The center is staffed by personnel from Britain's biggest computer company, ICL Plc.

—Keith Jones

## Multiplex files suit against Fortune

A trademark-infringement suit before a Los Angeles federal court may cost one of its participants a fortune—in more ways than one. In a case brought by systems house Multiplex Information Systems, Los Angeles, against Fortune Systems Corp., San Carlos, Calif., Multiplex claims Fortune, the widely publicized year-old start-up that manufactures systems under the name of Fortune 32:16, has violated a trademark Multiplex has held for seven years.

Multiplex contends it began selling its "Fortune 2000" products in 1978, after Cincinnati Milacron ceased production of its "George" microcomputer. Multiplex had been an OEM for Cincinnati Milacron, added its own hardware and software enhancements to George

and marketed the product under the name Fortune 2000.

"Defendant's advertising, offering selling of computer system, component parts therefor and computer software under the marks Fortune 32:16 and Fortune Systems are likely to cause confusion," contends Multiplex's legal brief.

Multiplex is asking the court to order Fortune Systems to stop using the name for its products and to award all of Fortune's profits from its use of the name, which Multiplex estimates at "well over \$10 million," to Multiplex. The suit contends the confusion has caused an estimated \$1 million in damages to Multiplex.

Fortune Systems president Gary Friedman says the suit is "totally without merit," noting that Fortune



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## One Program Drives Many Devices

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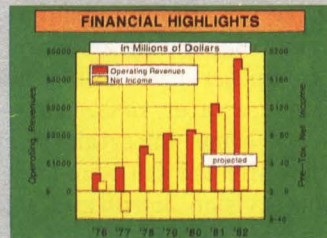
## They Run On Most Popular Computers

Including IBM, VAX, PR1ME, Hewlett-Packard, CDC, Honeywell, Data General, DEC 10/20, Harris, Univac, Cray, and DEC PDP-11.

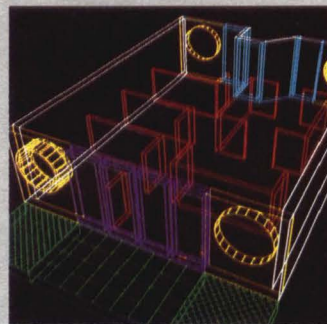
Precision Visuals software tools require a surprisingly small amount of computer resources. Even on smaller machines they provide access to the full capabilities of the CORE graphics standard.

*"At Martin Marietta, DI-3000 serves as a common interface between our numerous graphics devices and software applications. We use DI-3000 for applications including structural analysis, business charts, graphs, animation, 3D modeling, and general-purpose graphics."*

Karin Bruce  
Senior Graphics Software Engineer  
Martin Marietta Denver Aerospace



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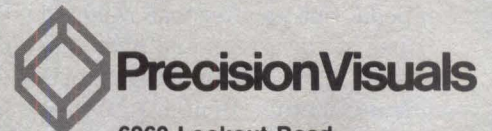
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CIRCLE NO. 34 ON INQUIRY CARD



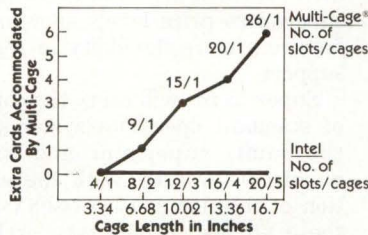
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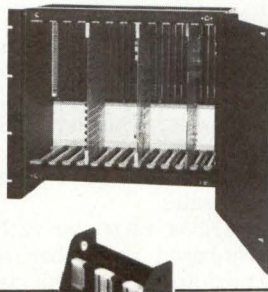
You get more room for extra cards without increasing overall size, because our design gives you greater inside dimensions.



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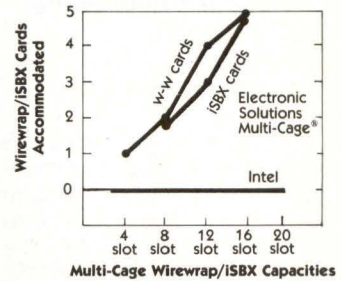
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conducted a thorough patent and trademark search before adopting the name. "A lot of lawsuits are filed

by people who expect the defendant to pay them some money just to shut up," Friedman says. "If that's

the case here, they've chosen the wrong company to sue."

—Robert A. Sehr

## MARKET BAROMETER

A monthly column devoted to an expert's look at an industry

### Supermicros: a dominant new wave

By Omri Serlin  
ITOM International Co.

Supermicros are taking over the world. These general-purpose computers combine a fast, 16/32-bit MPU (such as the Motorola 68000) with 64K-bit RAM chips and the new generation of dense, 5¼-in. Winchester. Supermicros offer up to supermini performance in desk-top packaging at less than \$15,000.

Such start-ups as Convergent Technologies, Inc., Fortune Systems Corp. and Wicat Systems, Inc., have hitched their wagons to the rising supermicro. But the significance of the trend has not been lost on IBM Corp., NCR Corp., Hewlett-Packard Co. and Tandy, now offering such systems, as do Intel Corp., Zilog, Inc., and Texas Instruments Inc. Burroughs Corp., NCR and others sell supermicros under private-label arrangements. By 1986, supermicros will generate nearly half of the worldwide revenues from microsys-

tems sales (see chart 1).

Supermicros are of special interest to small and medium resellers, which may be locked out of the 8-bit field by overcrowding and lack of product differentiation. The higher supermicro price levels allow manufacturers more flexibility in reseller support.

Supermicros will carry the concept of standard operating systems into the mini, supermini and small-mainframe worlds. With the exception of the IBM 370/43XX/30XX lines, these ad hoc, proprietary architecture machines are supported almost exclusively by vendor-supplied software. Their installed bases are too small to attract third-party software suppliers. This is no longer a tenable approach.

We have an excellent model of the future in CP/M, an operating system usable on the huge installed base of 8080/8085/Z80-based machines (estimated at more than 700,000 by year-end 1982). A vigorous third-party software market has emerged around CP/M and the popular 6502-based Apple Computer, Inc., and Commodore Business Machines lines. The wide availability of third-party software in turn encourages hardware sales.

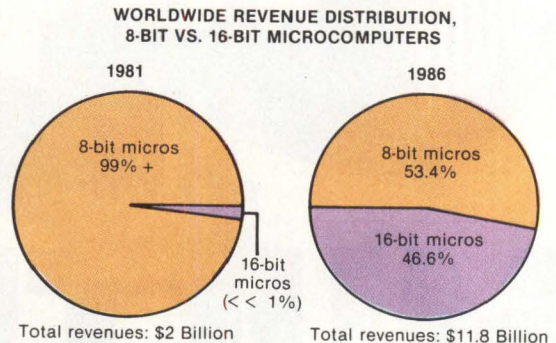
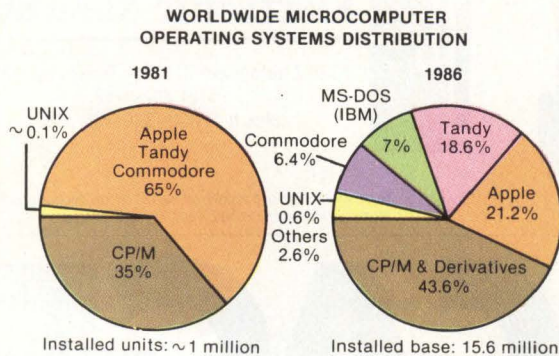
Various CP/M derivatives run on 8086-based and other supermicros. Another contender is UNIX, a multi-user operating system devel-

oped at Bell Laboratories. UNIX is much richer than CP/M, but requires much more memory and is notoriously unfriendly. Its main attraction is the relative ease with which it can be transported ("ported"), because it is coded mainly in C.

UNIX usage is currently very limited. Despite the mass hysteria around this operating system, I do not expect it to become a dominant factor in the overall microsystems market (see chart 2). But by 1986, it will probably be running on about 20 percent of the installed base of about 615,000 supermicros.



Omri Serlin heads ITOM International Co., a Los Altos, Calif., research and consulting firm. ITOM recently issued a supermicro market study and is publishing a monthly newsletter on the subject.



Source: 1982 ITOM International Co.





MAKING THE LEADING EDGE WORK FOR YOU

# Introducing a brainy new solution from the Wizards of Winchester Disk Controllers.

A new Winchester controller. Plus floppy controller. On one low cost board. Small enough to mount atop a 5¼" drive. And ST500/SA1000 compatible. "Smart," you say? What did you expect from the Wizards of Winchester Disk Controllers?

We promised you more for less. Our new WD1002 delivers. At \$195 (U.S. OEM quantities) it's \$50 less than its predecessor, the WD1001.

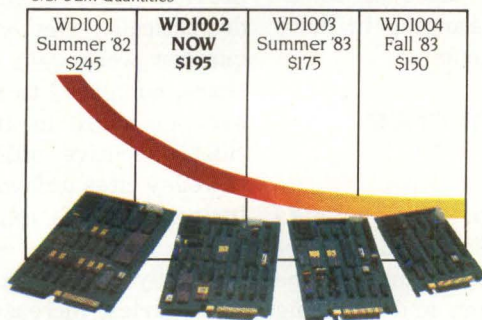
The big news, though, is that we've made the WD1002 the brainiest disk controller yet, with an abundance of new LSI innovations. Such as our WD1010 single-chip Winchester controller device. It replaces the microprocessor on our earlier boards. And about 25 other devices. Plus we've added the new WD1014 Error Correction device and the WD1015 Buffer Manager device.

Because just about every system with a Winchester has a floppy nearby, we included our new WD279X single chip floppy disk controller, too. So you get a complete, powerful solution on one reliable 5¼" x 8" board. And you're on the upgrade path to our upcoming WD1003 and WD1004 boards.

To make our disk controllers even more irresistible, we'll customize them to your bus and form factor. Or sell you our LSI, along with everything you need to build a controller yourself.

It doesn't take too much brains to see that it's safe, smart and simple to commit your disk-based systems to WD. Call our controller hotline, 714/966-7827 and we'll arrange to sit down with you and get into the details you need.

U.S. OEM Quantities



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Buy our board-level disk controllers. Have us build a custom board for you. Or do-it-yourself with our LSI. If you choose the latter, we'll provide schematics, microcode and generous engineering assistance.

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WD1011: Digital Data Separator

WD1012: Write

Precompensation

WD1014: ECC

WD1015: Buffer Manager

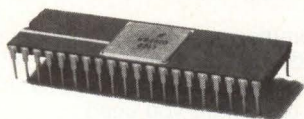
WD1510: LIFO/FIFO

external sector buffer

WD279X: Single Chip

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# Mini-Micro World

CORPORATE AND FINANCIAL

## In transition

Kendata, Inc., has purchased M/A-Com's small-business computer manufacturing facility, M/A-Com Office Systems, Inc., for an undisclosed amount of cash, notes and other considerations. Kendata was known as Ohio Scientific, Inc., before its acquisition by M/A-Com in 1980. Kendata says it changed the name back to Ohio Scientific, Inc., to take advantage of Ohio Scientific's reputation.

## Formations

The first of several **Businessland** retail centers has opened in San Jose, Calif. The centers will focus on automating small businesses. Businessland, whose management includes such notables as David Norman, president and founder, who previously founded and headed market research firm Dataquest, Inc.; Enzo Torresi, a Businessland co-founder and vice president of systems who was previously president and founder of Olivetti's Advanced Technology Center, Inc.; and Phil Reed, vice president of marketing, who was previously general manager of On-Line Microcenters, a chain of about 20 franchised computer stores. Businessland prides itself on having system-integration expertise, and has assembled a series of small-business systems ranging in price from \$2500 to \$15,000.

## Distribution/service deals

**Datapoint Corp.** has completed agreements with independent companies in three countries for the distribution, support and servicing of its products: Ecosistemas S.A., Ecuador; Abdulla Fouad Corp., Saudi Arabia; and Emirates Elec-

tronics Establishment, United Arab Emirates....**Centronics Data Computer Corp.** will supply Leasametric, Inc., with the model 6081 600-lpm line printers and model 353 Printstation dot-matrix printer....**Plexus Computers, Inc.**'s first order for its MC68000-based systems running under UNIX System III came from Southwest Modular Systems, Inc. The one-year, \$2-million agreement concerns the Plexus 16-bit P/40 and P/25 and the 16/32-bit P/35 and P/60 supermicros.

## Quarterly report

Although **Datapoint Corp.**'s revenues for its first fiscal quarter ending Oct. 31, 1982, rose slightly to \$132 million from \$126.5 million the



**Datapoint chief executive officer Harold E. O'Kelley** predicts a difficult time for the company during the remainder of fiscal 1983, but notes that Datapoint is well-positioned to participate in an economic recovery.

previous year, net earnings dropped dramatically. Net earnings for the quarter were \$461,000 or 2¢ per share, compared to \$10.9 million or 54¢ per share in 1981. Datapoint chief executive officer Harold E. O'Kelley cites unfavorable manufacturing variances, expanded international marketing costs incurred primarily by the addition of new subsidiaries, increased product advertising, legal costs and financing expenses as primary reasons for the decline.





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When you make the Wizards of Disk Controllers your design partners, there's no cause to approach any disk interface task with trepidation. Because now, in addition to our industry standard floppy disk controllers and ST500/SA1000 Winchester disk controllers, Western Digital delivers a single chip solution to SMD, CMD, MMD, LMD and FHT interfaces. Oh my!

It's the WD1050, a 64-pin VLSI controller/formatter. That's *one* chip, instead of up to 40MSI devices and a microprocessor. And instead of innumerable nights and weekends of software drudgery.

How powerful is the WD1050? Powerful enough to handle eight high level macro commands, auto format/verify with programmable interleaving, single/multiple record operation, hard sector formatting, CRC checking with external ECC compatibility and a 16-bit direct buffer access interface for disk drive-to-buffer data transfers.

Systems builders already following our Yellow Brick Road of disk controller solutions know that our ongoing LSI innovations soon turn into cost effective board level products for those who prefer "buy" to "build."

Starting today, though, adding the extra capacity and higher performance of SMD compatible drives to your system doesn't take courage. Just the brains to start with our new WD1050.

The next step is yours. Call our Controller Hot Line, (714) 966-7827 for more details. Or write on your letterhead.



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# Mini-Micro World

CORPORATE AND FINANCIAL

## GUEST FORUM

A monthly column for guest experts to speak out

### Read between the lines of market forecasts

By Daniel M. Sullivan  
Frost & Sullivan, Inc.

In 21 years of market research publishing, I've never seen such a hunger for information as that from small computer system manufacturers and integrators today. But with new and usually conflicting forecasts issued almost daily from a growing roster of forecasters, whom can you believe? The answer, unfortunately, is no one.

Unlike a profit-and-loss statement, a market forecast can in no sense be summed up for its user by the bottom line. Investors now have vehicles that allow them to buy (or, more accurately, to bet on) the stock market as a whole, as reflected in popular indexes. But no high-technology company (excepting perhaps IBM Corp. in mainframes) identifies its market with *the* market for a given product category.

All surveys are crude approximations of reality. Even a 100-percent sample of a population induced by sodium pentathol to tell nothing but truth could not tell you the precise size of a future market, because, as any salesman knows, a buying intention is not a sale, particularly when talking about five or ten years down the road.

User and supplier surveys are just one tool used by our report authors, each of whom is an independent management consultant who has devoted his professional life to understanding an industry.

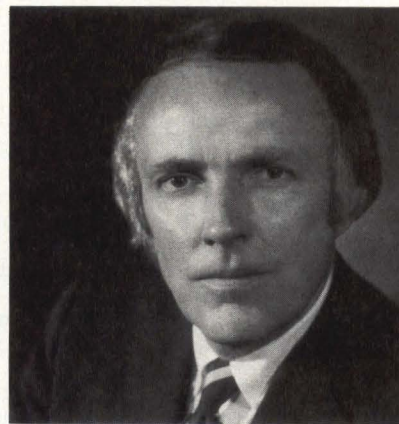
The true value of a market research forecast is not the numbers, but the detailed picture of future changes in technology, users, applications, suppliers, distribution channels and the general economic, cultural

and regulatory contexts in which they develop.

That is why our reports are rarely less than 200 pages in length and often more than 300. Our smartest customers read the whole thing and use it just as they use their trade magazine reading, conversations with customers and colleagues and rumors about competitors. They take what is fundamentally consistent with, but expands upon, their own view of the future market; they put aside—with not unfurrowed brows—conflicting views, perhaps to be reviewed later if their long-term marketing plan proves flawed.

Does this mean we forecasters have carte blanche for inaccuracy? Absolutely not! The market is our master, too. If we published useless reports, we would lose repeat business, which is most of the business we get. Our consultant-authors would in turn lose their publishers. And my editors and I would lose peace of mind.

But if, two years or five years from now, we turn out to have hit a forecast to the third decimal place, does that prove our reports worthwhile? Not if the numbers were generated by incorrect though mutually canceling assumptions about the future market because it is these "details," by which businessmen live, succeed or fail.



Daniel M. Sullivan is president and founder of Frost & Sullivan, Inc., a large publisher of market research reports, with principal offices in New York and London.

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You know how costly time and data losses can be should your "bargain" diskette be faulty. Every penny you think you save on the purchase of magnetic media could cost you dearly. Why take the risk when you can have Dysan?



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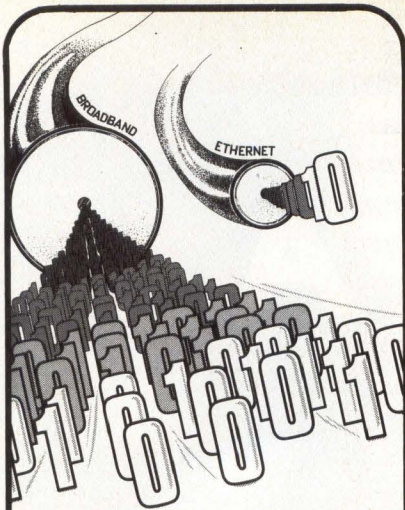
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\*\$4.00 represents Dysan's suggested retail price for a one-sided, single density 8" diskette, packaged ten to a box. Minimum total cost of ownership = \$186.50

\*\$182.50 represents the cost of data loading (approximately 22 hours at 11,106 keystrokes/hour at a labor cost of \$8.23/hour), based on 1981 Data Entry Management Association (DEMA) National Averages.

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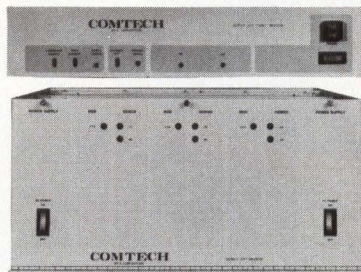
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# Mini-Micro World

CORPORATE AND FINANCIAL

## BOX SCORE OF EARNINGS

This monthly table lists the revenues, net earnings and earnings per share in the periods indicated for companies in the computer and computer-related industries. Parentheses denote losses. Comments are from corporate summaries unless otherwise noted.

Company	Period	Revenues	Earnings	Eps
AGS Computers, Inc.	9 mos 9/30/82	\$46,073,000	\$1,803,000	.54
	9 mos 9/30/81	26,332,000	1,141,000	.38
Applied Materials, Inc.	year 10/31/82	88,269,000	(9,237,000)	(1.86)
	year 10/25/81	77,490,000	4,264,000	.90
Centronics Data Computer Corp.	3 mos 10/3/82	40,847,000	(13,497,000)	(1.20)
	3 mos 10/3/81	28,383,000	(2,675,000)	(.44)
Communications Group, Inc.	6 mos 9/30/82	3,746,000	(90,000)	(.09)
	6 mos 9/30/81	3,639,000	184,000	.46
Cullinane Database Systems, Inc.	6 mos 10/31/82	34,177,000	4,991,000	.73
	6 mos 10/31/81	21,735,000	3,444,000	.50
Dataterminal Systems, Inc.	9 mos 10/31/82	73,522,000	(9,450,000)	(1.61)
	9 mos 11/1/81	89,006,000	(7,190,000)	(1.28)
Genesco Technology Corp.	year 9/30/82	28,288,782	1,511,021	.77
	year 9/30/81	23,280,373	1,236,266	.63
Harris Corp.	3 mos 10/1/82	425,561,000	14,701,000	.47
	3 mos 9/25/81	392,287,000	23,949,000	.77
Intercom, Inc.	3 mos 9/30/82	10,987,000	1,933,000	.16
	3 mos 9/30/81	3,253,000	(1,447,000)	(.16)
ITT Corp.	9 mos 9/30/82	11,813,467,000	430,813,000	2.91
	9 mos 9/30/81	12,353,640,000	429,640,000	2.91
M/A-COM, Inc.	year 10/2/82	587,646,000	33,933,000	.88
	year 10/2/81	498,484,000	40,275,000	1.05
Molex, Inc.	3 mos 9/30/82	41,672,000	4,902,000	.74
	3 mos 9/30/81	39,585,000	5,178,000	.79
Perkin-Elmer	3 mos 10/31/82	235,253,000	10,982,000	.25
	3 mos 10/31/81	251,040,000	18,655,000	.43
Scan-Data Corp.	9 mos 9/30/82	9,827,111	(2,572,438)	(1.01)
	9 mos 9/30/81	9,314,143	(2,583,723)	(1.02)
Tandem Computers, Inc.*	year 9/30/82	312,143,000	29,856,000	.76
	year 9/30/81	208,397,000	26,549,000	.72
Timeplex, Inc.	3 mos 9/30/82	9,327,000	522,000	.13
	3 mos 9/30/81	7,038,000	467,000	.11
The Ultimate Corp.	6 mos 10/31/82	16,781,347	1,854,882	.31
	6 mos 10/31/81	14,914,097	1,198,607	.21
Unitrode, Inc.	9 mos 10/30/82	89,339,323	9,584,019	1.63
	9 mos 10/31/81	84,817,855	8,339,583	1.45

Comments: **M/A-COM's** earnings were down 3 percent from fiscal 1981. The company cited the recession, approximately 60 percent higher research and development investments, pricing pressures in the cable and components industry and the write-off of old inventory at one of its operating companies as major factors in the decline. M/A-COM's fourth-quarter earnings, however, were \$12 million, up from \$11.5 million, an increase of 1 per share. M/A-COM projected growth in the second half of fiscal 1983, based on an improved economy. **Centronics Data Computer Corp.** is attempting to cut costs—it has discontinued its Quietwriter printer development and has shut down its line printer plant in Stevenage, England, transferring the operation to Rochester, Mich. Subsequent to the financial release, Centronics announced it is transferring its Puerto Rican operation to its Hudson, N.H., facility.

**Centronics** said its recently acquired Line Printer Division accounted for approximately \$16 million of the quarter's sales. The company has changed its fiscal year to correspond with the 1983 calendar year. Although **Data Terminal Systems, Inc.'s** nine-month sales and earnings were down from 1981, the company reported its first profitable quarter in two years. Third-quarter earnings were \$209,000, or 4 per share, compared with a loss of \$312,000, or 5 per share, in 1981. **Perkin-Elmer's** Data Systems Group reported revenues of \$52.6 million for its first quarter, compared to \$51.5 million in 1981. (The 1981 figure includes \$7.6-million net sales from the sale of the Memory Products Division.) **Tandem Computers, Inc.'s** revenues and earnings are restated. The company said the restatement reflects a deferral of revenue, not a loss of sales.



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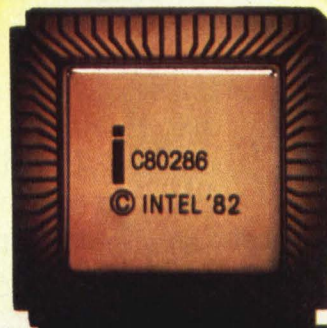
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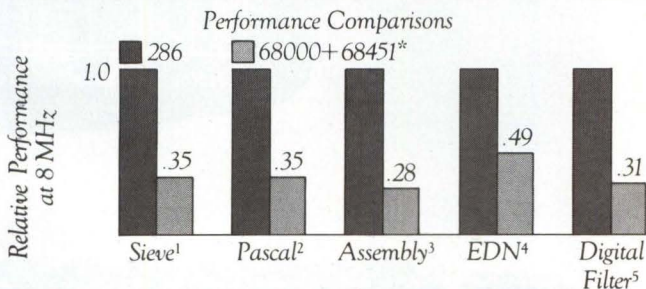
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The 286 has been optimized to handle advanced operating systems. Such as the UNIX\* and iRMX™ O.S. It also provides new instructions for languages such as Pascal, BASIC, FORTRAN, C and ADA.



\*Performance adjusted to reflect indicated system configuration. Details available from Intel. <sup>1</sup>"A High Level Language Benchmark," Byte, Sept., 1981. <sup>2</sup>"A Performance Evaluation of the Intel iAPX 432," Computer Architecture News, June 1982. <sup>3</sup>"16 Bit Microprocessor Benchmark Report," Intel Corporation, 1981. <sup>4</sup>"16 Bit Microprocessor Benchmarks," EDN, Sept., 1981. <sup>5</sup>"Digital Filter Implementation on 16 Bit Microprocessors," IEEE MICRO, Feb., 1981.

And to simplify sophisticated system development even further, there's an integration of performance-critical functions. Such as task switching, interrupt handling and O.S. call.

A couple more hot facts about software. The 286 is compatible with the iAPX 86, 88. So not only will you have the hottest chip on the market, but also immediate access to a huge software base.

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\*Based on published data sheets.

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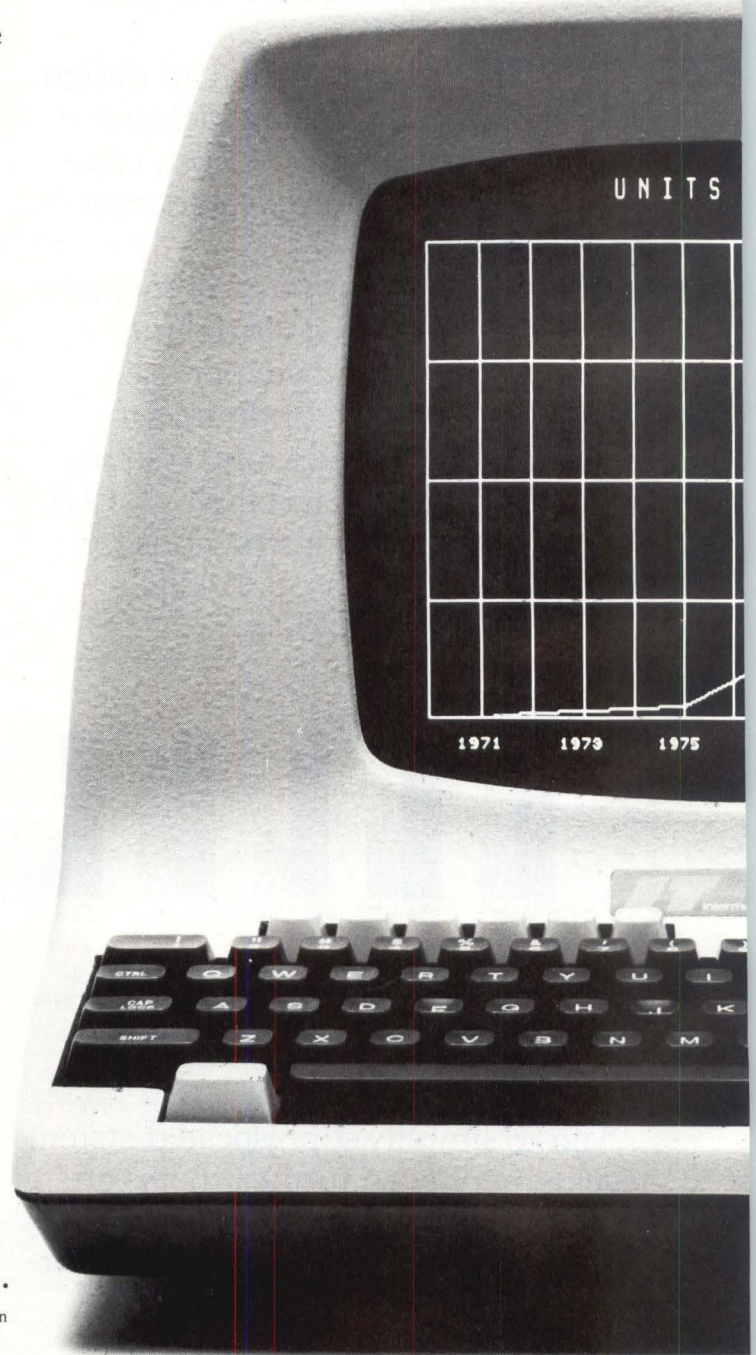
Who would have suspected eleven years ago that one Dumb idea could have taken us so far?

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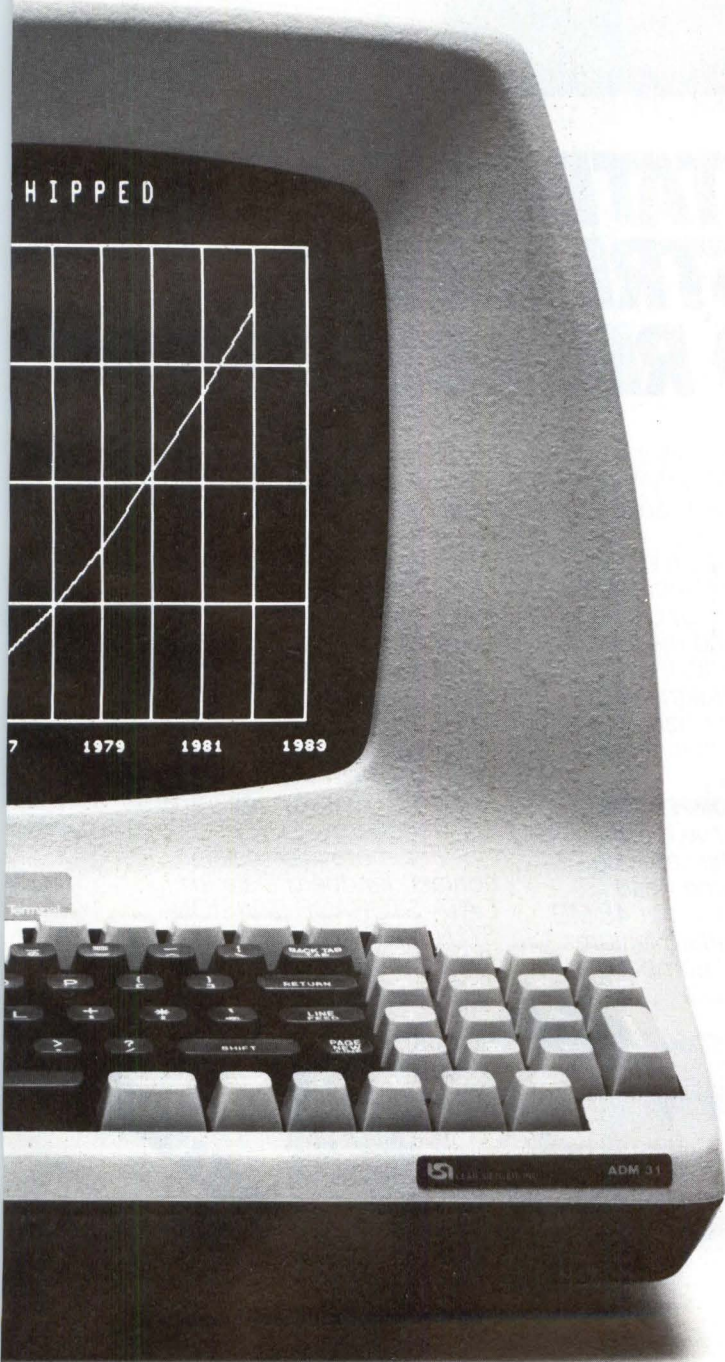
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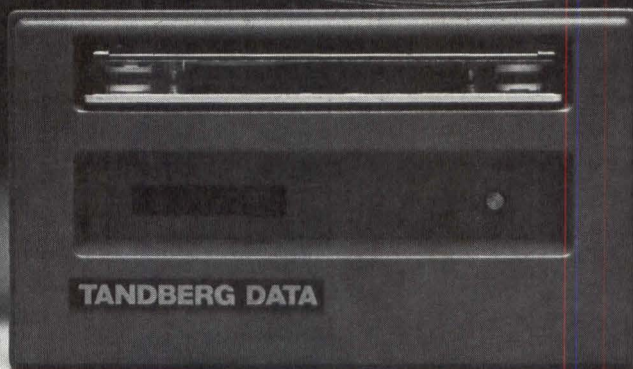


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\*1981 Datamation Brand Preference Study of the Data Processing Industry, OEM and End-User Markets. Infosystems Magazine, 1981 Survey of Terminal Usage. 1982 Brand Preference Survey conducted by Data Communications Magazine.

CIRCLE NO. 43 ON INQUIRY CARD





## A STRONG STATEMENT ABOUT OUR STREAMER'S ACCURACY AND RELIABILITY.

We're standing on our streamer to show you just how well Tandberg's 3200 family of 20 MB and 45 MB  $\frac{1}{4}$ " cartridge drives are engineered. Of course, we didn't design them to be stepstools.

### **DESIGNED FOR DATA INTEGRITY.**

Unlike most other drives, the 3200's body is fully cast to keep drive mechanisms stable and accurate. What's more, Tandberg's exclusive 3-point positioning and cartridge locking system ensures that cartridges are always correctly loaded and can't be jarred off track.

And while others still use less accurate mechanical referencing to locate the edge of the tape, Tandberg's exclusive Floating Head System finds this reference point dynamically using a signal seeking method. A precision, microprocessor-controlled stepping motor then locates the desired track—with better than 16 track accuracy. (Since our

20 MB and 45 MB units have 4 and 9 tracks respectively, the system is at least twice as accurate as it needs to be.)

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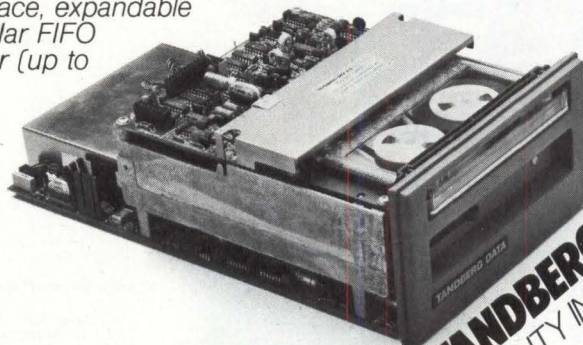
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CIRCLE NO. 44 ON INQUIRY CARD



# Mini-Micro World

INTERNATIONAL

## DEC to offer European software in U.S.

Though much attractive application software has been developed by software houses in Western Europe for Digital Equipment Corp. computers, many talented, but small, European software companies lack the resources to make their products widely available in the U.S. But now, DEC appears ready to sell and support European-developed products in the U.S. through its DEC Classified Software plan.

Dave Luccini with DEC's DCS program in the U.S. is unable to name any European product accepted by DCS managers in the U.S. yet. But he stresses that one goal of DCS is to have an unlimited flow of software from the U.S. to Europe and from Europe to the U.S.

DEC's European subsidiaries initiated their own DCS programs in 1982 and have just published their first catalogs. The catalogs include products developed by independent companies. DEC will sell and



**Geoff Beacroft**, head of DEC's Classified Software program in England, is bullish about prospects for some British products listed in the catalog.

support those products. Although some of the products in the catalog are from U.S. software houses, most are European. DEC has nonexclusive rights to the products, but those rights allow the products to be sold by DEC offices worldwide.

Robert DePicciotto, application

software manager at DEC's European headquarters in Geneva, Switzerland, is confident that DEC in the U.S. will adopt products from the European catalogs, and says, "Europe has tremendous software know-how." He believes that language problems will not seriously limit the spread of products developed in Europe. "The engineering community throughout Europe speaks English," he says. "DEC is encouraging software producers in Europe to make software transportable between countries." Britain is DEC's largest European market.

Geoff Beacroft, head of the DCS program at DEC's British headquarters in Reading, England, is optimistic about the prospects for some British products in the DCS catalog. He acknowledges that accounting application software is unlikely to create much interest, but says many products have universal applications, such as graphics, data management, financial modeling and communications.

DePicciotto, who is responsible

### LONDON SOFTWARE HOUSE SEEKS DISTRIBUTOR FOR DEC-COMPATIBLE PRODUCTS

A graphics package aimed at schematics generation, a document-preparation system, an operator-interface construction package and a videotex system are four software products for Digital Equipment Corp. machines available from Systems Technology Ltd., London. DEC is evaluating the oldest package, the document system IGOR, for possible inclusion in its DEC Classified Software catalog. Systems Technology managing director Les Hayden says he is independently seeking U.S. distributors for the products.

IGOR, for PDP-11s, was developed by Systems Technology in 1980 for internal use and is said to be far more powerful than a word-processing

package. A user can type in text in free format, and IGOR provides document features such as margin widths, page lengths, indentations and section headings. Hayden quotes end-user prices of \$1500 for the RT-11 version and \$3000 for the version that runs under RSX.

The graphics package, called Insight, is already used in Europe by a leading oil company at refinery installations, says Hayden. It can run on a PDP-11 under RT-11 or a VAX under VMS. Versions are also available for Hewlett-Packard Co. 1000 and 3000 systems. An Insight user can build a library of commonly used graphics—such as valves and process columns—for any display.

Episode, the operator-interface generation package, sells for \$1000 and is designed to run on PDP-11 machine under RT-11 or RSX with VT125 or VT131 display terminals. An application program can drive Episode via subroutine calls, and the package is said to relieve the application programmer of terminal-handling functions such as input and output for individual fields, input validation and the display of help information and fixed text.

The videotex package is aimed at PDP-11 hosts running under RSX, and is compatible with the Prestel standard adopted by IBM Corp. in the U.S. It currently lacks data-collection capabilities. Price is \$10,000.



# Mini-Micro World

INTERNATIONAL

for DEC's DCS strategy in Europe, including Britain, notes that most European products being adopted by DEC are aimed at users of the Professional and Rainbow personal computers launched last year. But Beacroft points to several products in the catalog aimed at PDP-11 and VAX users. They include at least two products already with small user populations in the U.S. acquired through channels independent of DEC: Xoren IPL-11 from Xoren Computing Ltd., London, and Simpleplot from Bradford University Software Services Ltd., Bradford.

Xoren IPL-11 enables files to be transferred between remotely located PDP-11 and VAX machines running under RSX, RT-11, TSX, RSTS or VMS. Xoren managing director John Jarvis says the product is already distributed in the U.S. by Softpak Associates, Inc., Marina del Rey, Calif., and Midcom Inc., Orange County, Calif. Jarvis names the City of San Jose, Mattel Electronics, Hawthorne, Calif., and Computer Timesharing Inc., San Diego, as users. U.S. end-user prices are less than \$1100.

Simpleplot is a library of FORTRAN subroutines for scientific and engineering graphics. Bradford's Dr. David Butland names the Life Sciences division of San Antonio Laboratory and the Hawaii University Physics Department as users. He says a version of Simpleplot for the Professionals will be available soon.

The British DCS catalog also includes Business Modeller for PDP-11s from Software Unlimited Ltd., Sunningdale, England, and two productivity aids from Filetab Support Services Ltd., London: Rapid Programming Language and Rapid Query Language, both of which can also be used on VAX machines. Filetab managing direc-

tor Richie McGladdery says the products are used at 300 European DEC sites, mostly in Britain, where together they sell for \$10,000 to \$15,000. British users include the Plessey Co. Ltd. and the *Financial Times*.

RPL is called an automatic language with logic capabilities based on decision tables, while RQL is a very powerful reporting system that uses a concise English instruction set.

"None of these products was developed to DEC specifications," notes Beacroft, "but we are talking to British software houses about future products that will meet our specifications." He lists graphics, communications and financial modeling as major applications.

Beacroft says DEC has four staff members in Britain engaged in the technical evaluation of products for possible inclusion in the DCS catalog. He notes that their investigations include talking to end users and

asking the opinion of appropriate user departments within DEC.

DePicciotto reveals that DEC's policy in Europe is to offer a deal under which a software house gets 17 to 18 percent of the end-user price charged by DEC for its product. This rate applies to worldwide sales. Each software house will deal only with the DEC company in its own country, which will collect information on sales of the product from DEC offices worldwide and pay the appropriate amount. Beacroft says, "They have to trust us," adding that the software houses he deals with also trust that DEC will not alter their software so much that DEC will be able to claim it as a DEC product. But he stresses that some of the products adopted for DEC catalogs will be altered somewhat by DEC, and that DEC will seek to influence the further development of products by their originating software houses.

—Keith Jones

## French company paces international Ada development

Development of the Ada real-time process, a fact underlined by the key role played by French company

### 5000 ORGANIZATIONS CONTRIBUTE TO ADA SPECIFICATIONS

More than 5000 worldwide organizations contributed to the Ada specification submitted to ANSI in January by the Ada Joint Program Office of the Department of Defense. Dr. Robert Mathis, technical director of the AJPO, notes that the companies' comments were all given "careful consideration" and affected the final definition produced by AJPO in cooperation with Alsys.

Mathis notes that nearly 100 of the more than 5000 organizations were asked to vote on whether the final definition was technically acceptable. The 100 included most major manufacturers of computers, universi-

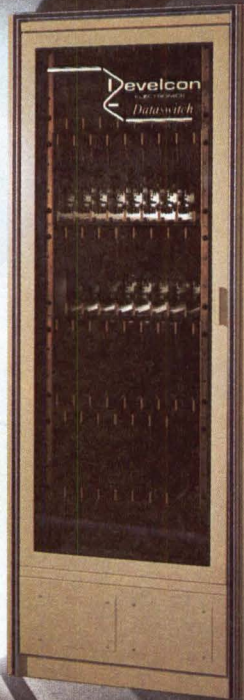
ties, professional organizations and end users. Mathis says 81 companies responded positively, five reacted negatively, and the rest abstained.

Mathis explains that the final definition does not differ substantially from the 1980 Ada definition as far as programmers are concerned, but it is implemented somewhat differently. He says adoption by the International Standards Organization will follow acceptance of the definition by ANSI. Because of the "slow and deliberate" workings of ISO, Mathis says, it will probably take three to four years to adopt the Ada standard.



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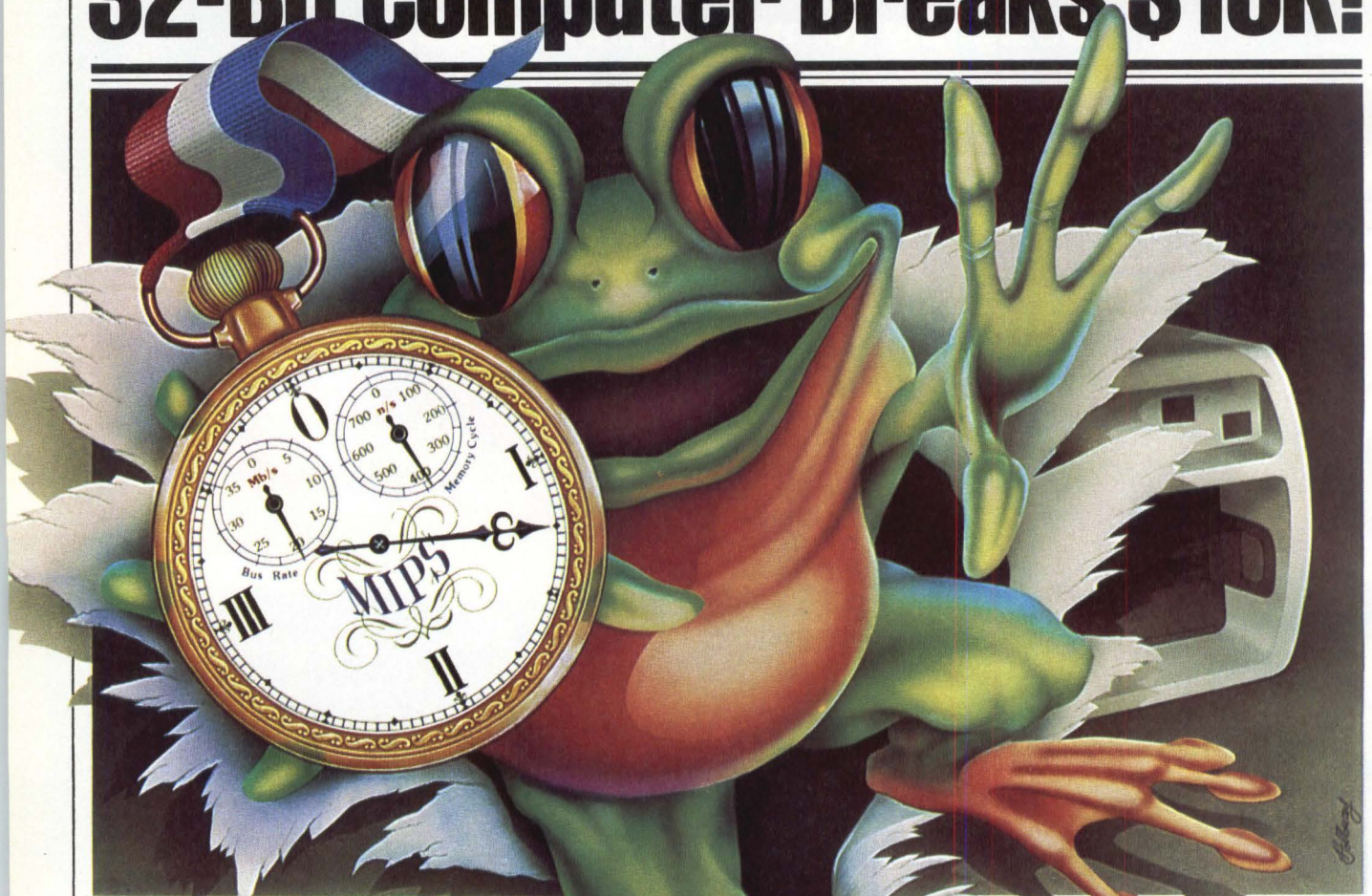
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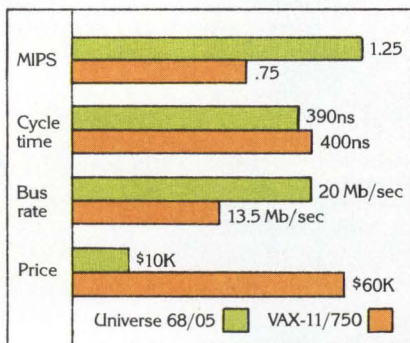


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CIRCLE NO. 46 ON INQUIRY CARD



# Mini-Micro World

INTERNATIONAL



**Jean Ichbiah, director general of Alsys S.A., France, was a principal designer of Ada in the late 1970s. Alsys has played a major role in the proposed final ANSI Ada specification. The company is also developing an Ada compiler for the MC68000 and a training course for programmers converting to Ada from other languages.**

Alsys S.A. With the U.S. Department of Defense, Alsys has led the work resulting in the final definition of Ada, which is now in the hands of the American National Standards Institute.

Alsys is developing compilers for high-performance microprocessors. A fully optimized compiler for the Motorola 68000 should be available by the second quarter of 1984, says Alsys director general Jean Ichbiah. The company is also developing microcomputer-based training courses for professional programmers converting to Ada from FORTRAN, Pascal and other languages.

Working at Cii Honeywell Bull in the late 1970s, Ichbiah was a principal designer of Ada, which was selected by the DOD in 1979. In 1980, he left Cii HB to establish Alsys, and has since then worked with the DOD's Ada Joint Program Office in preparing the final definition of the language submitted to ANSI this January.

Ichbiah notes that the Ada compilers will possess some portability, but that substantial efforts

will still be required to tailor them for specific machines. "The machine-dependent part is about 80 percent," Ichbiah explains. "We have already started development of the 68000 compiler and are

considering a compiler for the 8086, but that is less definite."

Ichbiah acknowledges that Ada products for the 68000, including an interpreter from Telesoft Corp. and a cross-compiler from Softech, Inc.,

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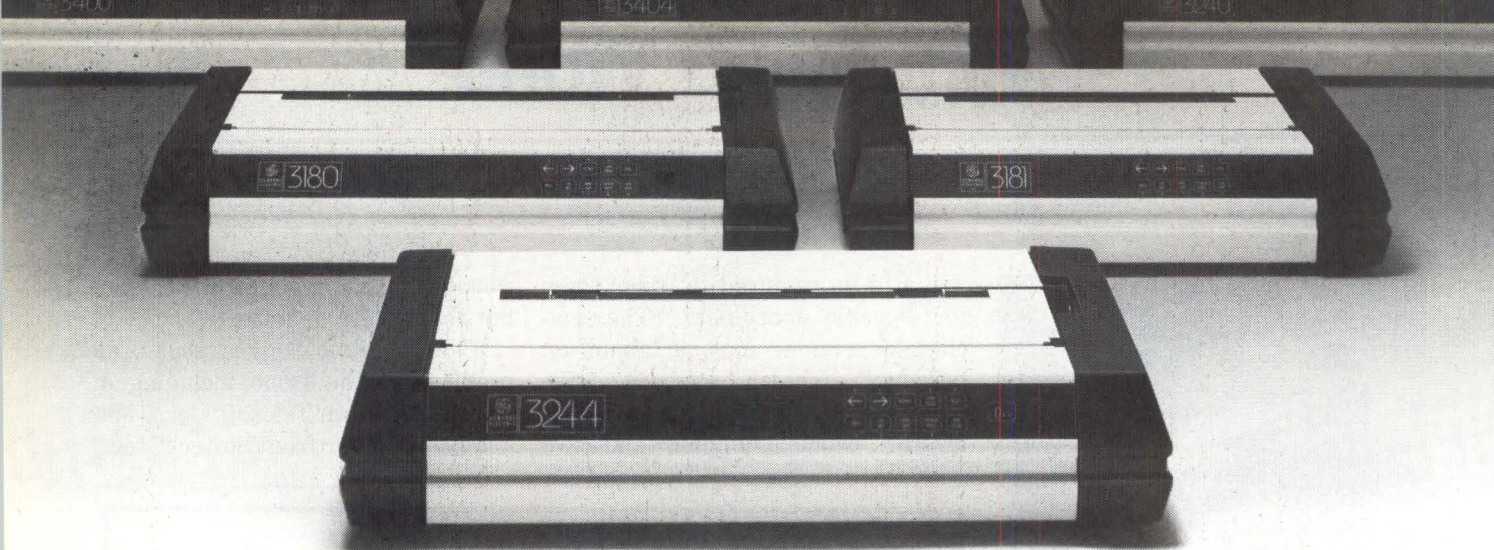
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# Mini-Micro World

INTERNATIONAL

already exist, but claims that the Alsys offering will be the first fully optimized compiler for the 68000. He notes it will comply fully with the Ada definition that ANSI has. Development is taking place under UNIX.

The compiler work at Alsys is funded in part by the European Economic Community, which has allocated about \$6 million to cover 40 percent of the cost of Ada-oriented products at several European companies. Besides Alsys, Cii Honeywell Bull and Siemens are also receiving funds for compilers from the EEC. Olivetti SpA, Ivrea, Italy, and Danish companies Christian Rovsing and the Dansk Datamatic Center are being helped with work on Ada Program Support Environment tools. The funding was allocated about 18 months ago for a period ceasing at the end of this year. The EEC's Council of Ministers is considering new funding.

A consortium of four British companies, the Ada Group Ltd., is seeking about \$10 million in funding from the government to develop APSE tools for a variety of target machines. The four members are leading British computer manufacturer ICL Plc, computer services group Software Sciences, SPL International and Systems Designers Ltd. SPLI and SDL have considerable experience in projects based on Digital Equipment Corp. hardware.

One of the earliest Ada products from Britain is a compiler for DEC VAX machines complying with the 1980 Ada definition and developed by the University of York (MMS, November, 1982, p. 138).

Softech Inc. and Intermetrics Inc. are leading APSE development in the U.S. (MMS, September, 1982, p. 223). The Ada training course from Alsys is expected to be

available in the U.S. in 1983, says Kit Lester, an Alsys software engineer. He notes that it will be tailored to suit English-speaking users and is designed to be "more flexible than a textbook." Development is on a Pascal-based Intel

8086. Paradoxically, Pascal is one of the languages that Ada is intended to supersede, at least in some applications. Lester explains that Pascal was chosen because of its portability across numerous microcomputers. —Keith Jones

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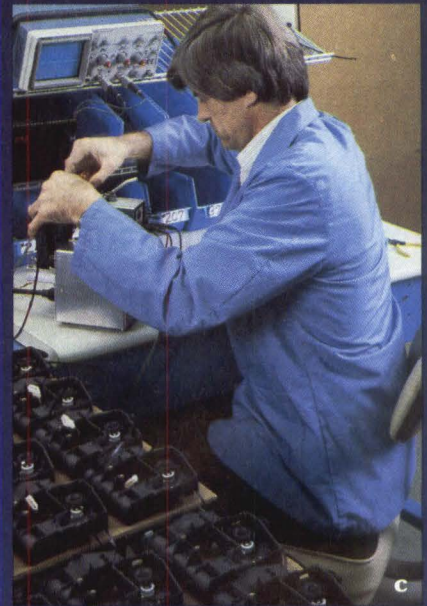
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# Mini-Micro Interpreter

An analysis of news, issues and trends affecting the computer industry

## High-end, 16-bit microcomputers gravitate toward MC68000 chips

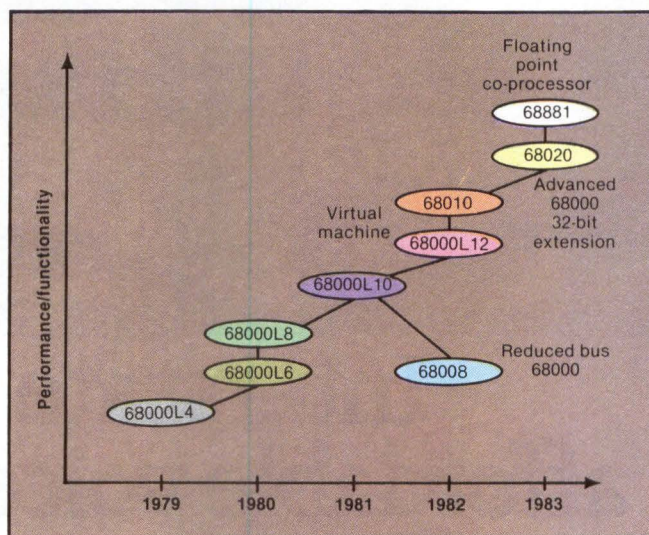
By Sarah Glazer

Introduced in late 1979, the Motorola MC68000 has cut a wide swath through the field of 16-bit microprocessors, emerging as designers' favorite chip for high-end microcomputer systems. Although it still costs considerably more than its two main competitors—the Intel 8086 and the Zilog Z8000—the MC68000's 32-bit internal architecture, speed and well-designed instruction set are making it the chip of choice for systems that must perform sophisticated, multi-user applications.

Produced by Motorola, Inc., Austin, the MC68000 accounted for 25 percent of the 16-bit microprocessors shipped in 1982, says Kenneth McKenzie of Dataquest, Inc., a Cupertino, Calif., research firm that follows the microprocessor industry. He estimates that the iAPX 8086 from Intel Corp., Santa Clara, Calif., had 70 percent of the 1982 16-bit market and the Z8000 from Zilog, Inc., Campbell, Calif., had about 5 percent. Egil Juliussen, chairman of Future Computing, a market research firm in Richardson, Texas, says the MC68000 appears in systems at the high end of the market and predicts it will remain strong there for some time. "For the future, the 68000 will be very prominent in what we call the \$10,000 computer," he says.

"Although the 68000 is called a 16-bit machine, the architecture is more of a 32-bit machine. That is the key," Juliussen explains. The 68000 has a 16-bit-wide external data path, and thus is tagged a 16-bit chip. However, internally it has 32-bit registers throughout—eight general-purpose data registers and eight general-purpose address registers. "When programs become larger and the applications more sophisticated, this becomes very important," Juliussen stresses.

Roger Melen, vice president of R&D at Cromemco, Inc., a Mountain View, Calif., manufacturer of desk-top computer systems based on the MC68000, agrees with this analysis of the 68000's popularity. He explains that the MC68000's linear, 32-bit architecture allows it to address far more memory than can a chip with 16-bit internal architecture. The MC68000's address space goes from 0 to 16M bytes, with any location equally accessible. "The 68000 is much more like a mainframe than like a 16-bit machine, at least in its ability to address large amounts of memory," Melen says. This is important, he emphasizes, when running software



**Genealogy of the MC68000 processor family.** The first chip on the market was a 4-MHz version, denoted by the L4 at the end of the model number. Its siblings are either faster or have different functional features.

packages that previously ran on mainframes. "Mainframes are designed to address megabytes as easily as they address a byte," he says. "If you try to patch their software to run on a truly 16-bit microprocessor, you can do it, but you run into software bugs."

### Segmented addressing limits

Juliussen explains that an architecture using segmented, 16-bit registers theoretically can directly address only 64K bytes of memory at a time, although memory-management schemes allow the chips to address more memory. He describes such memory management as "a 64K window you can move around within the larger memory space." But he notes, "It's cumbersome for programmers. You'd prefer not to do it."

Both the 8086 chip family and the Z8000 family have segmented registers. Jeffrey Miller, marketing manager for Intel's microprocessor operation, dismisses the segmentation issue, saying, "This is primarily a religious issue—segmented address space versus flat address space." He believes that Intel's most powerful chip, the iAPX 80286, scheduled to begin volume production this month, will find a home in high-end, multi-user systems with its memory-management, memory-protection and virtual-memory features, even





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though it has a segmented address space and 16-bit registers.

However, Melen of Cromemco says that memory addressing strongly influenced Cromemco's choice of microprocessor when designers began planning its computer three years ago. They considered three chips, he says: the iAPX 8086, the Z8000 and the MC68000. "Since memory was coming down in price very rapidly, we wanted a processor that could accommodate vast amounts of memory efficiently and effectively," he says. The designers had planned initially for a 256K RAM chip, which Melen explains would provide memory economically in the several-megabyte range. "When you look at the 8086 in that context, it has only a 1M-byte address space," Melen says. "And that's a severe limitation." The Z8000 relies on an external chip to address large amounts of memory, but that support

chip wasn't available when Cromemco's decisions were being made, he adds.

James Groff, product marketing manager at Plexus Computers, Inc., Santa Clara, Calif., which manufactures a supermicro based on the MC68000, says the Motorola chip is leading its competition notably in some applications. He names intensive program development, relational database management, computer-aided design, large inventory control and material requirements planning systems as MC68000 strongholds.

In addition to address space, Groff credits the chip's popularity to its speed. His company uses a 12.5-MHz MC68000. (The chip is also produced in 4-, 6-, 8- and 10-MHz versions.) Groff explains that in multi-user applications such as program development, there might be four or five simultaneous C compiles. "There, the

16-bit Microprocessors				
	MC68000	iAPX 8086*	Z8002	NS16032
Speed	10 MHz (also available in 4, 6, 8 and 12.5 MHz)	8 MHz (8 and 12 MHz for the 286)	4 MHz (also available in 6 and 10 MHz)	6 MHz (also available in 10 MHz)
No. memory fetches per sec.	2.5M	2M (4M for 286)	1.3M	1.5M
No. fetches per instruction	1-5	1/2-4	1	1-5
Time from valid address until data needed from memory	225 nsec.	295 nsec. (242 nsec. for the 286)	295 nsec.	125 nsec.
Floating-point chip	Not yet available	8089	Not yet available	16081
Memory-management unit	68451	Not available (integral to 286)	8010, 8015	16082
Virtual-memory CPU	68010	80286	8003, 8004	16032
Physical address space	16M bytes	1M byte (16M bytes for 286)	8M bytes	16M bytes
No. of instructions	52	87 (103 for the 286)	114	86
Second sources	Signetics, Hitachi, Mostek, Philips, Rockwell, Thomson CSF	AMD, NEC, Western Digital	AMD, SGF, Sharp, Toshiba	Fairchild Synertec, Eurotechnique
Chip with 32-bit-wide external data path	68020 (prototype Dec., 1983)	80386 (prototype late 1984)	Z80,000 (prototype late 1983)	32032 (prototypes now; sampling mid-1983)
Price (each)	in 100 quantity: 68000 \$61 (8 MHz) 68008 \$38.25 68010 \$185 68451 \$58.80	in 100 quantity: 8086 \$25 8088 \$14.10 186 \$50 188 \$50 286 \$237	in 100 quantity: 8001ps \$28.50 8002ps \$20.75 8003ps \$57 8004ps \$41.50 8010ps \$28.50 8015ps \$71.50	quantity of one: 16032 \$162
Source: Motorola, Intel, Zilog and National Semiconductor *Where information for the iAPX 80286 is significantly different, it is given in parentheses.				



# The Interpreter

brute processing power of the 68000 is very appropriate." Relational database management also requires CPU power to manipulate large tables of data, he notes. In addition, he says, the more of a table that can fit into memory at once, the better it is for such an application. "All these things play strongly to the 68000's advantage," he says.

Plexus manufactures a sister computer system to its MC68000-based system that uses a Zilog Z8000 as the CPU. For I/O-intensive applications, such as inquiry response for verifying bank account balances, Groff believes, the Z8000 is an excellent CPU. In such a case, he stresses, "There's no need to spend the additional money for the performance-assistance 68000." A standard MC68000 sells for \$61 each in 100-unit quantities, whereas in similar quantities, a Z8000 CPU sells for \$20.75, and an 8086 sells for \$25.

## Ties to an 8-bit base

Some of the reasons for the differing technical features among 16-bit chips can be traced to their ancestry in the 8-bit market. "Intel had such a large installed base for its 8-bit chip [the 8080] that it had to come out with a 16-bit version of the 8-bit chip to save that base," says Miles Rickard, general manager of Ryan McFarland Corp., an Austin software company. Because compatibility with its installed base was very important, Intel designed the 8086 so that application software need not be rewritten. (Zilog also designed the Z8000 to be software-compatible with its popular Z80 8-bit chip.)

Although compatibility is a big selling point for users, Cromemco's Melen believes it is a double-edged sword. "Because Intel was attempting to get backward compatibility with the 8080, its upgraded chips have essentially the same instruction set. The 8086 is just patch upon patch," Melen says. He describes the instruction set as unsymmetrical, saying the attributes of instructions change radically from one to another. "It's a compiler designer's nightmare," he concludes.

"The 8086 doesn't program like a real computer," says Robert Osborn, a computer systems consultant in Arlington, Mass. He terms its instruction set "terrible," but adds, "Some people argue it doesn't matter because you write all your code in high-level language." He gives the Z8000 higher marks, although, he says, "It still has a microprocessor-oriented instruction set." In contrast, he says of the MC68000, "It's the only one that has a minicomputer-type instruction set."

Rickard of Ryan McFarland believes this break with a more primitive type of instruction occurred when Motorola decided to abandon its 8-bit base. "Motorola

leapfrogged to a 32-bit chip and then came out with a 16-bit version they could implement," he says. In so radically changing its architecture and instruction set, Motorola abandoned existing software as well. "In the short term, they may suffer," Rickard says, "but in the long term, they're probably going to have better success."

In addition to the MC68000, Motorola has added other CPUs to its family, all based on the 32-bit internal architecture. The MC68008 has an 8-bit-wide external data path. The MC68010, scheduled to be in volume production by now, has a 16-bit external data path like the standard MC68000, but it supports virtual memory. And scheduled to be introduced next December is the MC68020, which is planned as a fully 32-bit chip, with a 32-bit-wide external data path.

Another microprocessor family with 32-bit internal architecture that is entering the 16-bit market is Santa Clara, Calif., National Semiconductor Corp.'s NS16000 series. And, because the NS16032 CPU was introduced only last May, National had several years more than its competitors to hone technical features. "It's one of the best-thought-out devices from an architectural standpoint," says McKenzie of Dataquest. "National is last into the market, so it had the last look at the mistakes everyone else made." McKenzie questions the NS16000's ability to gain market share but says the recession has bought National some time by causing customers to postpone purchases. "The longer the recession lasts, the healthier the prospects for the 16032 become," he says.

## The software issue

Because the MC68000 represents a departure from the previous generation of Motorola chips, it entered the market with virtually no software support. "There's a very large new market for the 68000 that requires new software," says Ron Conway, vice president of marketing at Altos Computers, Inc., San Jose, Calif. Altos is handling this problem by producing two lines of computers—one based on the MC68000 and the other on the 8086. Conway explains that Altos is directing its 8086 line at its existing 8-bit customer base that uses CP/M, MP/M and OASIS operating systems. "We had to offer those users an upgrade path to a 16-bit computer that would run their software," he says. The 68000-based line is aimed at what he describes as "the emerging market—engineering workstations and new OEMs who haven't written any software yet."

Some MC68000 users insist software is not an issue because so many application programs are written in high-level languages that can be transported to 68000-



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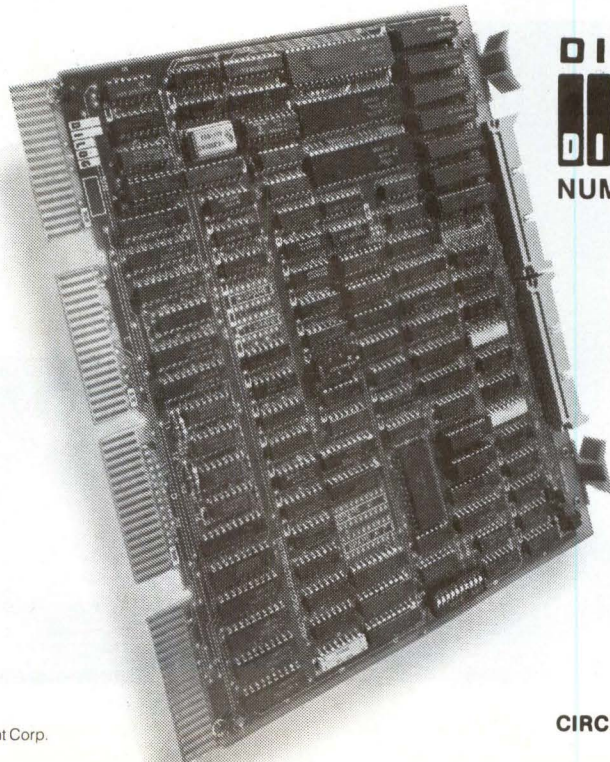
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based systems. "The issue of software went away with the introduction of UNIX-compatible systems on the 68000," says Jim Isaak, product manager at Charles River Data Systems, Inc., Natick, Mass., which produces a multi-user microcomputer system based on the MC68000. "All the major languages are available on the 68000 now," he adds.

The significance of the UNIX operating system is that it runs on computers ranging from micros to mainframes, says Jean Yates, president of Yates Ventures, a Los Altos, Calif., publishing company that specializes in operating systems. UNIX allows programmers to use all the features of a mainframe—compilers, debuggers, database managers and editors. Yates declares that UNIX has become a "portable software standard" that allows easy networking between 68000-based microcomputer systems, minis and mainframes.

"In terms of design-ins in UNIX-land, the 68000 is the chip of choice," says Yates. She credits this to its direct addressing capability and to the snowball effect of 68000-based systems coming on the market. "Everybody knows that Apple Computer and Tandy have

computers with it. Then Fortune Systems made a big splash. It's the name-brand value of the companies that are selling them," she says.

Consultant Osborn also believes that UNIX and the MC68000 are a good fit because of the chip's large address space. "UNIX is a hog," he says of the operating system's memory requirements. However, he explains that UNIX was written for a machine with a small address space, the Digital Equipment Corp. PDP-11, so it can be put on any 16-bit processor. "You can do UNIX on the 8086," he says, "but the 68000 is easier to use." Microsoft has written XENIX, a version of UNIX System III, for the 8086.

Yates believes that the 68000 will continue to dominate in UNIX-based computer systems. Of the more than 1 billion microprocessors she estimates will be UNIX related by the end of 1986, 70 percent will be in the 68000 family, 28 percent in the 8086 family and 2 percent in the Z8000 family, she predicts.

Even though UNIX has smoothed the path for the 68000, much application software remains to be written. Application software is still one of the main

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strengths of the 68000's chief competitor, the 8086—especially for single-user computer systems, says Yates. "I think it's a drawback for the 68000 that they don't have that kind of software support," she says.

McFarland's Rickard believes software support will continue to be a strength for the 8086 family in the personal computer market. Even before IBM Corp. chose the iAPX 8088 (part of the 8086 family) as the CPU for its personal computer, Rickard says, software written for the 8086 had become the "single-user de facto standard." An additional strength he cites for the 8086 family is a strong base of low-cost support chips, giving computers based on it a competitive price edge. Support chips lower design costs by cutting the need for custom circuitry. "The 8088," he says, "is the obvious choice for a personal computer from a marketing standpoint, if not from a technical standpoint."

To hasten the development of its own support chips, Motorola is building an impressive second-source team, says Charles River's Isaak. "Second sourcing is an important factor in the way the marketplace works," says Isaaks, naming, in addition to plentiful support

chips, cost reduction, availability and promotion of the entire chip family as benefits. However, most of the MC68000's second sources are not yet in production, says Motorola's director of marketing and applications for advanced microprocessors, Jack Browne. "Second sources are coming on line as soon as they get their engineering problems ironed out," he says.

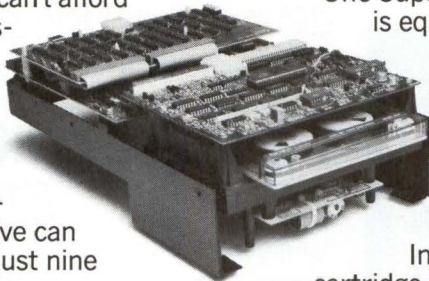
Still, the MC68000 has created excitement that is itself an important marketing tool. Groff of Plexus describes it as "a bandwagon effect." He explains, "There are a lot of vendors announcing, and it's a favorite with programmers and technical people." In addition, there is a persistent industry rumor that IBM's Instruments Division may market a 68000-based desktop computer as a high-end personal computer.

Even without the added boost of riding on IBM's marketing coattails, the MC68000 has a strong image. Groff says customers are demanding Plexus's 68000-based system whose needs could be met by the less expensive Z8000-based system. "Nonetheless, they perceive the 68000 as leading-edge technology," he says, "And you can't argue with that." □

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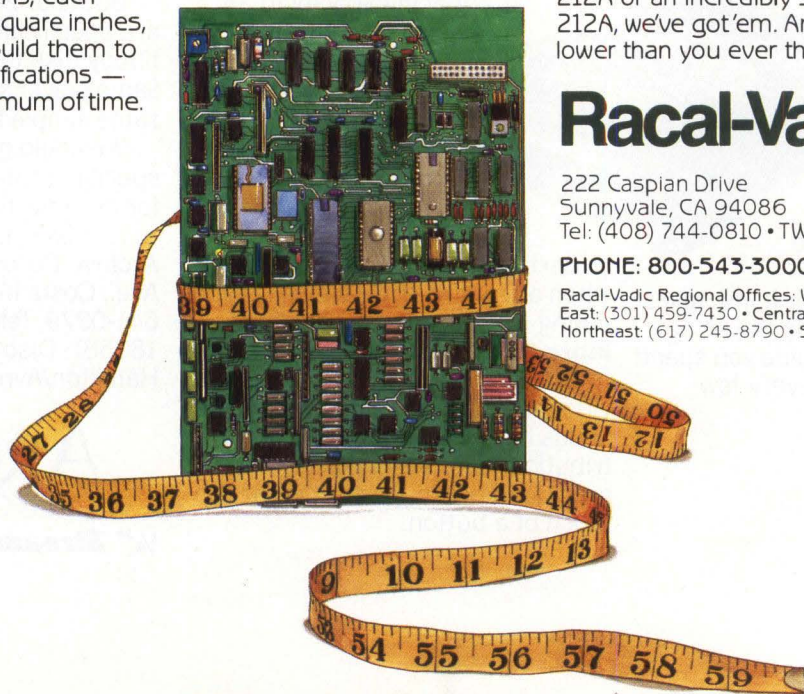
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## Software distributors fill gap between developers and dealers

By Geoff Lewis

The explosive growth of the personal-computer/desktop microcomputer market has seeded many ancillary businesses. Among the most dynamic of these beneficiaries is the software-distribution industry. Almost nonexistent three years ago, distribution companies are beginning to play a dominant role in the sales and marketing of microcomputer business software.

Companies such as Softsel Computer Products, Inc., Software Distributors and Micro D, Inc., have become the latest variety of overnight sensations in the microcomputer market. They have done so, says industry analyst Egil Juliussen of Future Computing, because they "filled a crying need in the market." The need was for some order in an uncontrolled, chaotic market in which retailers had to choose from among thousands of packages from hundreds of suppliers. And once the retailers made their choices, they had little assurance that the products would operate as advertised or would meet commercial standards. Hardware distributors did the little they could to supply a software repertoire with their machines, but neither they nor the dealers had the resources to sort out the rapidly rising flood of software products for small-business applications.

"Hardware distributors just didn't carry software," explains Juliussen, whose Richardson, Texas, firm tracks the personal-computer market and the retail channels through which its products flow. "When Softsel started two years ago, they were the first in the market, and they and the others have performed a tremendous service. Store owners previously had to order from hundreds of vendors, and now they can get a wide variety of products from a single source," he says.

Starting from that simple premise—one-stop shopping—software wholesalers have taken on additional responsibilities. Perhaps the most significant is their intermediary role between software developers or publishers and computer dealers and software stores. As products flow from the suppliers, software distributors claim to perform a screening function, rejecting inadequate products before they reach the store shelves. The distributors also act as a conduit to the suppliers, carrying market-response information from the dealers.

Softsel, based in Inglewood, Calif., claims to be the



Illustration by Jim Wiley

largest software distributor, expanding from distribution of computer games (recreational software) to business applications in the 2½ years since its inception. Executive vice president David Blumstein says the company enjoys a 700-percent annual growth rate and had more than \$35 million in gross sales last year. Its chief rival, Software Distributors, was established almost two years ago and claims to be the largest distributor of business application packages with revenues comparable to Softsel's.

Software Distributors president Linda Johnson notes that as Softsel has added business applications to its line of game software, the company has begun adding recreational software. Using this strategy, Johnson says, Software Distributors is growing 20 percent per month. Softsel now derives as much as 80 percent of its revenues and 50 percent of its unit volume from business packages. Johnson says recreational packages account for about 35 percent of Software Distributors' unit volume.

Overall, software distributors—which include in their ranks other national organizations such as Micro D as well as dozens of regional operations—handle 50



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# The Interpreter



**Linda Johnson, president of Software Distributors, says, "Software-only retailers have hundreds of products in their stores [compared with hardware dealers that frequently carry fewer program products]. It is, therefore, critical for them to use distributors."**

percent or more of all the business application software sold, Juliussen estimates. According to Future Computing's projections, sales of business application software such as personal productivity tools, accounting and word processing for machines in the \$3000 to \$10,000 range will grow from \$330 million annually in 1981 to \$2.6 billion in 1986. For the over-\$10,000 personal-computer segment, Future Computing expects software packages to rise from \$100 million annually to almost \$1 billion in the same period. Overall—with entertainment and consumer applications factored in—sales are expected to rise from \$500 million annually to \$6 billion in 1986.

The software distributors' share of this market is the difference between the discount they receive from manufacturers and the price they charge dealers. Distributors typically get discounts as high as 60 percent, while dealer discounts are around 40 percent, leaving distributors with about 20 percent of the retail purchase price on each package they sell.

In the case of Software Distributors, however, the margin can be higher. Johnson explains that her company has established a floppy disk-duplication facility able to produce floppies for 37 computers. The company has duplication licensing agreements with 45 manufacturers, she says. She declines to disclose what financial arrangements Software Distributors has with

these companies, but acknowledges that her company's profits are higher on company-duplicated products. She also points out that this method enables her company to supply dealers with packages that manufacturers have not formatted for some computer brands.

## Distributors add value

As distributors gain clout in the business software market, they are taking on added functions to help move packages smoothly through the dealer channel. However, providing any value added is a challenge for Softsel and Software Distributors, each of which carries about 1000 titles for sale to more than 2000 dealers. Nevertheless, Johnson and Blumstein both stress the service aspects of their companies. In addition to providing a one-stop shopping service, both companies offer dealers liberal return policies, 24-hour shipment on orders (most of which come over the telephone) and discounts based on dollar volumes.

In addition to the standard reseller discount, which varies according to the price of a package, Softsel deducts as much as 10 percent more for stores ordering \$20,000 a month. Software Distributors takes volume discounts on a case-by-case basis, Johnson says, declining to specify representative examples.

Both Johnson and Blumstein stress their companies' roles in evaluating packages. Blumstein says more than a dozen Softsel employees work full time evaluating about half of the 300 or so packages submitted monthly by authors and manufacturers. Of those evaluated, 3 to 4 percent are chosen for resale to dealers. Johnson says, "Before we'll include any new title, it goes through a technical evaluation, then we look at the documentation, then we look at the market demand for such a product, and finally, we evaluate how support-intensive it will be."

"When we started, there was only a limited number of products available," Blumstein recalls. "Now it's an easier process because we can compare a new product against what has already succeeded in the market." He points out that some rejected products are resubmitted after the publisher has attempted to rectify a product's shortcomings.

"Now that there are a number of major distributors," Johnson says, "we can make some demands on the manufacturers, and if they don't live up to them, we won't handle their products." As the market gets more competitive, with more first-time users going to stores to purchase business packages, the distributors are pressuring the manufacturers for better documentation and merchandising materials, she notes. "I don't think any of the distributors would indiscriminately add new





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# The Interpreter

products at this point," she says.

## Distributors' role questioned

However, some software suppliers, including Microsoft, Inc., national sales manager for consumer products Nick Roche, question Johnson's statement. "I don't think distributors can prevent bad products from coming into the marketplace," he says. "They are in the same boat with everybody else. There are so many products out there that it's impossible to keep up. If VisiCalc were garbage, but if it were still the best selling product on the market, they'd carry it."

Roche, whose operation handles some 60 versions of about six basic products, adds, "The distributors are really a conduit at this point. I would like to think otherwise, but I see no evidence." Roche, whose background is in consumer products, adds, "It used to be that a distributor would go out and push a good product, build a market for the manufacturer and help the dealer." He complains that many software distributors don't pay enough attention to merchandising issues such as shelf facings and promotional materials, but acknowledges that distributors' margins do not leave much room in their budgets for these items.

While manufacturers are happy to have distributors give their products rapid and widespread markets, they sometimes have difficulty delineating who has responsibility for supporting the dealer and end user.

Software Distributors' Johnson says, "Theoretically, the guy who sells the dealer the package should support the dealer, and the manufacturer should support the distributor. We don't support end users, but we do support the dealer," she continues, "If they have a technical problem with a package, they call in and can talk to an expert on database-management systems, accounting or spread sheets, all in one call." Dealer training itself, however, "is a responsibility of the software manufacturer," says Johnson. The manufacturer is expected to provide materials and personnel to make the dealer conversant in the product.

Software Distributors does plan to augment vendor training, Johnson says. This year, the company is launching a 12-month road show that will travel throughout the U.S. to give dealers intensive training on generic packages such as spread sheet, word processing and accounting. Johnson says her company is also working on additional merchandising aids such as in-store display racks.

Microsoft's Roche agrees with Johnson's view that training is largely the responsibility of software vendors. "There is absolutely no question that we as a manufacturer have an obligation—and probably it's in



David Blumstein of Softsel Computer Products, Inc., recalls, "We got a head start when only hardware distributors existed. We slipped in there, and people have said to us we were the first."

our best interest—to train dealers how to sell and service our products. Therefore, we are hiring reps all over the country to train dealers who then will be able to do the end-user handholding."

A similar effort has been launched at VisiCorp, whose VisiCalc remains one of the top-selling business applications. Vice president C. Gerald Diamond says, "We have a support center with an 800 number to handle dealer questions. In addition, we send dealers a monthly newsletter giving answers to frequently asked questions about VisiCorp products." The company also has a cadre of sales trainers who travel throughout the country, training 800 dealers per calendar quarter.

## Categorizing dealers

Another solution, adopted by Management Science America's Peachtree Software, Inc., subsidiary, is dividing the dealer network between those dealers serviced by distributors and those that deal directly with the company. Peachtree marketing and sales manager Julian Puckett says the move was made last summer when the company created a new class of dealers known as Authorized Software Centers. Some 350 of 1500 dealers, which traditionally acquired Peachtree's business and accounting packages through distributors, have signed for the program. Under ASC, a dealer receives a better price than available from a distributor, but must provide merchandising, promo-



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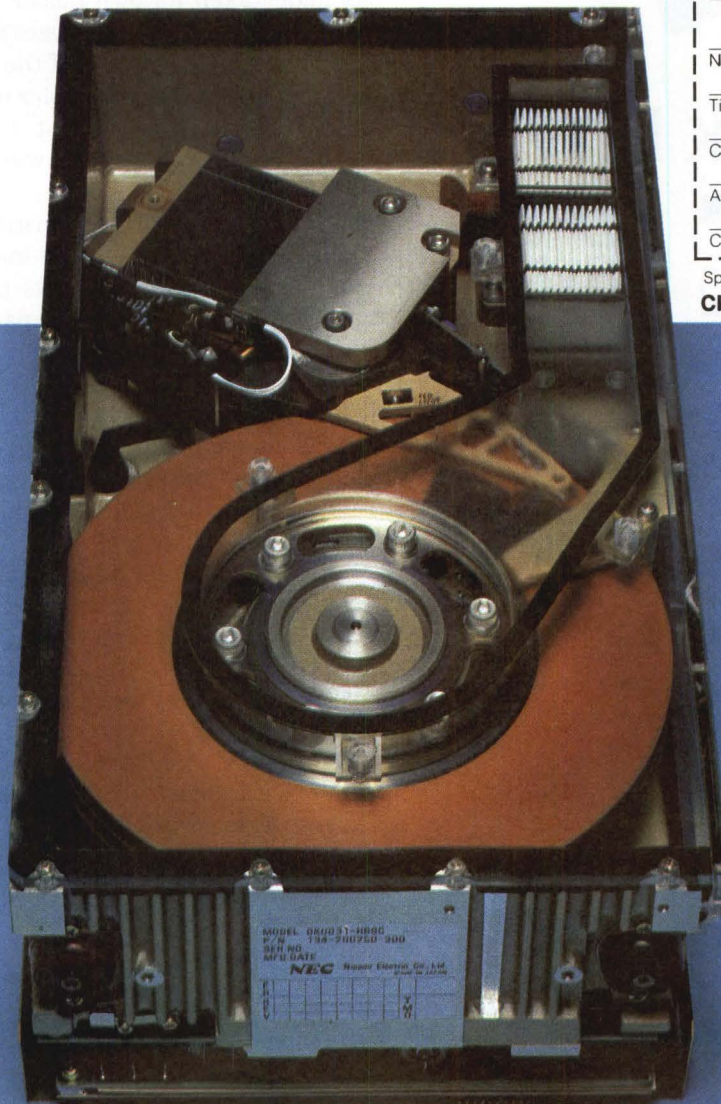
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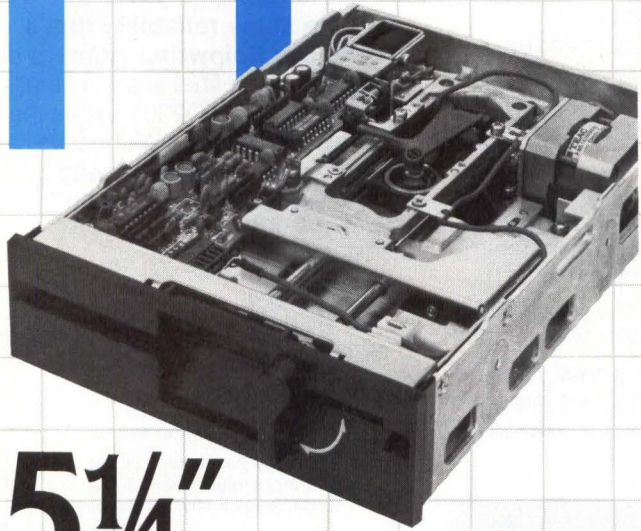
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## The Interpreter

tion and support. For dealers that acquire products through distributors, prices are higher but include end-user support from Peachtree. "A support card is included in every package and entitles a user to 30 days of free support via a toll-free hot line to our support center," Puckett says, adding that the service is available for a fee after the 30 days.

Dealer training in the distribution channel falls to the distributors, Puckett says. "We do not supply dealer support in distribution products, but the distributors are moving very quickly to train dealers. To date, we have had very good experience with distributors supplying support to dealers," he adds.

However, other suppliers are less sanguine about leaving sales training to their distributors. Software Publishing, Inc., Mountain View, Calif., for example, moves most of its products through distributors, but has undertaken its own dealer training performed by Software Publishing employees and independent representatives. "The key role of the distributor is one-stop shopping and letting the dealer mix and match products for volume discounts. What is missing, however, is in-store training," says Software Publishing president Fred Gibbons.

Software Publishing has installed more than 120,000 copies of its PFS database-management system on Apple systems. Gibbons says products such as those marketed by his company are part of the initial systems sale in many cases and therefore require a more knowledgeable salesperson. "We really don't see the distributors offering support beyond a macro level—such as knowing which packages will work with which printer. What the distributor can do is keep the dealer from buying blind and keep him informed about what products are selling well."

Softsel "would like to educate dealers," says Blumstein, but has been prevented from doing thorough dealer training by the company's rapid expansion. Dealer training sessions are now taped, and Blumstein says the tapes may be made available to dealers who could not attend.

The company, however, has developed a monthly binder with information on all Softsel lines for its dealers. That project was the result of a year-long effort aimed at keeping dealers up-to-date on Softsel's offerings and features of various packages. In addition, the company supplies a newsletter listing products the company plans to offer and provides dealers with advance copies of new products under a special program. Another merchandising aid is a weekly poster listing the 100 top-selling packages. □





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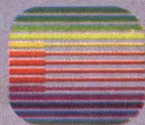
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**CIRCLE NO. 61 ON INQUIRY CARD**



# The Interpreter

## Network management and control: different meanings to different vendors

By Dwight B. Davis

Over the past 10 to 15 years, networks have become integral parts of many companies' operations. Firms with widely dispersed offices and personnel, such as banks, insurers and airlines, were the first to embrace networking concepts and products, but hundreds of other businesses have followed the lead of the pioneering firms. In doing so, these companies have realized benefits equivalent to those generated by the advent of stand-alone data-processing equipment. But as networks have grown to include hundreds of lines supporting thousands of users, the implications of network failures have become staggering.

In response to networking users who faced severe consequences to their businesses when network failures occurred, communications vendors began introducing automated test and monitoring equipment about 10 years ago. Before the 1973 introduction of the MPT 500 network control system by Intertel, Inc., users had to rely on manually operated equipment such as oscilloscopes and patch panels to isolate and repair network problems. Such "tech control" equipment still performs an important role in network diagnosis and reconfiguration, but the trend has been to automate as many control functions as possible and to generate detailed reports from the data gathered by the monitoring equipment.

It was natural for Intertel, Andover, Mass., to enter the network monitoring and control business because the company was already selling modems to network users. Other modem and network component suppliers, including Codex Corp., Paradyne Corp., Racal-Milgo, Inc., and General DataComm Industries, Inc., have also added central-site monitoring and control equipment to their lines. While the functions performed by each of these companies' products vary, they all have one common denominator. The monitoring and control equipment links to the networks' remote modems and polls them to obtain information about their status and about the analog communication lines' parameters. "The term 'network control' is synonymous with 'modem control,'" says Van Chu, director of network control products at Intertel.

Therein lies a semantic problem that blurs the distinction among products sold in this market. Other vendors—non-modem suppliers—also sell products

Alarm Parameter	LSI FP Series	MX Series	CS Series
Carrier on	X	X	X
Carrier off	X	X	X
RTS on	X	X	X
RTS off	X	X	X
Good data off	X	X	X
Marginal circuit on	X	X	X
DTR off	X	X	X
Streaming device disconnect	X	X	X
DSR off	X	X	X
User special No. 1 on	X	X	X
User special No. 2 on	X	X	X
Receive level low		X	X
Receive level high		X	X
Marginal poll		X	X
Signal-to-noise ratio		X	X
Phase jitter		X	X
Gain hits		X	X
Phase hits		X	X
Impulse hits		X	X
Dropouts		X	X
Frequency offset			X
Nonlinear distortion			X
Retrans			X

**Alarm parameters monitored by three series of Codex modems** are said by the company to be the most extensive in the business. Codex contends that the detail provided by such analog and EIA status monitoring helps reduce finger pointing between vendors when problems occur, but some competitors claim users rarely need or understand such detailed information.

billed as network control, monitoring and/or management devices. Rather than poll the network modems to obtain information, products from these independent vendors, such as Avant Garde Computing, Inc., Dataproducts New England, Inc., and Datacomm Management Sciences, monitor and collect actual network transmissions to and from the central site. The functions performed by these independent products, which essentially overlay any existing network, can differ substantially from those performed by the modem vendors' network management and control products. Not surprisingly, each camp believes its approach is the best.

### Secondary-channel monitoring

Modems that operate in a network control environment with central-site equipment provided by the modem vendor require the addition of network control



# The Interpreter

and secondary-channel test cards. Some modem models may not be able to incorporate such cards, but most recent versions have been designed with network control in mind. Intertel, known primarily as a network control and management vendor, designs all its modems for operation in controlled networks, for example.

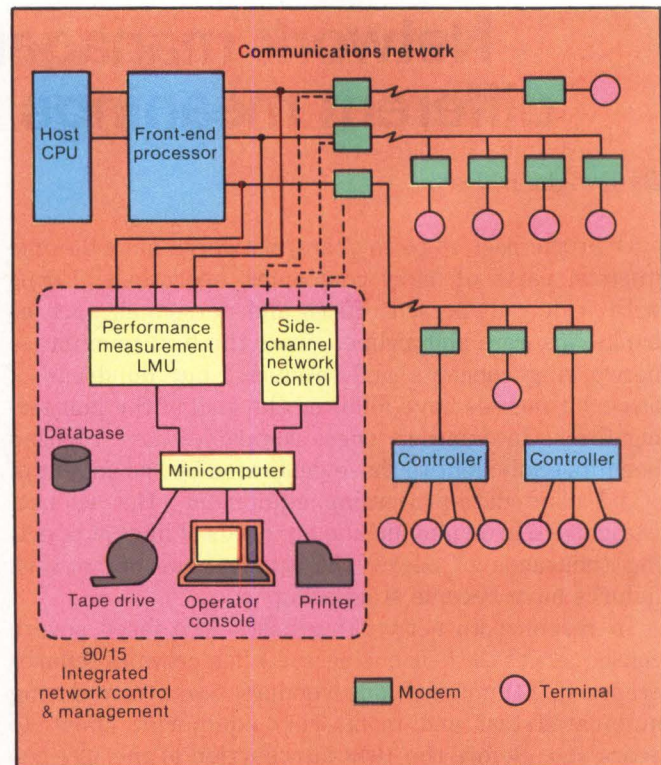
To communicate with the network's modems, the central-site control equipment from these vendors uses a secondary channel that resides at a different frequency on the same analog lines that carry the main data channels. Control information passes to and from the intelligent modems at a relatively low rate over the secondary channel, usually at about 75 to 110 bps. The modems supply the central-site equipment with information about their own operation and about the condition of the analog communications line.

This reliance on modem-supplied data prompts David Tolwinski, director of marketing for control systems at Codex, to note, "Any kind of network control that you've got is only as good as the modem." He claims the analog parameter measurement and EIA status monitoring capabilities of Codex's modems are more extensive than any competitive products (see table, p. 101).

Parameters monitored by the network control equipment can be set to trigger alarms if the condition of any falls below a specified threshold. Such alarming is a key aspect to these control systems because a major objective of the systems is to diminish network downtime and the losses associated with it. If deteriorating conditions can be spotted early, the network manager can take corrective action to avoid an all-out crash. And the extent of the parameters monitored also helps users determine exactly what equipment or line in a multi-vendor network is malfunctioning. Such detailed diagnostic data prevent responsible vendors from claiming the network problem resides in another vendor's component, Tolwinski says.

Because of their tight link with the network modems, network control products from modem vendors typically can effect some corrective actions when network components or lines malfunction. For example, most network control products in this category can automatically disconnect a streaming modem from the network. Also, if remote sites are configured with "hot" spare modems, these control systems usually permit a system operator to switch in the backup modem if another modem at that site fails. And, if a leased communications line goes down, these systems typically have a dial backup feature, with which a temporary toll connection between the remote and central sites can be manually or automatically set up.

In addition to monitoring and reconfiguring net-



**Intertel's 90/15 system** includes a performance-measurement line-monitoring unit, a PDP-11/24 minicomputer for analysis and report-generation functions, Z80-based satellite processors that monitor as many as eight lines each and a central-site modem control facility (the EMS-One system). The modem control portion of the system communicates over secondary channels to the network's remote modems, and the performance-measurement module monitors and analyzes traffic on the main data channel.

works, some control systems from the the modem vendors have storage and report-generation capabilities. With such capabilities, a system can collect statistics about modem and line operation and present the data in reports designed to help network users evaluate their network reliability and configurations. But collecting data from the modems over a secondary channel has a major drawback that severely limits the type of information collected and the scope of the management reports. Intertel's Chu explains, "The fundamental drawback to secondary-channel monitoring is that you have no visibility into what's occurring on the main data channel."

To solve this problem, several of the modem control vendors have introduced modules that monitor the main data channel and report such parameters as terminal response time, number of transactions within certain time periods, CPU processing time when answering inquiries and line use. Commonly called performance measurement or monitoring systems,



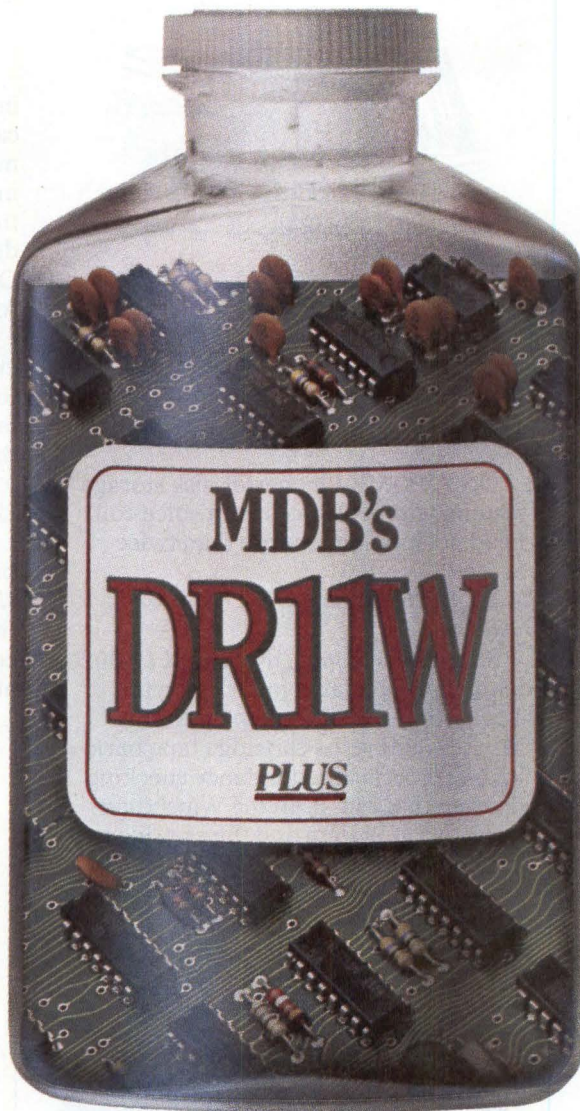
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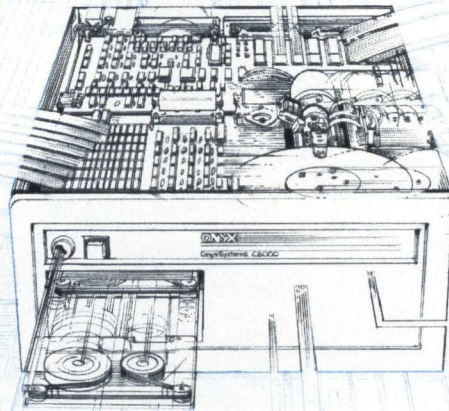
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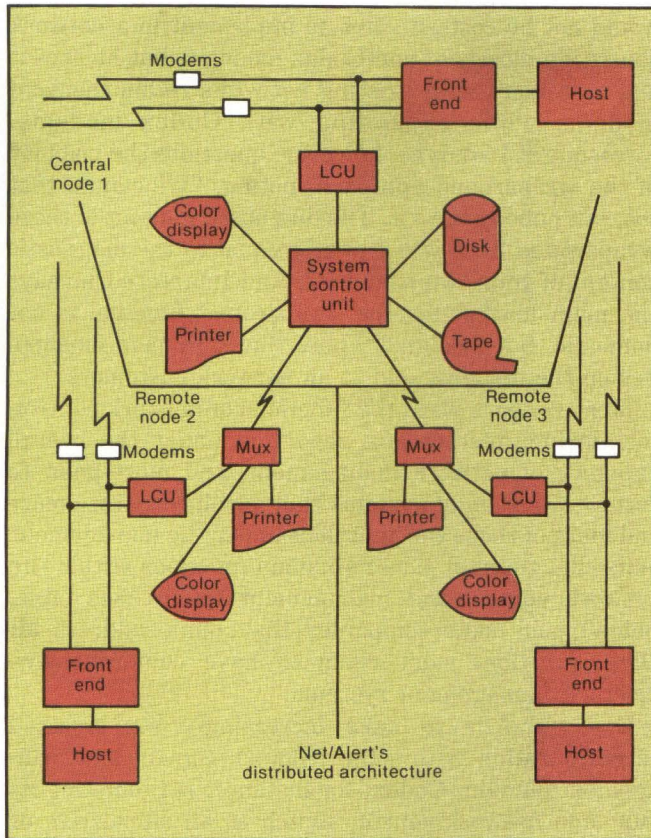
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# The Interpreter



Avant Garde Computing, Inc.'s Net/Alert system includes a central-site system control unit (based on a 3200 series Perkin-Elmer minicomputer); as many as 128 line-monitoring units, which monitor digital data on the main data channels; a color graphic CRT; disk and tape storage; and various printers and color plotters. The SCU can support remote LMUs to monitor distributed networks, but the system has no direct link to the analog portion of the networks.

these modules are integrated with the vendors' modem control systems. Intertel, which claims to be the only modem vendor that builds its own performance module, the 90/15, claims to have a more integrated total system than its competitors, which buy the module from outside vendors.

Performance measurement products such as the 90/15, the Datalyzer from Paradyne and the Network Performance Facility from Racal-Milgo expand these firms' network control systems into the realm of main-channel monitoring, which was once the exclusive domain of the non-modem network control and management vendors. But even as the modem suppliers adapt some of the capabilities inherent in the independent suppliers' products, the independents still claim the modem vendors' approach has a serious flaw. The modem vendors' systems, say the independents, lock the customers into the vendors' entire communications product lines.

## Marketing sizzle to sell modems

"Companies such as Codex, Paradyne and Racal-Milgo are in the business of selling modems, and the strategy of using network control systems to sell modems is a very good strategy," says Tim Ahlstrom, president of Avant Garde Computing, Cherry Hill, N.J. Ahlstrom claims the Net/Alert network management system sold by his firm is a more generalized approach that permits various vendors' modems to operate in users' networks. Like the performance-measurement modules, Net/Alert monitors the digital traffic on the main data channels entering the central site. The system, incorporating a Perkin-Elmer Corp. 3200 series minicomputer, generates extensive management reports and color graphic displays about the information collected.

Peter Frigon, marketing manager at Dapaproducts New England, Wallingford, Conn., echoes Ahlstrom's criticism of the network control products from modem vendors. "Our Cenpat 700 system overlays existing data-communications hardware so we can operate with anybody's modems or in an all-digital network," Frigon says. "With our approach, customers also have flexibility for future growth of the networks. They can acquire the best modems available, regardless of which vendor is selling them."

Even though the Cenpat 700 and Avant Garde's Net/Alert both monitor the main channel data, the systems provide very different functions, illustrating another split in the network management and control market. While the Net/Alert is essentially a powerful performance-measurement system with management report-generation capability, the Cenpat 700 is a computerized network-testing system. It offers no storage or report-generation capability, but it automatically performs extensive diagnosis operations and can perform some central-site port switching. By using remote voice-frequency and EIA control modules, the Cenpat 700 can also obtain information about remote line and component failures, but, because it has no secondary channel, main data traffic must be disrupted to perform remote tests.

In response to the independents' charges that the modem vendors' control systems are just ploys to sell more modems, the accused admit they are guilty as charged—with one important caveat. "Once a network reaches a certain size and complexity, it really needs network control to test continuously and report degradations or outages," says Mike Levesque, general manager of Paradyne's Special Products division, Largo, Fla. Tolwinski at Codex concurs. "Customers absolutely benefit from having network control."



# The Interpreter

On the other hand, Levesque admits, "Network control does the selling, but modems are the high-volume item with which we make money. Network control is important, but at Paradyne, we never lose sight of the fact that we only use network control devices to sell modems."

Even at Intertel, known for its network control systems, not for its modems, "Over 75 percent of our profits come from modem margins," says Thomas J. Mercer, director of market development. He says this percentage is probably typical for companies such as Racal-Milgo and Paradyne.

## Wraparound capability

While the modem vendors admit their primary source of revenues comes from the high-volume sales of modems, not from central-site equipment, some dispute the charge that their network control systems lock customers into just a single vendor's modems. Codex, for example, points to its NA 1296 network adapter, which permits its DNCS network control systems to encompass virtually any modem.

In operation, an NA 1296 box is attached to the digital and analog sides of each non-Codex modem, and central-site signals pass through the adapter before reaching the modem. "With the NA 1296, you get all the EIA signals and signal quality measurements," Tolwinski says. "You don't get all the detailed analog parameters you would get from, say, our CS modem, but you do get most of the analog functions you would get from most competitive modems."

Tolwinski admits that the wraparound approach

would not be cost-effective to implement in a network consisting mostly of non-Codex modems, but he says it lets customers with existing networks retain their old modems while expanding with Codex modems. Levesque at Paradyne, however, questions the viability of the wraparound approach, noting, "We can do that too, but nobody buys it. The diagnostic content of those wraparound lines is not nearly equal to the diagnostic content of your own modems." And Intertel's Chu says the main market for the wraparound function is not domestic, but foreign, "where the PTTs have monopolies on the modems sold to all network customers."

Most vendors place the functions of network control, monitoring, testing and reporting under the overall category of network management, and most point to future evolution of systems that will incorporate more and more of these sub-functions under the management umbrella. Intertel places six main functions within the network control and management sphere (see table, below), and says companies that don't address all these functions can't claim to have comprehensive network management systems.

One trend is to have increasingly sophisticated reconfiguration within the network control and management domain. Codex, for instance, is promoting its IMS 7760 network control switch as an alternative or complement to the company's primary network control system, the DNCS. "The DNCS functions are heavily weighted toward the analysis side," says Mike Zak, Codex director of switching products. "The IMS is very physical, on the other hand. It takes lines and devices and rearranges connections from one device to another, in addition to doing some monitoring and testing as well."

Will the evolution of networks away from analog transmissions toward digital transmissions leave customers with modem-control equipment out in the cold? Intertel's Chu answers that modem companies already provide some digital capability with systems such as the performance-measurement modules. But he admits the complexion of the networking world is changing. "Right now, about 10 to 20 percent of all installed lines are digital," he says, "and that will probably go to 90 percent 10 years from now. But there will always be a small percentage of analog lines, and for the next two to five years, the modem will remain a very important part of the communications network." And, he suggests, network management devices that ignore the modems still residing in most networks are missing an important part of the network control and management equation. □

### NETWORK CONTROL & MANAGEMENT SYSTEM FUNCTIONS

- |  |   |
|--|---|
| • Network Configuration <ul style="list-style-type: none"><li>- System build</li><li>- Port-line-drop</li><li>- Logic-site-name</li><li>- Site info</li></ul>    | • Backup/restoral <ul style="list-style-type: none"><li>- Dial backup</li><li>- Hot spares (internal)</li></ul>   |
| • Alarm monitoring <ul style="list-style-type: none"><li>- Auto monitoring</li><li>- Auto preventive maint.</li><li>- Audible alarm</li></ul>                    | • Management reports <ul style="list-style-type: none"><li>- Report generator</li><li>- AM/AMP reports</li><li>- Trouble tickets</li><li>- Site info reports</li><li>- Graphical analysis</li></ul> |
| • Line/modem tests <ul style="list-style-type: none"><li>- Modem self test</li><li>- Loopback test</li><li>- Block error rate test</li><li>- Snapshots</li></ul> | • Performance measurement <ul style="list-style-type: none"><li>- Main channel analysis</li><li>- Response time</li><li>- Line utilization</li><li>- Color graphics</li></ul>                       |

**Intertel's view of network management and control functions.** Modem suppliers have only recently begun to add performance-measurement modules to gain a window on main channel traffic. Independent system suppliers have always accessed the main channel, but they don't typically get direct information about the analog lines or the analog side of the network modems.



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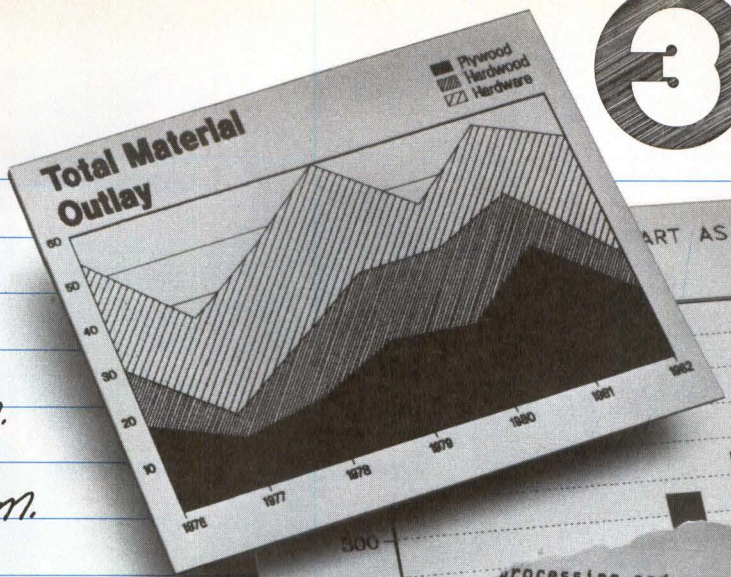
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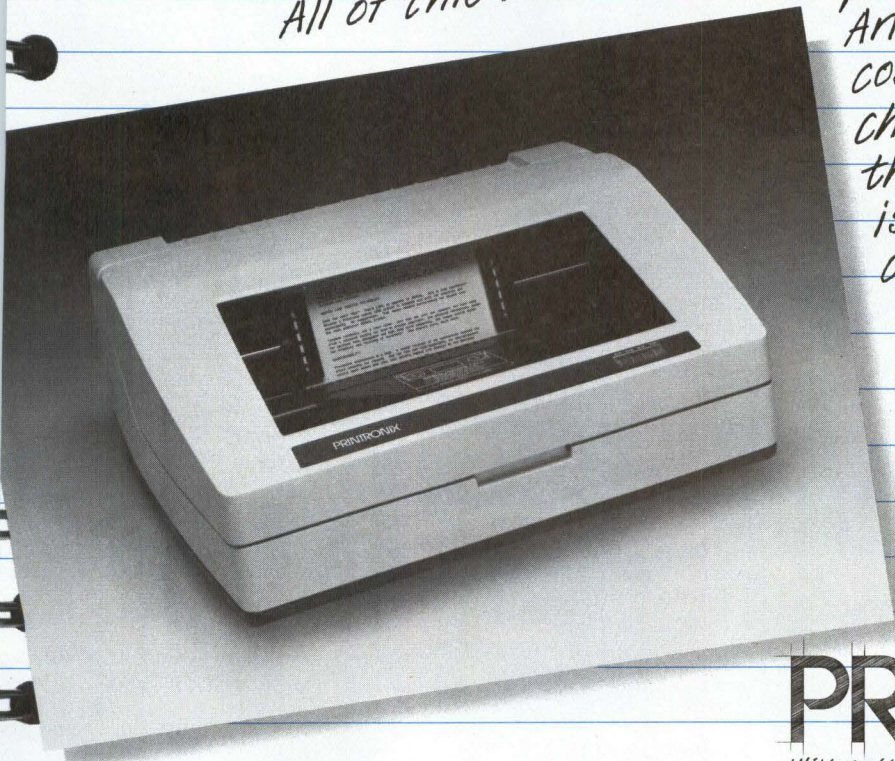
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**Region 3** - A nominal increase in sales in Region 3 was achieved against a backdrop of higher-than-planned personnel turnover. Market demand in this area remains strong but additional staffing and more senior management are prerequisites for next year.

R E G I O N				
	1	2	3	4
A	+11	+06	-02	+08
B	+07	+04	+16	+03
C	-01	+10	+17	+13

Percentage 1982 vs. 1981

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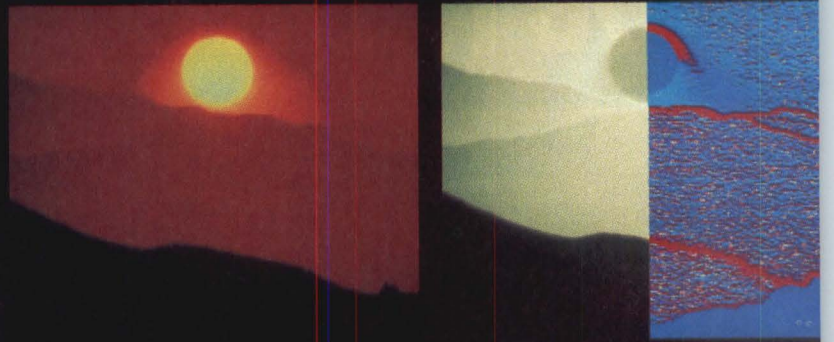
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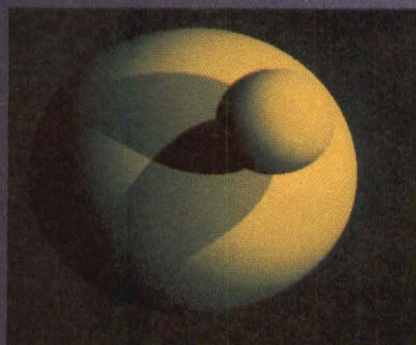
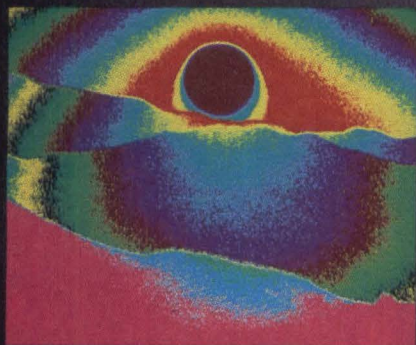


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# Systems in Manufacturing

Exploring the use of computers in the factory

## Robotics, vision advances emerge from industry, university cooperation

By Frank Catalano

Recognizing the limitations of robot and vision systems, manufacturing system suppliers and end users are looking for new technologies that will serve as the next generation of factory-floor products. But rather than relying solely on their own in-house research labs or on the labs of system houses or engineering consultants, companies are starting to pour money into universities interested in tackling problems associated with the factory of the future.

As a result, a new, mutually beneficial relationship is developing between industry and academia. The relationship provides cash-conscious universities not only with money and equipment, but also with the ability to train students to solve real-world, industrial problems. Industry gains relatively inexpensive research expertise as well as a pool of well-trained future employees.

Such industry/university relationships are commonplace in Japan but less so in the U.S., where only 1 percent of every research dollar spent by universities in both the hard and soft sciences is supplied by the commercial sector, says Thomas Hogan, director of the Industry Study Group of the National Science Foundation. Although companies as large as IBM Corp. and as small as Object Recognition Systems Inc.—a vision-specialized start-up—are participating in factory-technology research projects with U.S. universities, Ronald Sanderson, a market analyst with Tech Tran Corp., Naperville, Ill., says such participation is still a new phenomenon and is not at the level that it is in Japan.

One Japanese project that was sponsored at Yamanashi University by a number of competitive robot suppliers, including Pentel Corp., Nippon Electric Corp., Yamaha Co. and Sankyo Seiki Manufacturing Co., resulted in the development of a new robot arm and controller design, called selective compliance assembly robot arm (SCARA). Each participating company incorporated the technology into its own products. Products differed in terms of mechanics, gripper design, human interfaces and payloads, but the basic technology was the same.

Sanderson says that a stagnant climate in the U.S. robot market may make such industry/university cooperative projects more common in the U.S. "The robot industry has suddenly come to a grinding halt," he says. "Two years ago, we were seeing growth



Illustration by Jennifer Menn

projections as high as 50 percent, and now the industry is lucky if it's growing at all. Not only can users not afford to buy systems, they don't want to buy them. People have tried robots, they've seen their capabilities, and they've also seen their limitations. Now they're standing back and waiting for the next generation of products to come along."

Laura C. Conigliaro, a market analyst with Bache Halsey Stuart and Shields, notes that robot suppliers looking for new technologies are realizing that "they can't do it all," and are turning to universities for assistance. "Here we have a tiny little industry with umpteen competitors in the market," says Conigliaro. "Vendors can't sit around and worry about technologies or applications that are future-oriented. They have to worry about marketing and developing today's techno-



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MINI-MICRO SYSTEMS/February 1983



# Systems in Manufacturing

logies. I think they're looking to universities as a means of positioning themselves for the future."

But in helping companies prepare for future market needs, universities involved in robotics and vision research are trying to avoid some traditional academic pitfalls that they've met in the past. These include providing research results that industry can't readily use in products, spending too much time on projects and planning projects without considering markets or costs. "Universities are unfettered by commercial realities and don't worry about things like standard interfaces and components, manufacturing costs and final product costs," notes Michael Cronin, vice president of marketing at robot supplier Automatrix Inc., Burlington, Mass. "They might be very good at research into new technologies, but they're not so good at practical market development."

However, Dr. Eugene Bartel, director of research at Carnegie-Mellon University, says that by working closely with universities in the design and implementation of research projects, industry can reap more benefits from university research than it has in the past. Universities, in turn, can begin to understand the problems that industry needs to have addressed—whether those problems be technology or market related.

"We have a commitment at Carnegie-Mellon to develop technologies that are very quickly and readily transferable to industry," he says. "We encourage our sponsors to send their people here to work with us, so when we have a valuable new piece of technology, those sponsors can immediately transfer that technology into product development. Why waste time repeating one another's research when we can meet one another's objectives from the start?"

The goal of having industry and academia meeting

one another's objectives early is the basis of two National Science Foundation projects that began two years ago. With the charter of advancing the science base in the U.S., NSF is promoting the funding of university research. "Industry is a major user of university R&D and should be the major funder," notes Robert Colton, program manager for the Industry/University Centers project at NSF.

Colton's project is an attempt to bring together companies with similar research needs into a university research program tailored to meet those needs. NSF has thus far started 15 such programs that address research areas as diverse as polymer chemistry and VLSI technology, including a program for robotics research at the University of Rhode Island. Now in its second year, the program boasts 30 industrial participants including end users of robot technology, such as Digital Equipment Corp. and Chesebrough Ponds, Inc., as well as vendors in the robot market, such as Object Recognition Systems, Princeton, N.J.

"Our goal is to get the program started and then pull out our funding as soon as possible," says Colton. "Companies participating in each center then take over the program support through yearly fees."

The Robotics Institute at URI charges each of its participants \$25,000 annually. Nancy Harrison, a research assistant at the institute, says no company could duplicate the services it could receive at URI for the fee the university charges. "For \$25,000, a company couldn't hire researchers, buy equipment and allocate space," says Harrison. "Plus, they're getting the input from other companies involved. Each company provides its own technological expertise and marketing perspective."

From the program, Object Recognition Systems extracted the basic software design of its first product

## UNIVERSITIES CAN'T KEEP SECRETS

Any company that wants to do research leading to exclusive patents should confine its research efforts to in-house labs. Because one of the primary goals of academia is to add to knowledge, research performed within ivory towers usually ends up in the public domain via academic publications and conferences.

Many universities, however, provide that the results of any company-sponsored research project will not be released for two years after the project's completion. During the two-year interval, sponsor companies

can acquire, usually free, nonexclusive right to any patents resulting from the research. That allows a sponsor to get a jump on other companies and begin implementing the technology in in-house applications or commercial products.

Dr. Eugene Bartel, director of the Robotics Institute at Carnegie-Mellon University, says ownership of research results has not been a problem so far with companies that sponsor projects. The real problem, he says, is that companies sometimes supply the Institute with products that the

companies have on the market, but that they want the university to improve. "There is a real reluctance on the part of the engineering groups of various companies to release technical information about the products that they want us to work on," says Bartel. Such information, he says, usually details robot controllers or software. "Sponsors that finally agree to release such information usually require us to sign, in blood, confidentiality agreements."



# Systems in Manufacturing

—the i-Bot vision system (MMS, November, 1982, p. 201). ORS president William Artley notes that the company's affiliation with URI provided a springboard from which to develop the product in-house. "From a technological point of view, the program suggested some directions that we might not have considered in-house," says Artley. "We weren't looking for a blueprint of future products but for an input of ideas, suggestions and a focus."

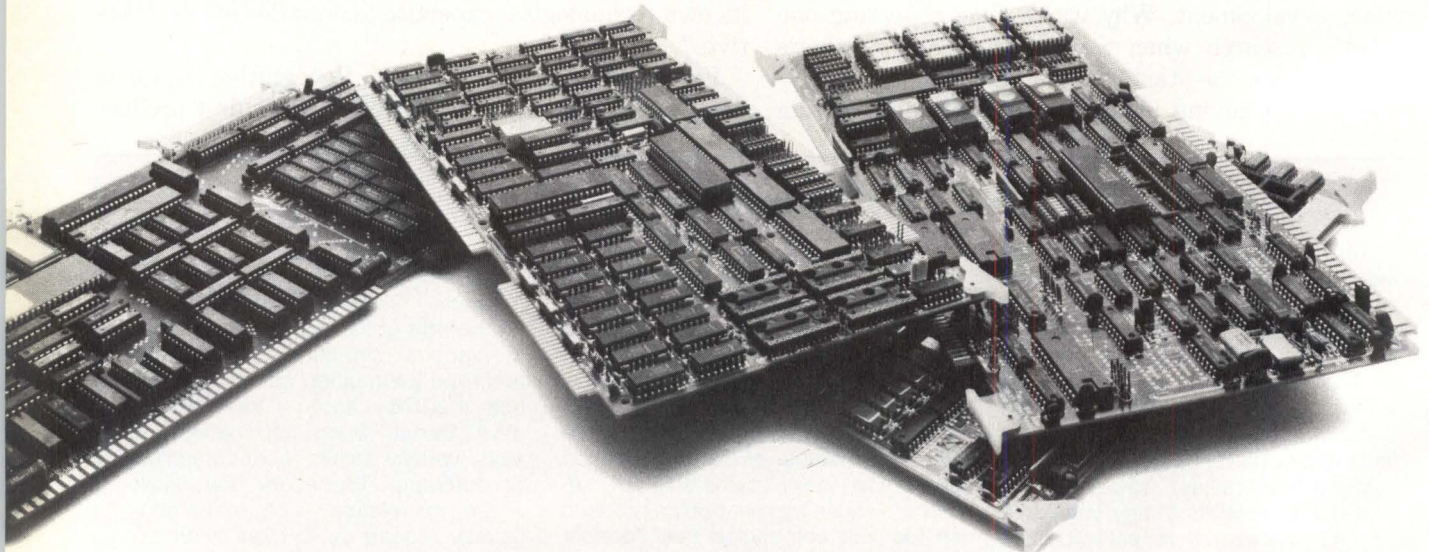
He says the marketing input from other companies involved in the program was of primary interest to him and was itself worth the yearly fee. "The program gave us the opportunity to chat with other affiliates—some of them large corporations—and get a feeling as to what their vision requirements would be in the coming years," he says. "You get a much different interaction from this type of arrangement than you would from trade shows or individual company visits. Since people are there to learn and share knowledge, they are much more open and honest."

Tom Williams, manager of the manufacturing automation program within the corporate R&D center at Digital Equipment Corp., says DEC participates in the

URI program to learn what robots and vision systems can do for DEC's manufacturing processes and to gain insight into how computers will be used in such systems in the future. "Computers are involved across the entire spectrum of factory systems," says Williams. "We need to know about standard interfaces to robots, the integration of robots with factory computers and the use of computers in intelligent robots. All of these issues are involved in posturing DEC in the competitive marketplace."

Besides the Industry/University Centers program, NSF sponsors a University/Industry Projects program. That program promotes one-on-one research efforts between universities and companies. Like the Center program, NSF funds the university during the initial stages of the program so that the university can establish labs and solicit contracts. Once enough contracts are signed, NSF pulls its funding and lets industry take over. The goal of the program, says Fred Betts, program manager at NSF, is to coordinate the research efforts of universities with those of corporate labs. "We're trying to advance science in a way that is technologically relevant to industry," says Betts.

# FAST.



Dual Bus is a trademark of Microbar Systems Inc. \*Multibus is a trademark of Intel Corporation. UNIX is a trademark of Bell Telephone Laboratories, Inc. XENIX is a trademark of Microsoft Corporation.



"Through the University/Industry Projects program, we're trying to get universities and companies to coordinate their research expertise in a way that industry and academia both benefit. Industrial people are very good at knowing the relevance of a technology to a future product, and university people are good at coming out with the new technology. By working together, they can advance science while developing products (see "Universities can't keep secrets," p. 115).

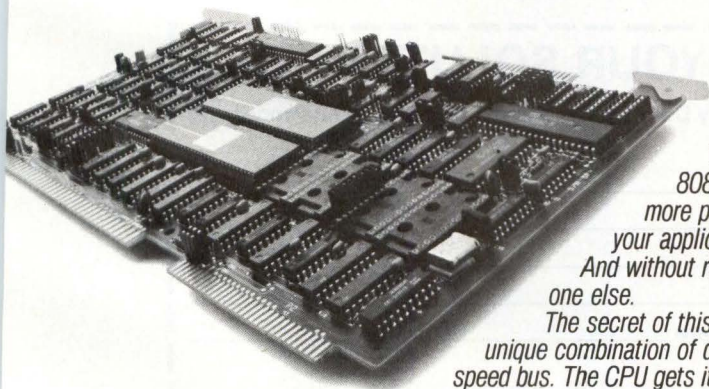
General Electric Co. channels \$5 million annually into such one-on-one projects at Rensselaer Polytechnic Institute, Carnegie-Mellon, Stanford University and the Massachusetts Institute of Technology. Dr. Roland Schmitt, senior vice president for corporate R&D at GE, says GE uses university research as a source of new technologies and to augment the company's own in-house work. "Much of the work being done at universities is frequently at a level of sophistication that isn't ready for application or product development," he says. "But when we see some work at a school that we feel will eventually result in technologies that GE can use in-house or develop into products, it's to our benefit to support that work." He adds that GE will

also contract with a university for an in-house project that has already been started if the university is experienced to handle one aspect of that project.

Nick Yaroshuk, manager of university projects at Westinghouse Electric Corp., says Westinghouse issues contracts with universities when the company identifies schools with research expertise greater than the company's in-house resources. "We go to Carnegie-Mellon because of the school's computer science expertise and to Ohio State University and the University of Wisconsin because of their welding expertise," he says. "We've found that the cost of funding university projects is relatively low compared to developing the expertise in-house."

But besides research expertise, university involvement also provides Westinghouse with a source of qualified employees, says Chris Hudson, manager of technology for the company's Industrial Automation division. "When we have graduate or advanced degree people come through one of our projects—or even another company's projects—those people are clearly of more value to us than students who have never worked with industry," he says.

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# Systems in Manufacturing

## Manufacturing package brightens lighting company's path

By Allan Ullman  
MiroFlector, Co., Inc.

In the past, overtime efforts by MiroFlector, Inc.'s employees were often able to solve manufacturing problems associated with the company's rapid growth and high customer demand for its products. But increasing competition and manufacturing costs have made it necessary for MiroFlector to acquire an Altos Computer Systems microcomputer to help manage time and materials. The microcomputer is enhanced by a comprehensive manufacturing software package from Trac Line Computer Corp.

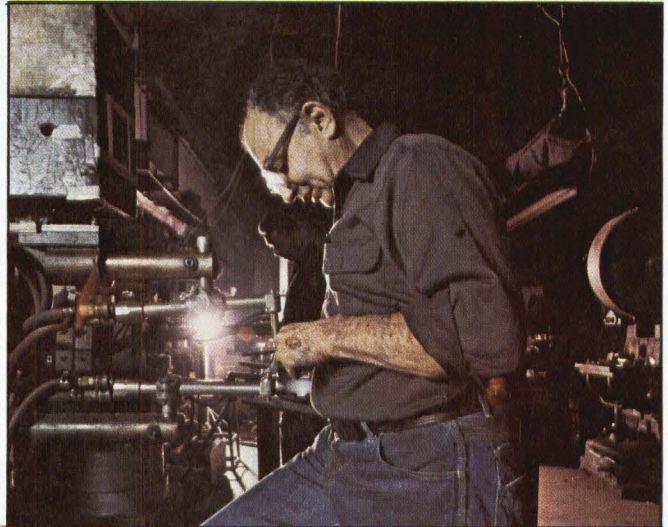
Along with the manufacturing package, called M-Trac, the system includes a 12M-byte Winchester disk drive and four user terminals. M-Trac works well because MiroFlector had a hand in specifying what functions the package should include. Trac Line personnel asked MiroFlector and other small manufacturers (\$1 million to \$10 million) about their needs, and designed M-Trac to conform to those requirements. MiroFlector also served as a beta test site for the software, giving the company two years' experience with the package.

Implementation of the system occurred in stages, and the company expects to make continuing improvements in its use of the system. For instance, MiroFlector found the 12M-byte disk too small for its requirements and plans to replace it with a 50M-byte disk. The larger disk will enable the company to increase its user stations to eight and to add M-Trac's Project Evaluation Review Technique module. The company has used the PERT module for scheduling customer shipments and evaluating the impact of such scheduling on production, but disk limitations forced temporary dropping of the module.

Implementation of any computer system is not done overnight. While software can run immediately given the proper data, it can take a company years to refine its data and its operations to the point at which it will receive the full benefits of a manufacturing system. One strategy that MiroFlector followed was to ease the conversion process by implementing each product line one at a time and by involving each key employee.

### Software requirements

MiroFlector is a small manufacturing company that produces three types of interior lighting for commercial



**A MiroFlector welder spot-welds subassemblies for the firm's lighting product line. M-Trac's bill of materials helps the company accurately monitor assemblies, subassemblies, purchased parts, manufactured parts and customized parts. (Photo: Jody J. Dole)**

and industrial markets. Its first product line, commercial incandescent, or high-intensity discharge, is used in large retail stores, shopping centers, airports, schools and other large public places.

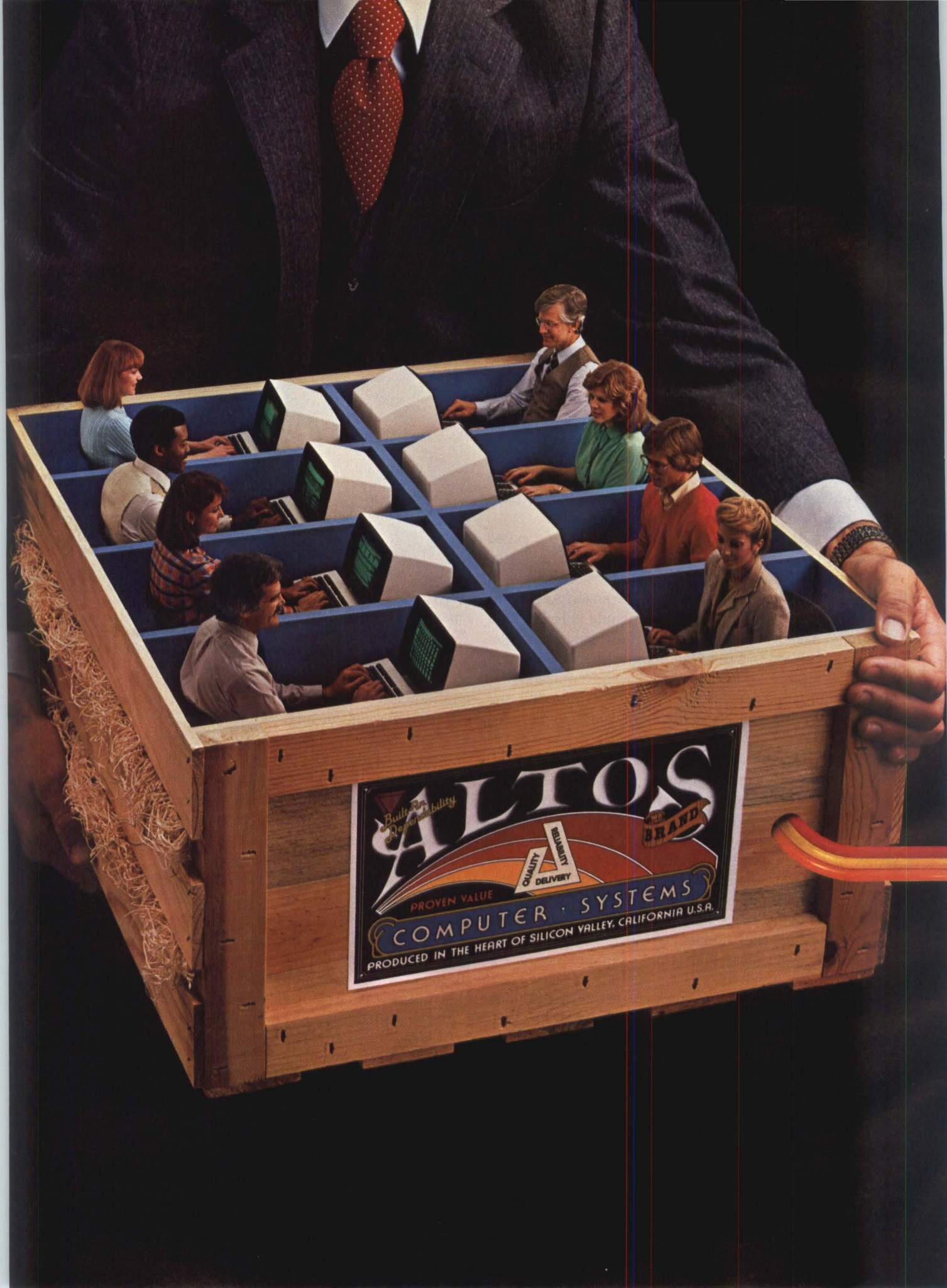
The second line is TV Trac, a multiple raceway (a channel for holding electrical wires in buildings) consisting of both AC current and a television jack. Used primarily by television sections in major department and appliance stores, TV Trac guarantees near-perfect reception while concealing cabling.

The third product line consists of two power poles. The Com Power Post is used in offices to contain power and telephone lines at each desk. The Com Power Post Checkout Light operates in supermarkets and other places in which checkout aisles are indicated by a light that works with a point-of-sale device.

Because its clientele is varied, MiroFlector's products must be made to customer specifications. This creates several inventory problems. For example, the company had difficulty in converting amounts of materials. Wire is purchased in feet, but used in inches. The company needed a software package that would allow it to retain standard measurements, but make the conversions to ensure that sufficient wire and other parts had been purchased to complete a job.

MiroFlector also had other requirements; because the company uses many identical parts, it must know





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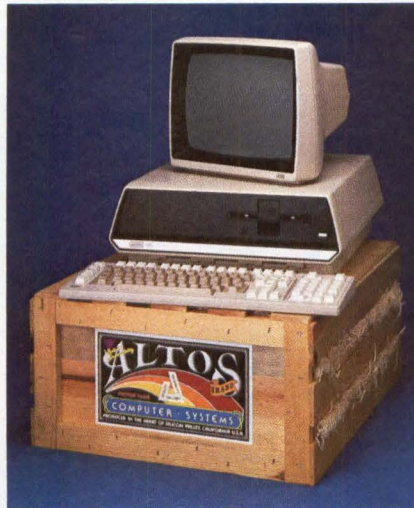
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**CIRCLE NO. 69 ON INQUIRY CARD**



# Systems in Manufacturing

how a part change in one product will affect production on other jobs. It also wanted an effective method of handling bills of material and production-line operations.

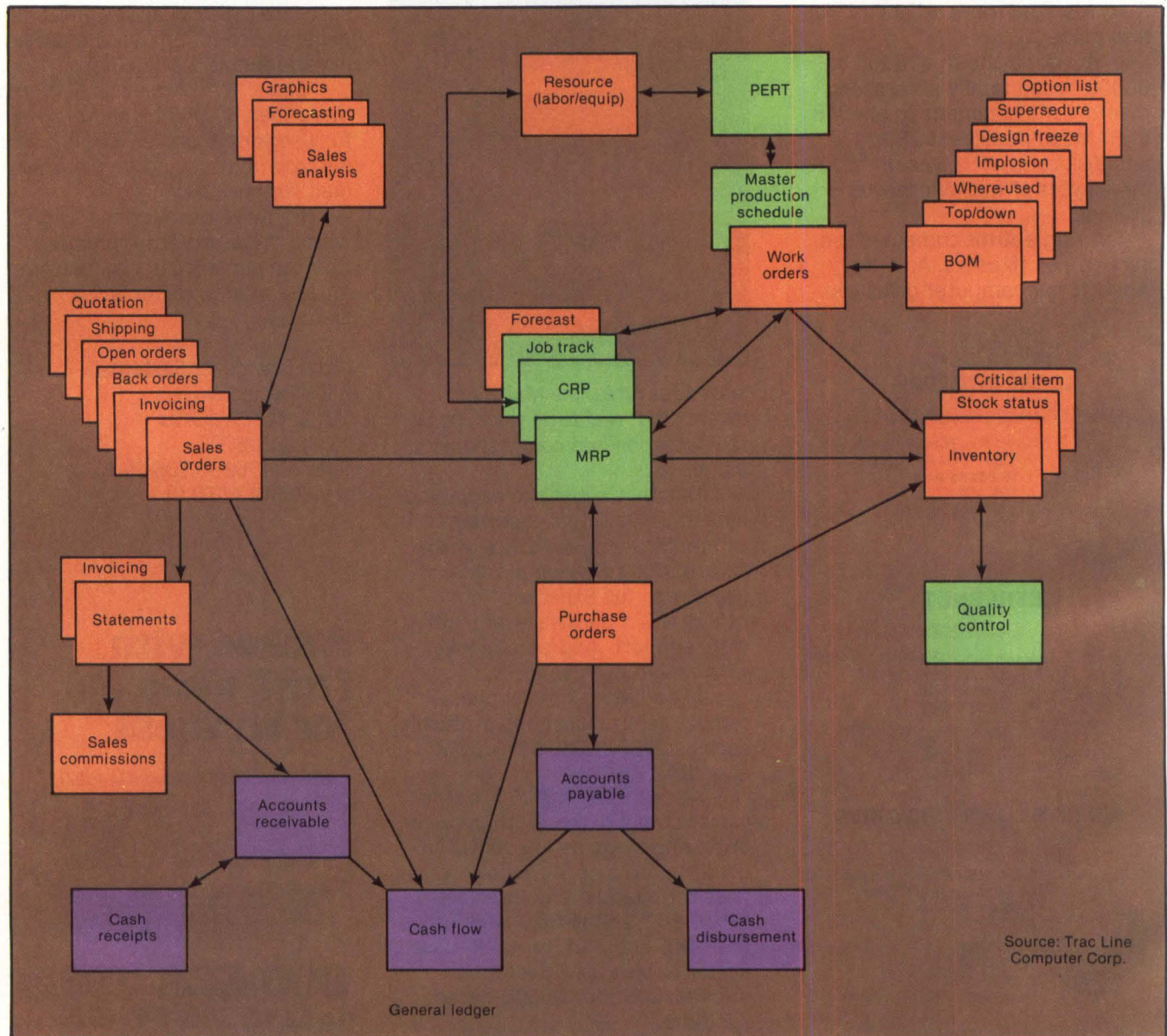
## M-Trac operation

When MiroFlector receives an order, delivery data are ascertained via the computer by determining whether the finished product or the necessary parts are in inventory. A pick slip is then generated through a special menu. Using this menu, data such as a customer's alphanumeric code, shipping address and

order revisions can be entered.

Next, the customer's credit history appears on the screen, giving the date of last payment, date of last sale, credit rating, credit limit and credit available. A salesperson then proceeds with the remainder of the order by generating a slip that itemizes the item and quantity to be shipped. M-Trac automatically prices and extends the order.

If an order depletes a part or a product to less-than-minimal reorder levels, the screen flashes, indicating the amount of the shortage. This helps establish the delivery date. There is also space for any



**M-Trac, a comprehensive, closed-loop manufacturing package, addresses both accounting and manufacturing. As information from various sources enters the system, it is integrated and synthesized into the general ledger. Of the functions illustrated, six are optional: material requirements planning, capacity requirements planning, job tracking, master production schedule, project evaluation review technique and quality control. End-user price for the basic M-Trac system is \$4600.**



## RADICAL RADIAL...

*True, the radial hookup scheme of DEC's UDA-50 allows you to drop a drive without saying "good-bye" to your entire system. But, is this really an advantage with new drives boasting long MTBF specs. Emulex controllers let you daisy-chain your drive connections using fewer, shorter (and cheaper) cables.*

## SEEK AND YE SHALL FIND...

*The UDA-50's ability to stack 16 seek commands does boost throughput—mainly for single drive systems. For all you multi-drivers, however, speedup isn't as pronounced. An Emulex-controlled multi-drive system stacks its seek commands (in effect) via its built-in system of overlapped seeks. Plus, overlapped seek and search commands (new to DEC in the UDA-50) already operate in Emulex controllers under all DEC operating systems.*

## TO ERR IS HUMAN...

*The 80-bit ECC of the UDA-50 can catch a lot of errors—it has to: High bit densities (try 11.4K bits per inch) on state-of-the-art media make 80-bit error correction a necessity, not a feature. And, the trade-off for correcting all those densely packed bits is loss of performance in skipping rotations every time an error occurs—All this in contrast to Emulex's proven 32-bit ECC.*

## PUTTING ON THE BRAKES...

*To slow the 2 MByte transfer rate of the disk to 800 KBytes at the Unibus, the UDA-50 uses a hefty 12 sector buffer. This means the UDA-50 can transfer 16-19 contiguous sectors at most before it skips a rotation and makes your software cry, "Uncle!"*

*In almost all applications, Emulex controllers can handle full (repeat full) track transfers of contiguous sectors and spiral read/write across cylinder head boundaries—and never skip a rotation. Why? Emulex passes data to your memory at rates much closer to those coming off your drives.*

## THINGS YOUR MOTHER NEVER TOLD YOU...

*For a complete report on these and other UDA-50 matters, write to Emulex.*

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*Results for the First Quarter, Fiscal Year 1983 are in: Revenues up 100 percent, net earnings up 109 percent, earnings per share up 100 percent (all compared to the same quarter last year). Check your latest Emulex mailing for price reductions on some Q-bus and Unibus products. Not on our mailing list? Write: Emulex Corporation, 3545 Harbor Blvd., P.O. Box 6725, Costa Mesa, CA 92626. Or better yet, telephone us toll free at (800) 854-7112. In California, that's (714) 662-5600, and let's talk DEC.*



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(DEC, Unibus, and Q-bus are trademarks of the Digital Equipment Corporation.)



# Systems in Manufacturing

notes regarding the order, such as a request for special delivery requirements.

Because each customer is assigned a salesperson, M-Trac automatically credits the correct commission file. It also provides a special feature that helps with agents' sales commissions.

M-Trac handles such conversions as feet to inches with wire so it also can make substitutions. For example, if a product calls for an 832 x 1/2 screw, but there are none in stock, the computer searches for a substitute such as an 832 x 5/8 screw.

In the bill of materials, the system deducts the screw used from inventory while showing usage of the screw originally required. This helps with reorders in determining whether to increase stock on an item. MiroFlector plans to implement M-Trac's word-processing package, which will permit the production of letters, reports and other written material required by the company.

## Rethinking operations

Because MiroFlector worked closely with Trac Line in developing M-Trac, implementation is a continuing

process that includes reorganizing each facet of the company and its operations. For example, in developing a bill of material, a key processing problem is a manufacturer's tendency to rationalize product components into assemblies, subassemblies, purchased parts, manufactured parts and customized parts. Each component needs a part number, and the number changes when a part goes into an assembly or is modified.

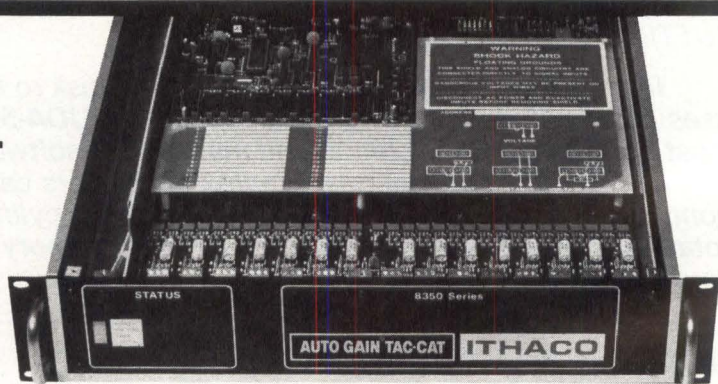
When similar subassemblies are needed in filling large or multiple orders, one bill of materials is insufficient. The company solved that problem with a bill of materials that could be used to add and delete items; this enables MiroFlector to offer high-end items in the same way that different models of automobiles are offered.

The company also established material interchangeability that prompts a user in the work-order sequence.

Allan Ullman is vice president of MiroFlector, Co. Inc., Inwood, N.Y.

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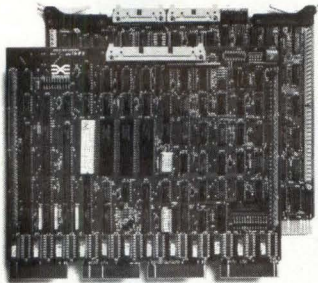
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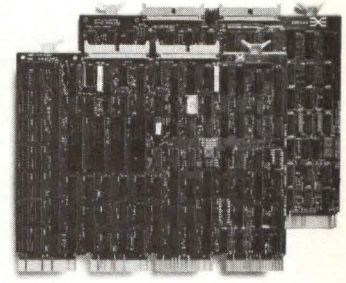
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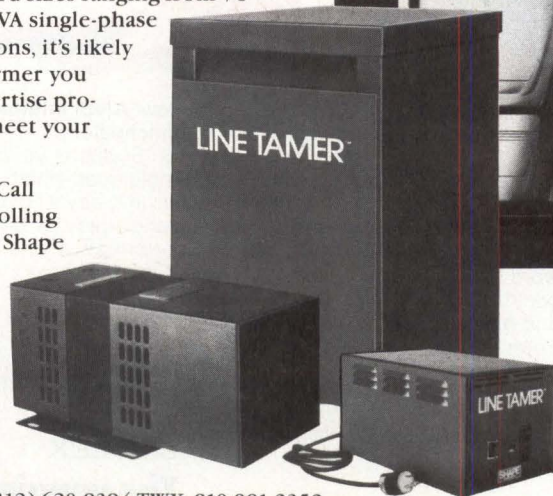
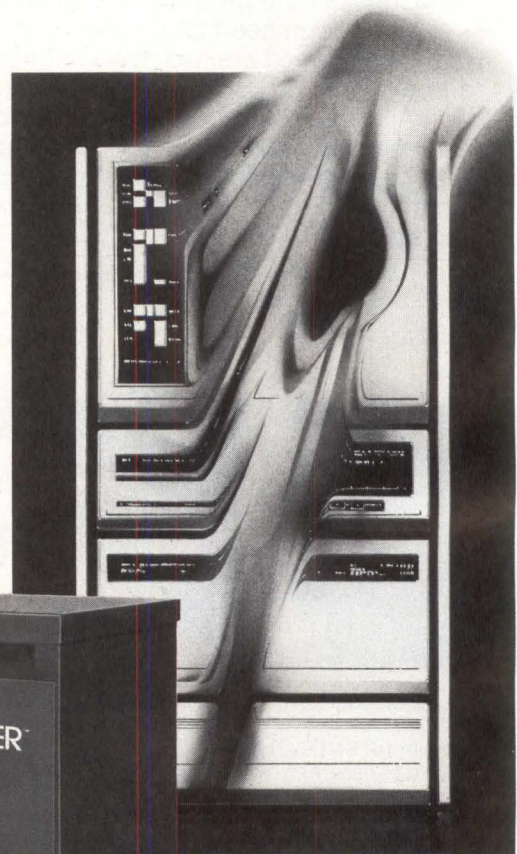
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The symptoms of power line pollution, such as unexplained memory loss or excessive downtime, are self-evident, but the answer isn't—unless you already specify Shape Magnetronics Line Tamer™ ferroresonant transformers.

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CIRCLE NO. 73 ON INQUIRY CARD



# Systems in Manufacturing

## Prime adds electronic CAE/CAD system

After a year and a half of marketing its Medusa mechanical design and drafting system, Prime Computer, Inc., Natick, Mass., has added an electronic CAE/CAD system to its product line. Prime's Electronic Design Management System exploits the company's Database Management System to integrate the logical schematic design function performed by engineering personnel with the physical design function performed by drafting personnel.

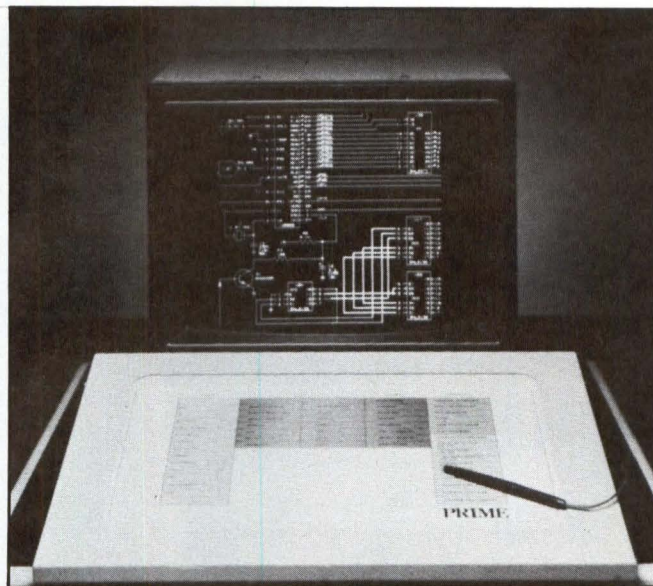
Roy Brubaker, Prime's vice president of sales and service, says the EDMS will almost double the company's potential CAD market. He estimates that 40 percent of the CAD market consists of mechanical design, 35 percent consists of electronic design, and the remainder includes such functions as mapping and building design.

EDMS uses two integrated databases—an electronic parts library and a repository for all project-design information—both under the control of Prime's DBMS. The library, which contains approved parts and their specifications, is generated and maintained using the EDMS Library Management System. Audit trails track all design changes in ongoing projects, and the databases are automatically updated when changes are made at any level.

The system provides interfaces to application programs required by personnel throughout the design process. One interface accesses the TEGAS-5 logic-simulation package, developed by Comsat General Integrated Systems. With TEGAS-5, engineers can run simulations of the logic schematic's operation before proceeding to the physical design stage.

Prime offers several physical design application packages, including the SCICARDS printed-circuit design program from Scientific Calculations, Inc. Also supported by EDMS are V-R Information Systems, Inc.'s MERLYN-G package for gate-array routing and an MP2D for standard cell layout. With these application packages, Prime says, users can convert the schematic designs into PC-board, wire-wrap-board or IC layouts without reentering the logical design data.

EDMS, which runs under the PRIMOS operating system on any of Prime's 50 series 32-bit minicomputers, uses simple English commands. The electronic engineering and design system can use Prime's 19-in. PW95 color graphics workstation. It also operates with the AED512 and AED767 workstations from Advanced Electronics Design, Inc., and the Jupiter 7 from Jupiter



Prime Computer, Inc.'s Electronic Design Management System can help engineers design IC and PC-board schematics, as shown on this PW95 graphics workstation. EDMS also simplifies the transfer of these schematics into IC layout and PC-board design.

Systems, Inc. Because of its compatibility with Prime's other hardware and software, EDMS has access to the company's networking capabilities such as PrimeNet and X.25 links.

A system consisting of the EDMS software, eight graphics workstations, 24 alphanumeric terminals, a Prime 750 minicomputer with 4M bytes of main memory and two 300M-byte disk drives sells for \$615,000. The EDMS software license is priced at \$75,000 with a monthly user fee of \$2800, which includes maintenance.

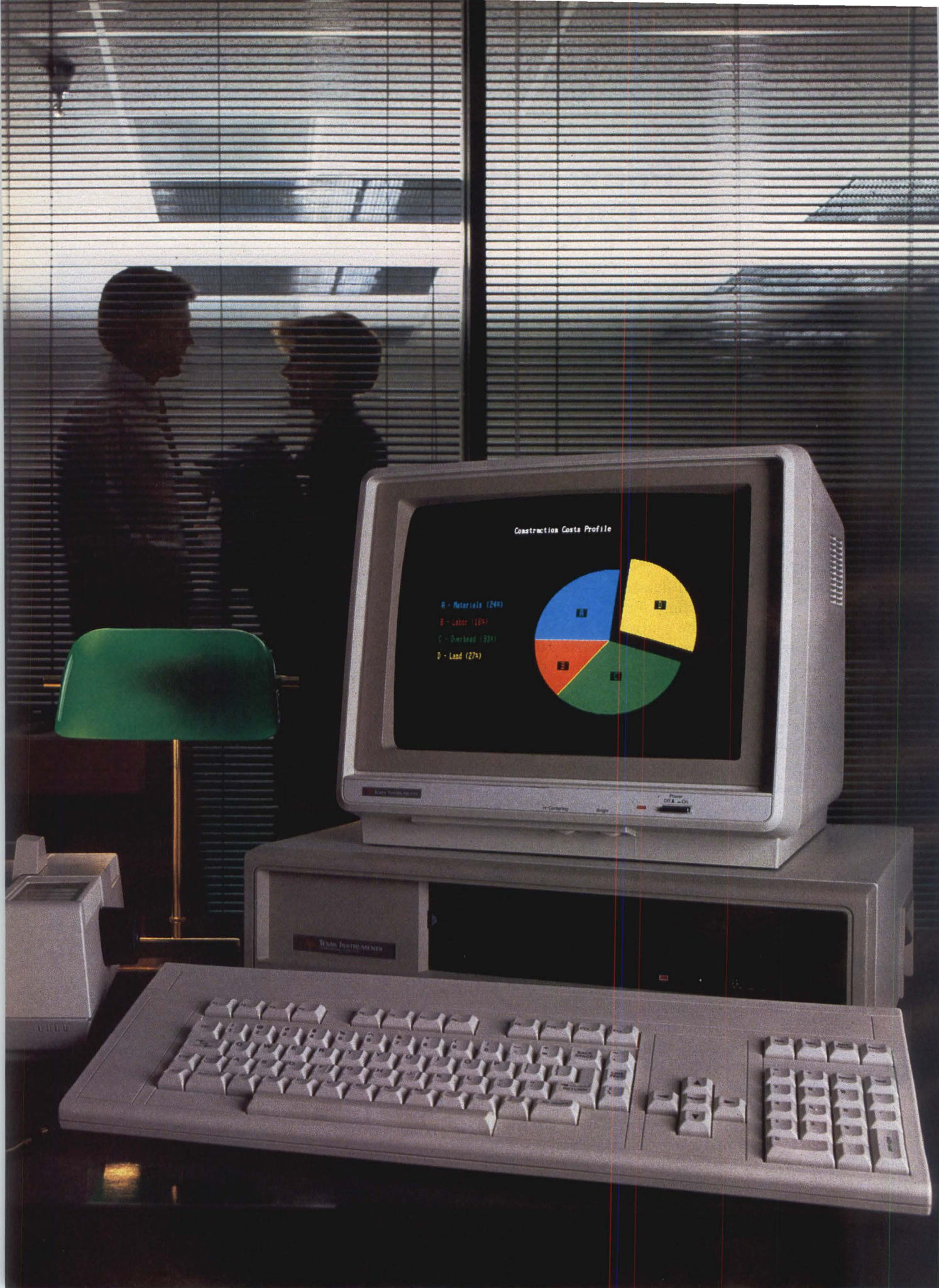
—Dwight B. Davis

### NEXT MONTH IN MMS

The March issue of Mini-Micro Systems will feature data communications. Heading the articles will be two profiles of "smart products," complete with extensive tables of what is available. Articles planned for the issue include:

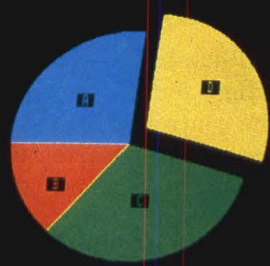
- \* Statistical multiplexers product profile,
- \* Intelligent modems product profile,
- \* Cellular radio and its implications for local-area networks,
- \* Innovative networking approaches to local-area networks and distributed processing





Construction Costs Profile

- A - Materials (24%)
- B - Labor (12%)
- C - Overhead (33%)
- D - Lead (27%)





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3270 SNA stand-alone (Summer 1983)  
3270 BSC and SNA cluster (Fall 1983)

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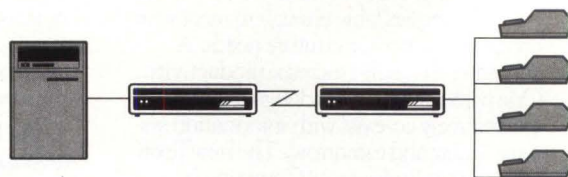
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# Systems in Manufacturing

## Cadlink provides a bridge between design and manufacturing

By Frank Catalano

Evolving from a company that provided custom software for major machine tool users such as General Motors Corp. and General Dynamics Inc., Cadlink, Inc., Elk Grove, Mich., has combined its software expertise with other vendors' hardware to create its Series 80 CAD/CAM network. The system automates many of the steps required between the design stage and the actual manufacture of parts in the metalworking industry.

The Ethernet-based network system comprises Motorola 68000 microprocessor-based workstations with the Intel Multibus, the UNIX operating system and a monochrome 1024 × 792 pixel graphics display screen. Each workstation includes 1M byte of RAM and 10M bytes of disk storage via a 5¼-in. Control Data Corp. floppy disk drive or a 5¼-in. Winchester from Seagate Technology Corp. or other vendors. Software available for the Series 80 was designed by Systems Associates Inc., which Cadlink acquired in 1981.

Priced at \$25,000 per workstation, the system is intended for large metalworking manufacturers and targeted for applications that are one step removed from the actual manufacturing process.

Clem Meas, marketing manager for Cadlink, says the Series 80 will most likely be used with CAD systems supplied by other vendors within a manufacturing organization. The system was designed to interface to products from such companies as Computervision Corp., Calma, Co., CADAM Corp., Gerber Systems Technology, Inc., and Prime Computer, Inc. Once an engineer designs a part on one of those systems, the design would be further refined and readied for the actual manufacturing process on the Series 80. "Traditional CAD systems have done a very good job in styling a part, but that's where they stop," says Meas. "What usually happens is that a blueprint of the completed part design is generated on a plotter and then sent to manufacturing for conversion into machine tool language."

Cadlink software offerings help designers perform additional drafting operations on the part design, plan the manufacturing process, design tooling and program the design for use on a numerical-control machine.

John West, president of Cadlink, says, because most CAD systems were designed for applications in the electronics industry, suppliers of those systems ignored



*The Cadlink Series 80 allows up to 16 programs to run simultaneously on a single screen—each program having its own screen area.*

the needs of machine tool users. "The steps between design and manufacturing in the electronics industry are completely different from those in heavy industry," says West. "Traditional CAD systems do little to answer the numerical-control-programming or process-design needs of metalworking manufacturers."

The networked Series 80 allows several users to share a database while performing computing functions at their workstations. Data are stored and managed within a file manager that includes four 160M-byte Winchester disk drives. The file manager also provides security for a set of released drawings and files, maintains administrative control over user access and supports peripheral sharing. Besides the file manager, the Series 80 is available with a peripherals manager, an inter-network gateway that connects a number of remote networks and a data gateway that connects the Series 80 with other CAD systems within a company. The network allows for communications as fast as 10M bytes per sec. and supports as many as 1024 users.

Although Cadlink configures the CAD/CAM system itself, the company buys system components from the board level up from outside vendors, says Meas. "We don't perceive ourselves as trying to be a computer company coming out with new hardware technologies," he says. "Our strength is in the value that we add by way of software. We equipped the system with standard hardware such as Ethernet and the MC68000 so that we could enter the market quickly without having to incur a lot of design costs." □



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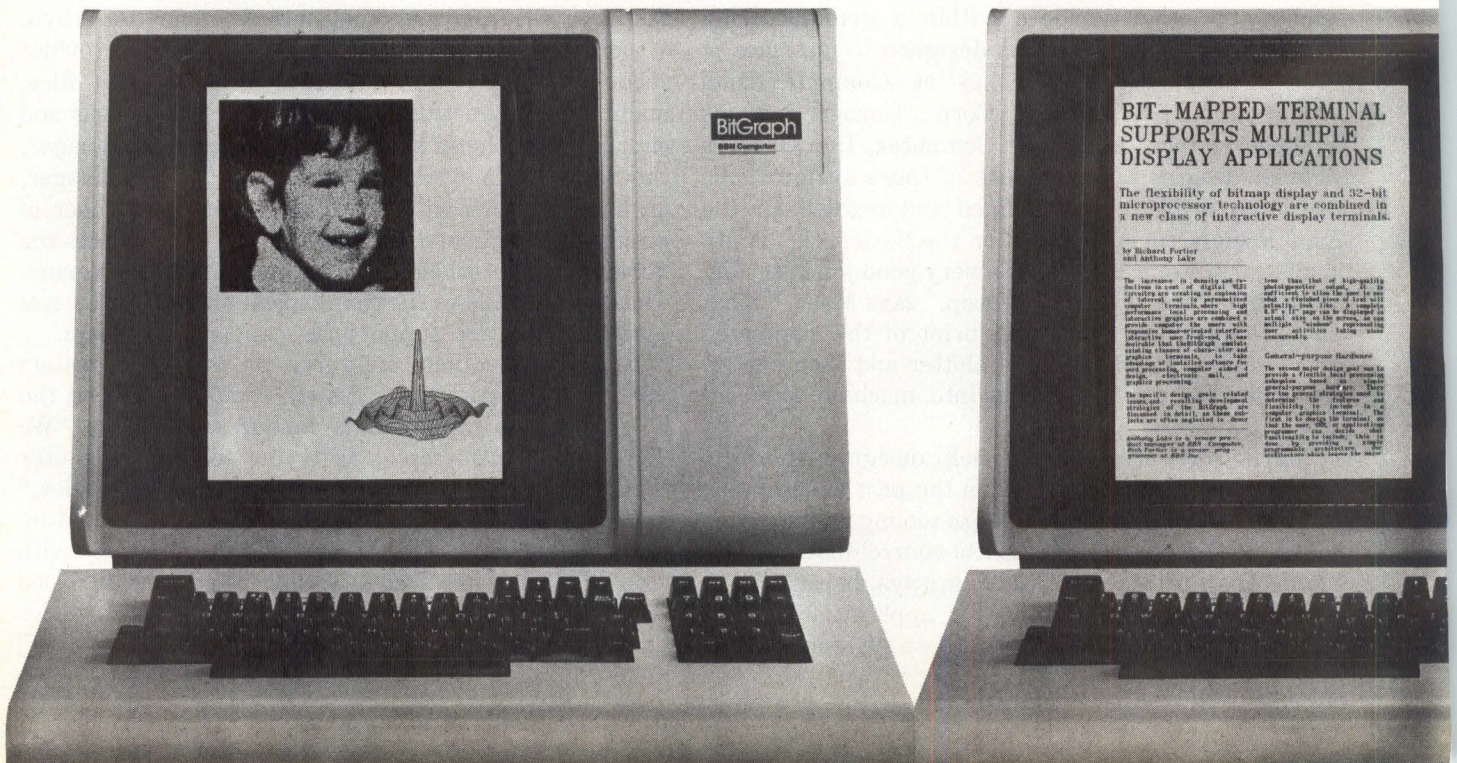
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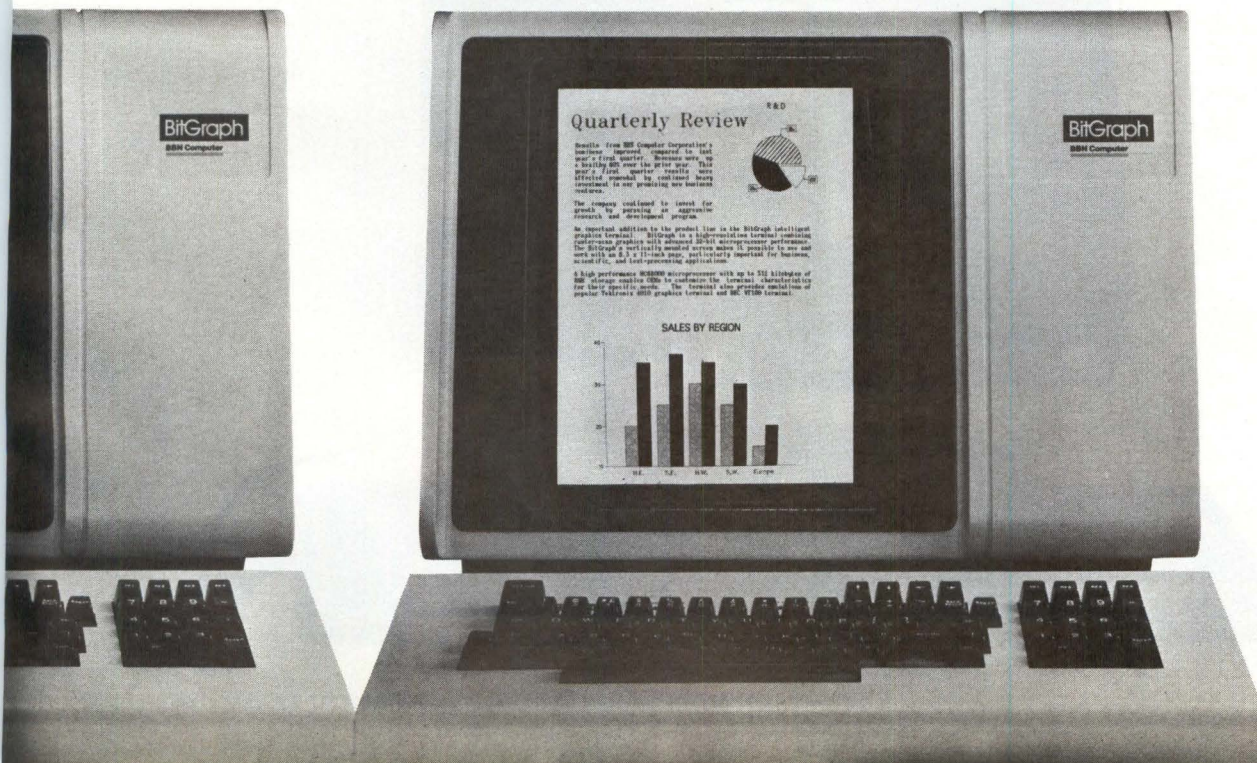
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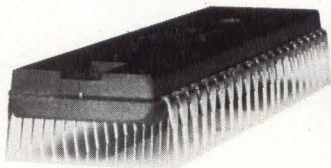
CIRCLE NO. 76 ON INQUIRY CARD





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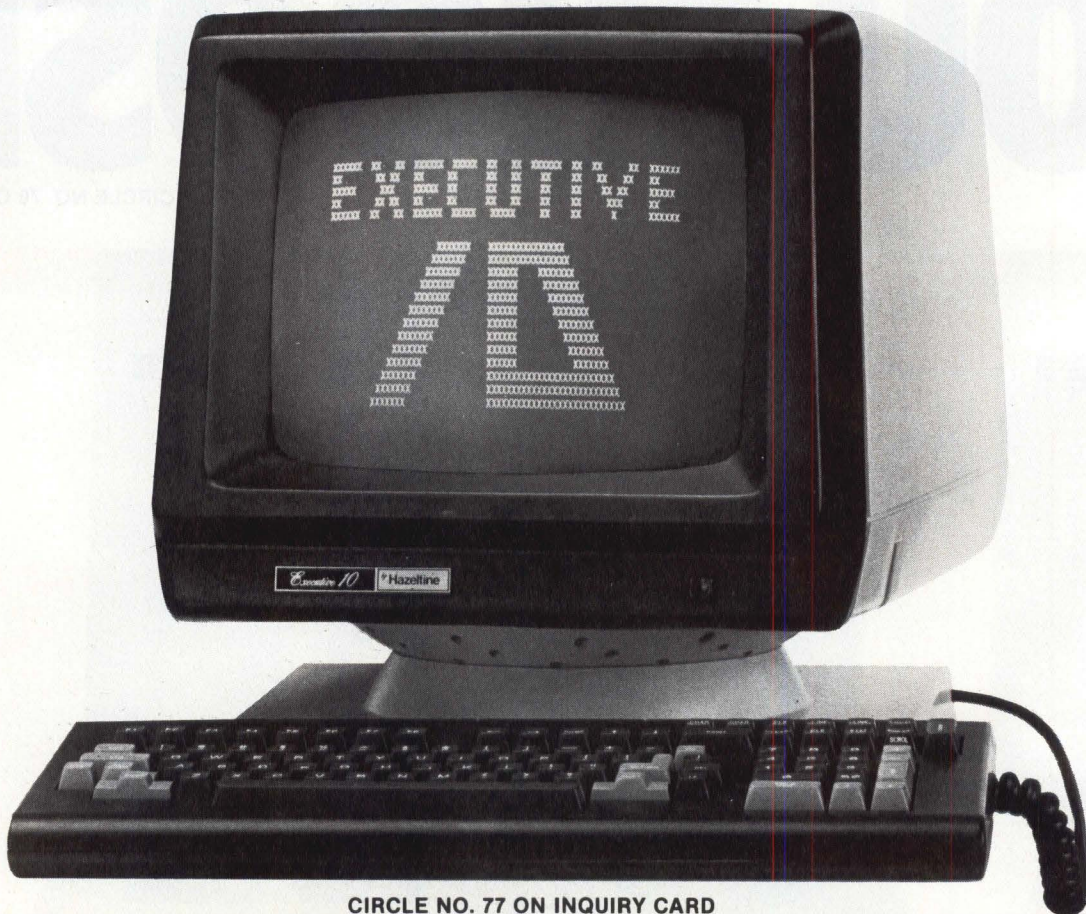
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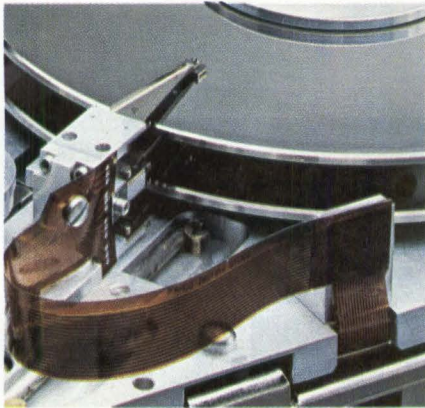
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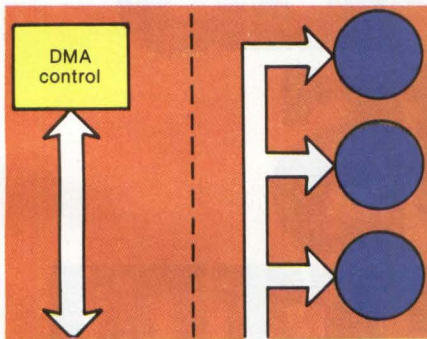
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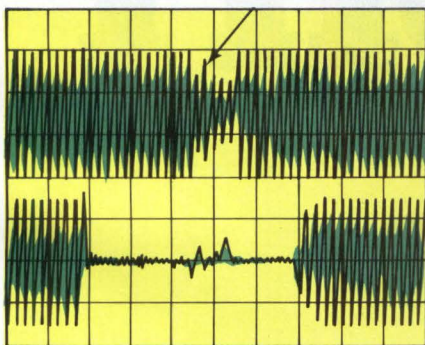
# FEATURE HIGHLIGHTS



**DISK DRIVES:** By placing the motor in the spindle, it now is possible to get 140M bytes in a 5¼-in. Winchester drive (Page 143) . . . The 8-, 5¼- and sub-4-in. floppy disk drive markets are all healthy in their own ways (Page 155) . . . Application needs are driving the requirements for small Winchester disk drives ever upward, and companies are appearing to meet these needs (Page 167) . . . By aligning magnetic particles like soldiers standing in a row rather than like cars along a busy street, engineers are crowding more and more data onto magnetic disks (Page 189) . . . A closed-loop servo positioning system can improve drive capacity and access time (Page 199) . . . Half-height floppies and hard disks pack more into less space (Page 211) . . . An embedded servo in a 5¼-in. Winchester cartridge keeps the media interchangeable (Page 219) . . .



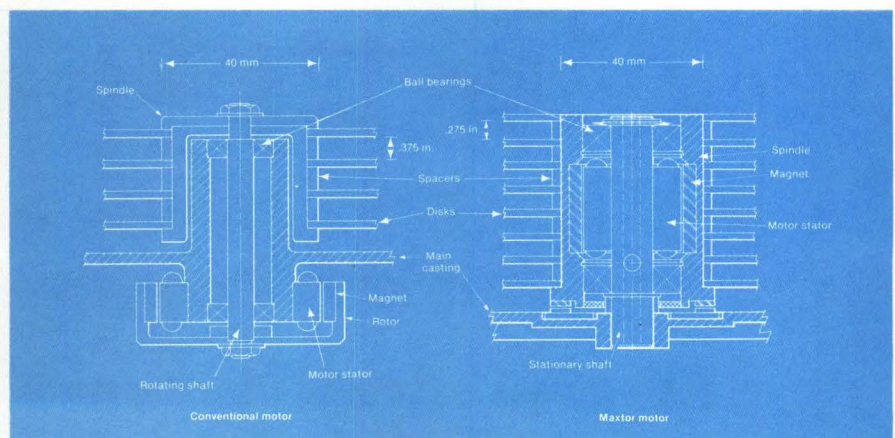
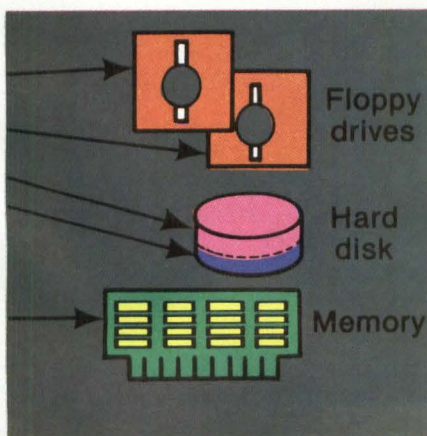
**DISK CONTROLLERS:** A cache helps a new floppy disk controller speed access time (Page 231)



**MEMORY SYSTEMS:** Manufacturers and OEMs can correlate test results of Winchester disk drives to keep their relations on keel (Page 239)

**OFFICE AUTOMATION:** Bit-map graphics move into the office workstation market (Page 245)

**OPERATING SYSTEMS:** MP/M-86 handles real-time and multi-user business applications (Page 253)





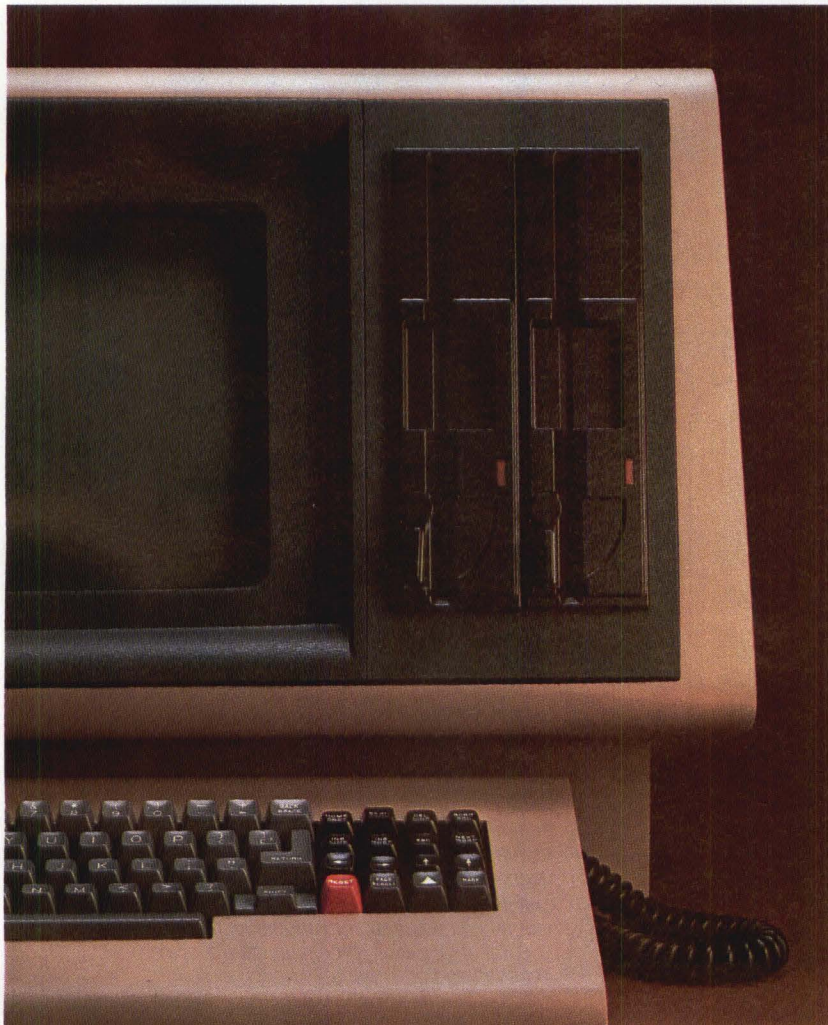
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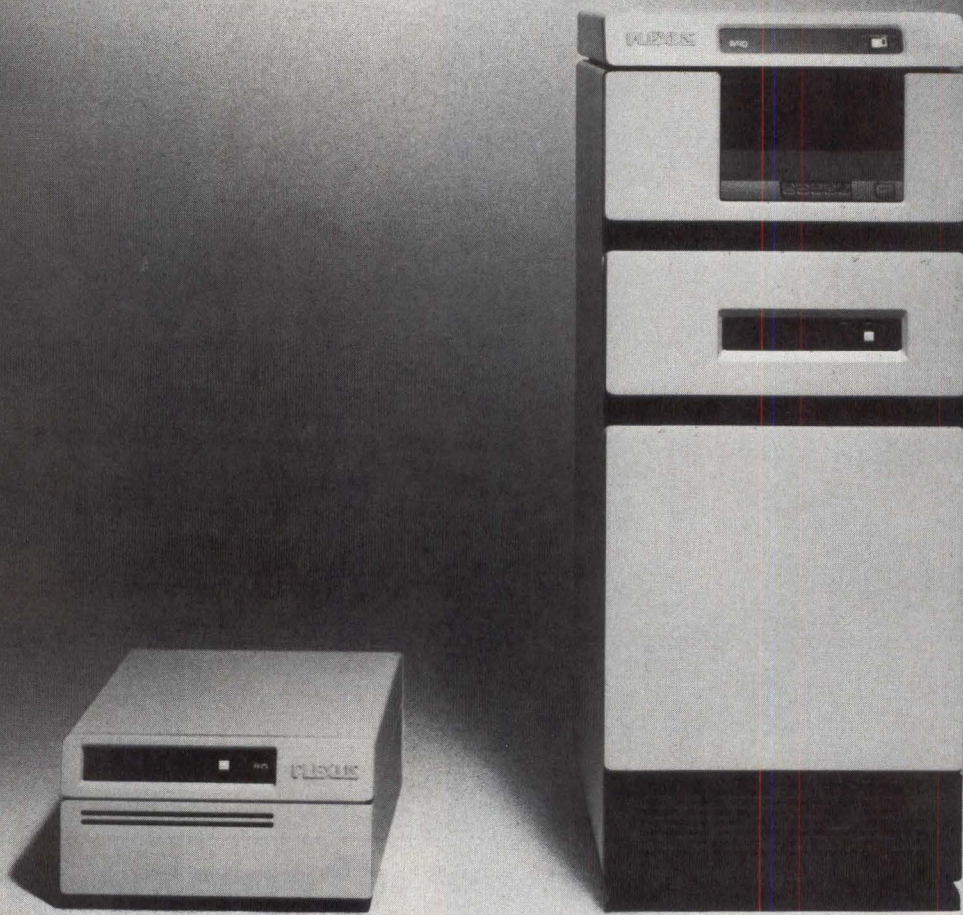
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## DISK DRIVES

# Motor in spindle gives micro-Winchester room for 140M bytes

JACK SWARTZ, Maxtor Corp.

*Space-saving motor, head and actuator get the most out of a 5¼-in. package*

A new family of 5¼-in. Winchester disk drives provides as much as 140M bytes of storage on eight platters with an average access time of 30 msec. Developed by Maxtor Corp., the XT-1000 disk drive family (MMS, October, 1982, p. 55) incorporates an in-spindle drive motor, a rotary voice-coil actuator, Whitney-type heads and a closed-loop, track-following servo system.

### Integral motor/spindle

To fit as many as eight disks in a standard 5¼-in. package, Maxtor departed from the conventional design of a separate drive motor and disk spindle. In most small disk drive designs, the motor is attached to the base casting below the stacked disks, taking up ¾ to 1½ in. of vertical height. The XT-1000 design places the drive motor inside the disk hub (Fig. 1), allowing almost the entire height of the package to be used for stacking disks. Although mounting a disk drive motor in the spindle had been accomplished in some early IBM Corp. products, it has not been previously achieved in a 5¼-in. disk drive.

The XT-1000 direct-drive DC motor has a two-bearing configuration in which the motor shaft is stationary and the outer race of the the ball bearings rotates. This design reduces vibration by providing a shorter load path between the spindle hub and support base than do conventional designs. Although the XT-1000 motor is smaller than the inside hub diameter, it accelerates an eight-disk stack to head-flying speed quickly enough to avoid unnecessary head and disk wear. At the same time, its efficiency is high enough and its power consumption low enough to reduce heating, a crucial



**Maxtor XT-1000, 5¼-in. Winchester disk drives** provide as much as 140M bytes of unformatted storage on eight plated disks with an average access time of 30 msec.

consideration with the disks mounted close to the motor. The hub material is thin enough to provide the necessary space for the motor, but thick enough to keep flux leakage below 1.5 Gauss. a 0.5-in. diameter drive shaft helps make the assembly rigid and keeps resonant frequencies higher than the critical frequencies of the drive itself.

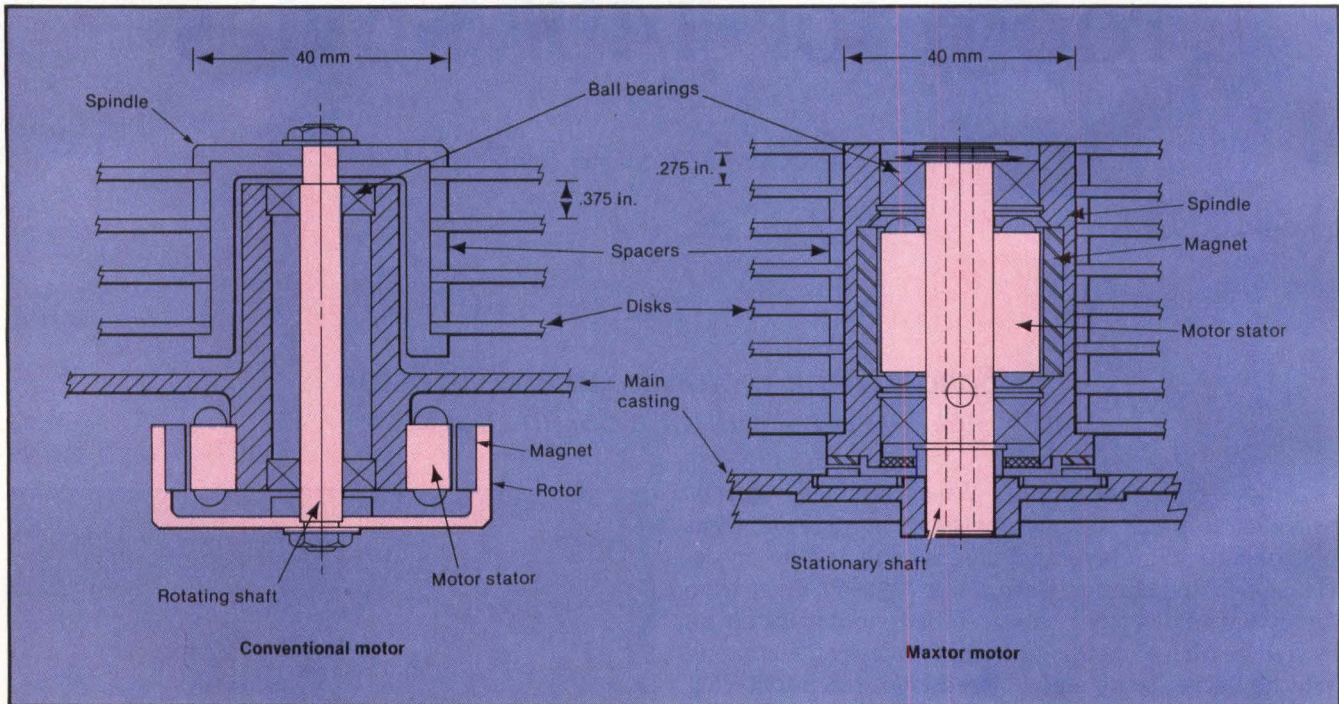


**Rotary voice actuator**

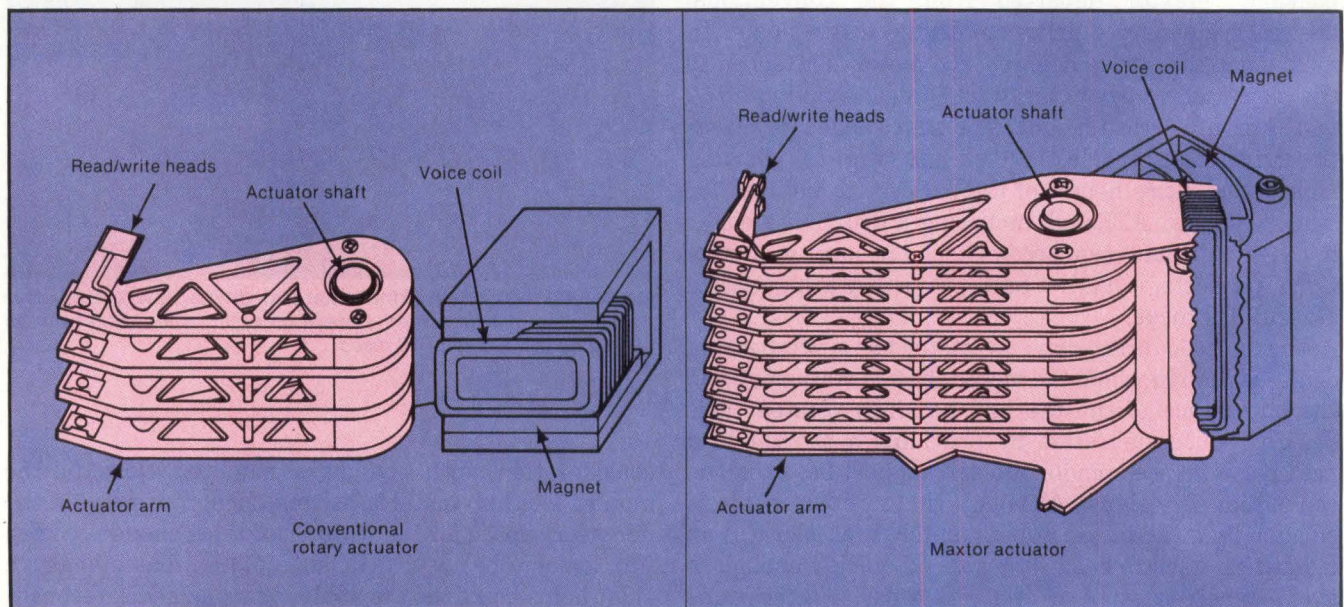
The XT-1000 uses a rotary voice-coil actuator, in which permanent magnets surround a cylindrical electromagnet (the voice coil) mounted on a pivot. When a current is applied to the coil, the field from the permanent magnets causes the coil to rotate, swinging

the head assembly across the disk. The two-bearing rotary design takes up less space and creates less friction than six-bearing linear voice-coil actuators, which move back and forth on two fixed carriage rails.

One problem with rotary actuators is head skew caused by the curved path of the arm. The skew can be minimized by lengthening the arm, thus increasing the radius of the arc described by the head's path and decreasing its curvature. Increasing arm length is difficult in conventional actuator designs, in which the coil is horizontal. The XT-1000 coil is mounted vertical-



**Fig. 1. Comparison of conventional and Maxtor motors** illustrates integration of motor and spindle in Maxtor design. Conventional motors are placed underneath the spindle, where a rotor turns a shaft connected to the spindle. The Maxtor motor is placed within the disk, with the spindle serving as the rotor, turning around a stationary shaft. The chief advantage to the Maxtor motor is the space savings afforded by bringing the motor into the spindle.



**Fig. 2. Comparison of conventional and Maxtor rotary actuator designs** shows that Maxtor's curved magnets and vertically wound coil leaves room for a longer actuator arm. The longer arm swings in a less curved path, reducing head skew.



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- **35 msec average access**
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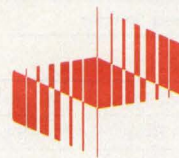
It's the Arapahoe 7110 from Amcodyne.

Arapahoe features advanced Whitney head suspension and read/write technologies derived from the latest generation of mainframe disk drives. Improved aerodynamic stability, superior head/disk compliance and higher signal-to-noise ratio result in data reliability that is substantially better than that attainable with Winchester technology.

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For Arapahoe product specifications and a free monograph on Whitney, the technology that's replacing Winchester in high performance disk, contact Amcodyne.




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	a. 5 1/4-INCH			b. 8-INCH			
MODEL	M2231	M2233	M2234	M2301B	M2302B	M2302BE	M2303BE
CAPACITY (M Bytes)	6.7	13.3	20.0	11.7	23.4	23.7	47.5
AVG. POSITIONING TIME (ms)	95	95	95	70	70	70	70
TRANSFER RATE (K Bytes/s)	625	625	625	593	593	1,200	1,200
INTERFACE	ST506/SA4000			SA4000			
POSITIONING METHOD	Buffered Stepper			Buffered Stepper			
	c. 8-INCH		d. 14-INCH			e. 10 1/2-INCH	
MODEL	M2311K	M2312K	M2280K/N	M2284K/N	M2294K/N	M2351	
CAPACITY (M Bytes)	48.3	84.4	84.3	169	335	474	
AVG. POSITIONING TIME (ms)	20	20	27	27	27	18	
TRANSFER RATE (K Bytes/s)	1,229	1,229	1,012	1,012	1,012	1,859	
INTERFACE	SMD		SMD			Modified SMD	
POSITIONING METHOD	Rotary Voice-Coil		Rotary Voice-Coil			Rotary Voice-Coil	

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QUALITY LIVES



## DISK DRIVES

ly, allowing sufficient arm length to reduce skewing to acceptable levels (Fig. 2). Lengthening the arm, however, increases the torque needed to rotate the arm with a given acceleration. This increased torque is supplied by adding windings to the voice coil, as the torque exerted on the coil is proportional to the number of turns of wire. In addition, the XT-1000's permanent magnets are curved to keep 80 percent of the coil in the flux field, achieving a relatively high torque for a given current. Also, by closing both ends of the magnet structure, the efficiency of the actuator is further increased through a shorter flux return path.

*The XT-1000 design places the drive motor inside the disk hub, allowing almost the entire height of the package to be used for stacking disks.*

### Servo system and Whitney heads

The XT-1000 incorporates a closed-loop, track-following servo system. The servo system monitors head position relative to a reference track, correcting off-track conditions. Open-loop stepper motors, in contrast, move the head across the disk in predeter-

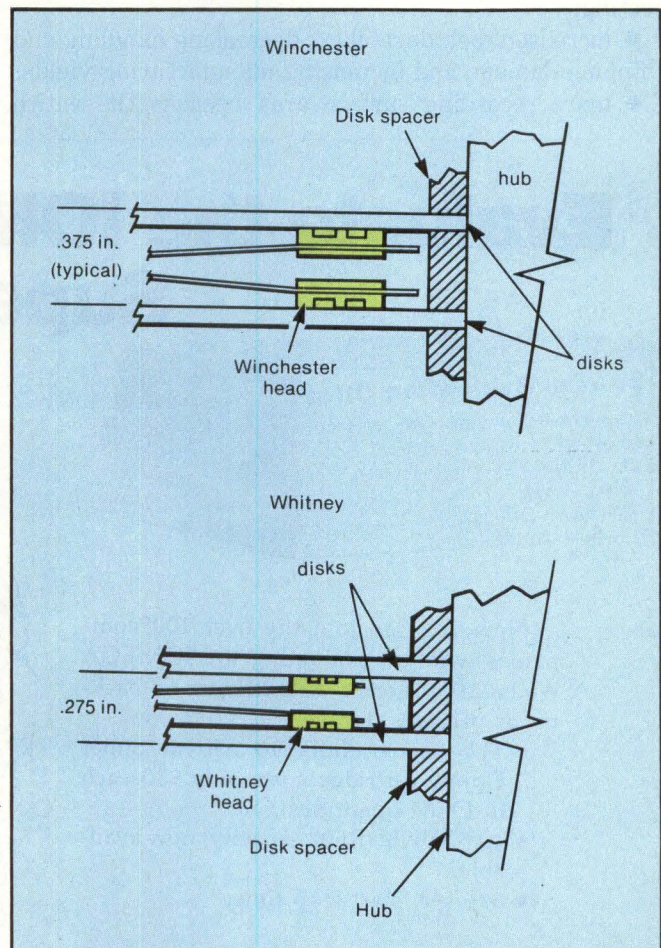
XT-1000 SPECIFICATIONS			
	XT-1065	XT-1105	XT-1140
Capacity, unformatted			
Per drive (M bytes)	66.93	105.18	143.43
Per surface (M bytes)	9.56	9.56	9.56
Per track (bytes)	10,416	10,416	10,416
Capacity, formatted*			
Per drive (M bytes)	52.64	82.72	112.80
Per surface (M bytes)	7.5	7.5	7.5
Per track (bytes)	8192	8192	8192
Per sector (bytes)	256	256	256
Sectors/track	32	32	32
Transfer rate (M bits/sec.)		5	
Access time (msec.)			
Average**		30	
Track-to-track**		8	
Maximum**		60	
Functional specifications			
Rotational speed (rpm)		3600	
Average latency (msec.)		8.33	
Recording density (bpi)		9430	
Flux density (fci)		9430	
Track density (tpi)		980	
Cylinders		918	
Tracks	6426	10,098	13,770
Sectors (000)*	206.1	323.0	441.6
Data heads	7	11	15
Servo heads	1	1	1
Platters	4	6	8

\*ST506/412-compatible format.  
\*\*Includes setting.

mined discrete steps, without feedback from the disk surface. Closed-loop systems can compensate for dimensional instabilities in the disk and drive mechanics, such as those caused by thermal expansion, and are required in drives with high track densities and thus decreased margin for error.

*Although the XT-1000 motor is smaller than the inside hub diameter, it accelerates an eight-disk stack to head-flying speed quickly enough to avoid unnecessary head wear.*

The XT-1000 uses Whitney head technology. Whitney heads, first used in the IBM 3380, use flexures and sliders that are smaller than those used in Winchester assemblies, yet have a higher load force for increased head-flying aerodynamic stability and superior head/disk compliance (Fig. 3). Because Whitney heads fly



**Fig. 3. Whitney heads are smaller than Winchester heads, requiring less space between platters. Whitney heads can also get closer to inner and outer edges of disk surface, allowing additional tracks.**



closer to the surface of the disk, bit densities can be higher than those obtainable with Winchester. The smaller Whitney flexures and sliders, furthermore, allow disks to be spaced 0.1 in. closer than with Winchester heads, gaining additional space inside the 5¼-in. package. The smaller head suspension can also get closer to the hub and the outer wall, thus supporting extra inner and outer tracks on the disk surface.

**Thin-film media**

The XT-1000 incorporates thin-film-plated media. Although plated media is more expensive to produce than conventional oxide-coated media, it offers several important advantages, including:

- increased signal-to-noise ratio because of higher coercivity of the magnetic plating;
- higher linear bit density because the plated magnetic coating is thinner than conventional oxide coating;
- increased disk durability, decreasing handling and shipping damage and increasing manufacturing yields;
- more recording surface area because the entire

*Future disk drives from Maxtor will take full advantage of the abilities of plated media, offering higher densities than the XT-1000.*

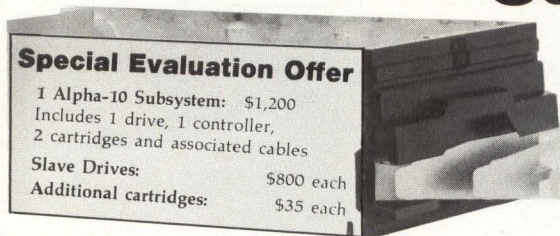
surface of the disk is plated.

Future disk drives from Maxtor will take full advantage of the abilities of plated media, offering higher densities than the XT-1000.

The XT-1000 drive electronics are mounted on a single PC board. The advantages of using a single board include a reduced part count, lower manufacturing and maintenance costs and better use of space within the limited height of the enclosure. Maxtor uses surface-mounted devices, electronic components one-third the size of conventional ICs that are soldered directly to the board without plated-through holes. The area saved with these components can be used for interfaces and controller functions that might be added. □

**Jack Swartz** is co-founder and vice president of engineering of Maxtor Corp., Santa Clara, Calif. He was co-founder of Rotating Memory Systems, Inc., managed engineering teams that developed Shugart Associates' Winchester disk drives and worked on several disk drives for IBM Corp. during his 18-year tenure there.

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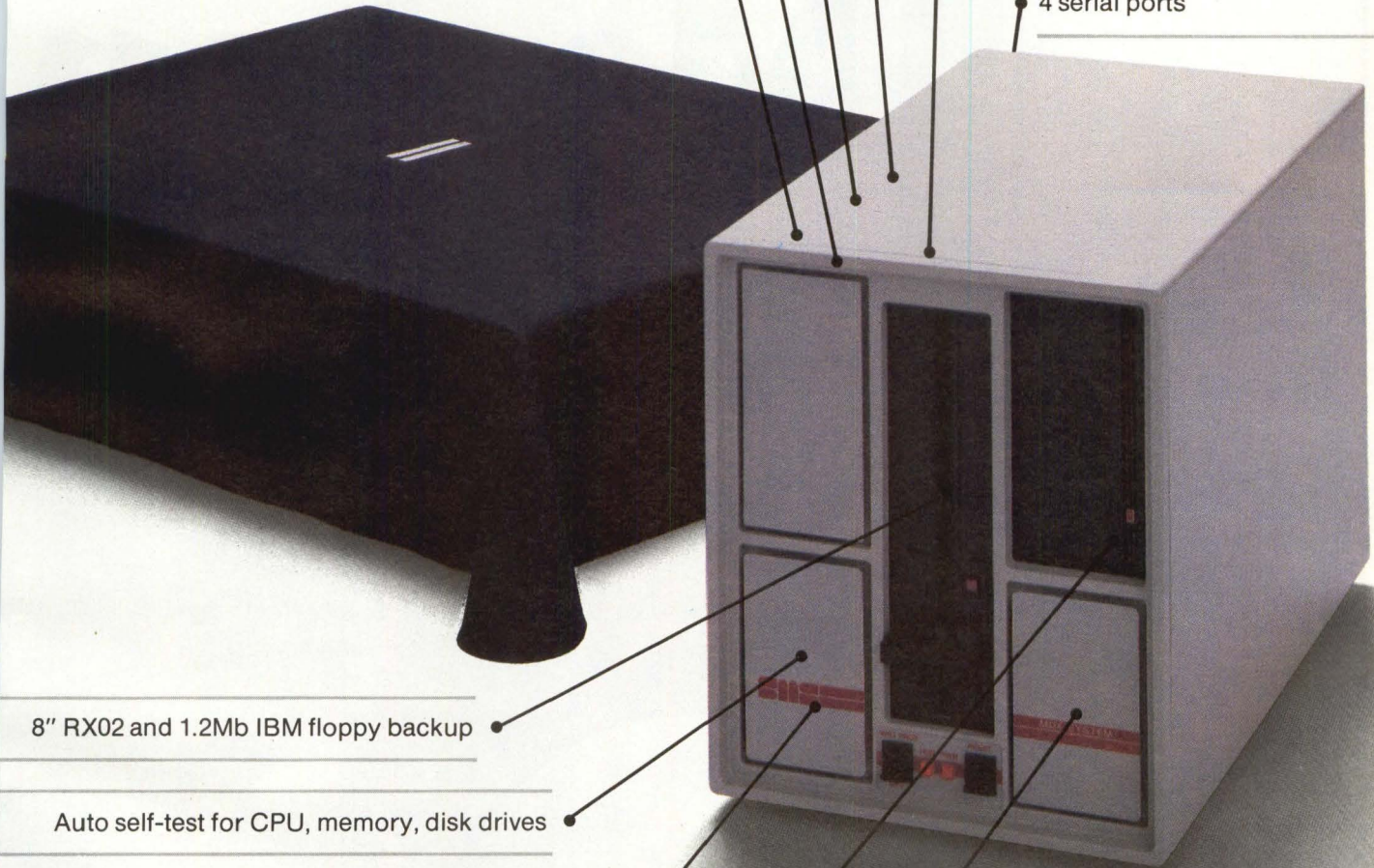
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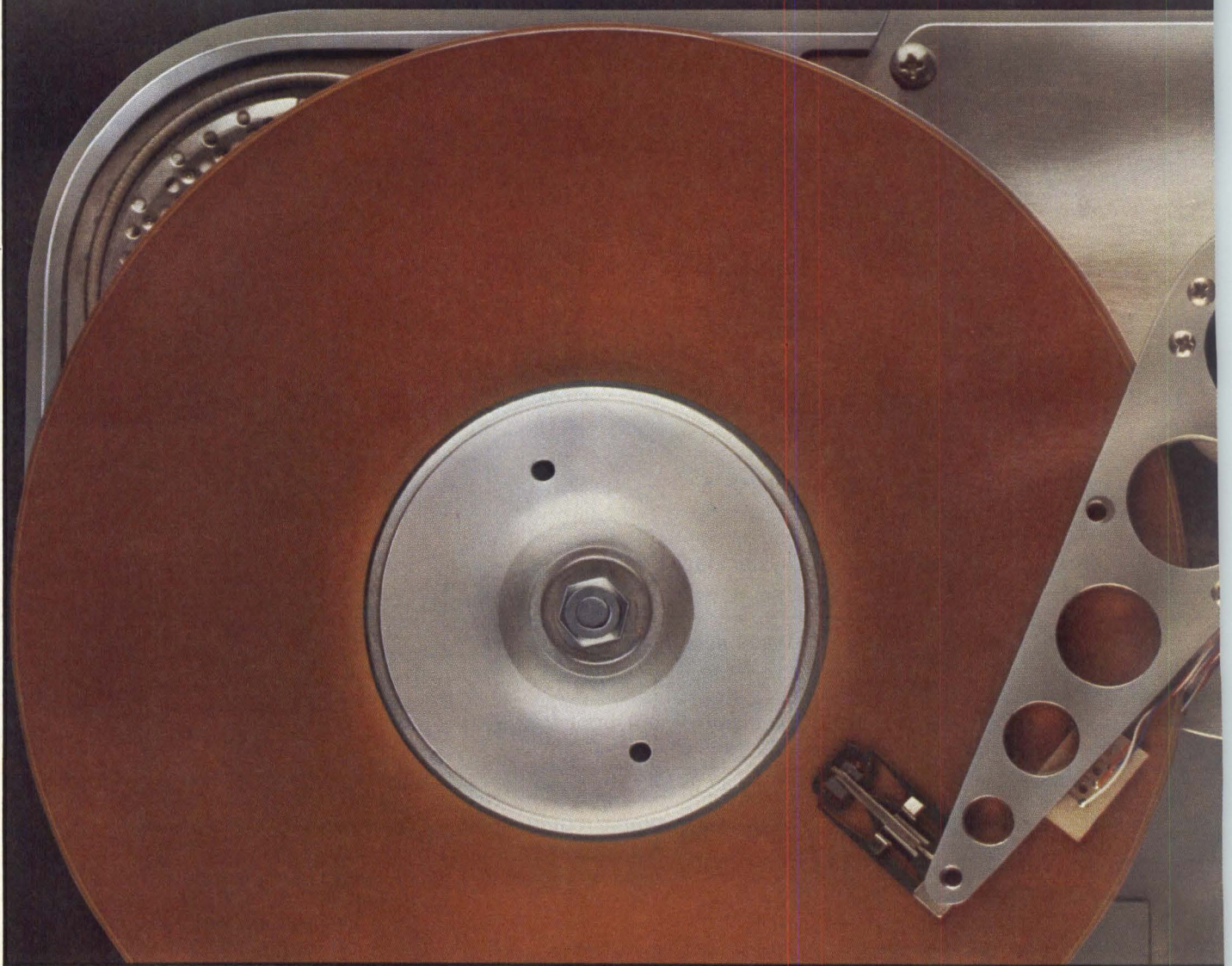
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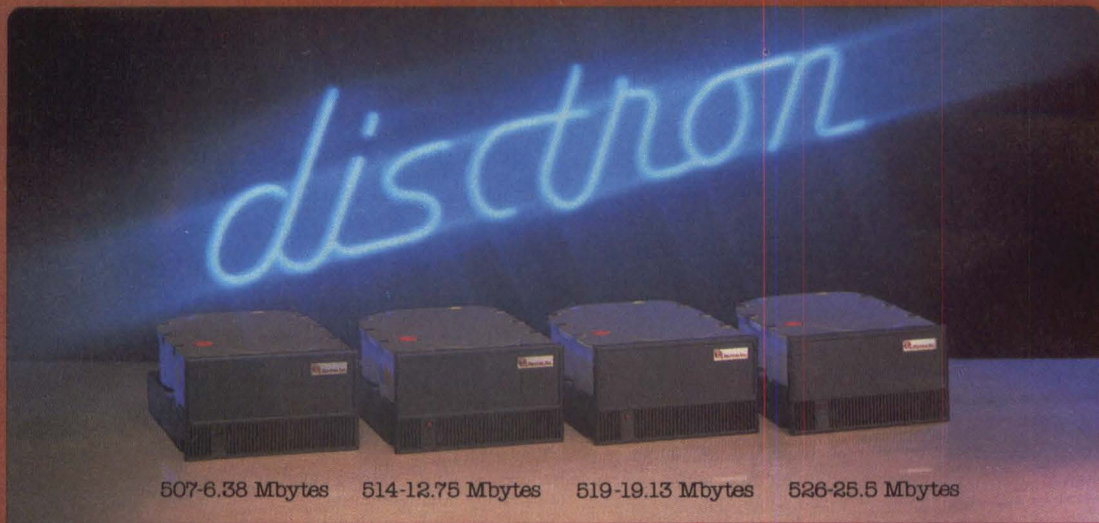
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# To 40 megabytes. Disctron 5 1/4-inch Winchester.



## Disctron Announces The 40 Megabyte Half-High 5 1/4" Winchester.



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# To 160 megabytes. Disctron 8-inch Winchester.



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8" Fixed Disc Drive



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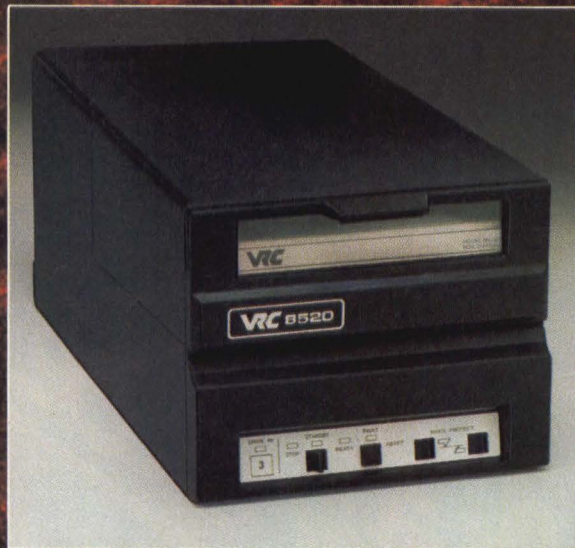
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The VRC 8520 is designed for high-capacity storage in fixed or mobile installations. Where less capacity is required, the VRC 8010 offers 11 megabytes of storage on an 8-inch removable cartridge. Both units are available with ANSI, SASI or DEC interfaces and optional power supplies.

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CIRCLE NO. 88 ON INQUIRY CARD



# Market snapshot: floppy disk drives

PATRICK KENEALY, Associate Editor

*Price, performance and compatibility determine sales  
in the three diskette drive market segments*

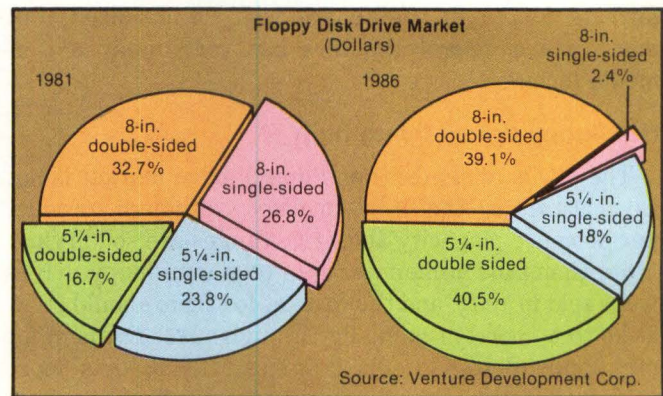
The floppy disk drive market has evolved into three markets based on 8-, 5¼- and sub-4-in. media. All three markets are healthy but in different phases of development. Growth in 8-in. floppy drive markets is fading, growth for 5¼-in. drives is still accelerating, and growth of sub-4-in. drives has just lifted off on an exponential curve. OEM customers have dozens of capacity, price and performance options, but smart shoppers start their selection process by deciding which media-based group of diskette drives to consider.

## 8-in. drives are commodities—almost

About \$400 million worth of 8-in. OEM diskette drives were sold in 1982 (Fig. 1). More than half the diskette drives sold last year were 8-in. units. Shipments of 8-in. drives are still growing at about 20 percent a year but should stabilize by 1985 and decline thereafter as full-sized diskette drives yield to competition from higher capacity 5¼-in. diskette drives and less expensive fixed and removable 5¼-in. Winchester. Although Pertec Computer Corp., Decitek Corp., Memorex Corp. and MFE Corp. are among companies that appear to be leaving the 8-in. drive market, at least two dozen U.S. firms plus a number of European and Japanese manufacturers are maintaining and expanding their 8-in. product lines.

Shugart Associates is still the industry leader, with Control Data Corp., NEC Information Systems, Inc., Qume Corp., the Remex division of Ex-Cell-O Corp. and Siemens Corp. still its major competitors. Tandon Corp. entered the 8-in. diskette drive market in 1981 with a half-height unit and has since landed major OEM contracts with Tandy Corp. and CPT Corp. New competition from Mitsubishi, Fujitsu and other Japanese producers will keep the pressure on.

Competition among 8-in. drive OEMs appears—at least for the moment—to be less directly based on



**Fig. 1. The OEM diskette drive market should grow from \$1.3 billion in 1981 to \$4.6 billion in 1986, according to Venture Development Corp., a Wellesley, Mass., research firm. This represents an annual growth rate of 28.7 percent per year. Venture Development found that 41 percent of diskette drives shipped in 1981 were integrated into personal computers, with smaller percentages being used in minicomputers, industrial microprocessor systems, word processors and intelligent terminals. By 1986, double-sided, half-height drives should dominate, but the effect of microflopies is still uncertain.**

technical virtuosity. Single- and double-sided, 8-in. diskette capacities have been limited to 1.6M bytes to date as a result of media properties, and the standardization that has resulted is one of the 8-in. drive's marketing strengths. The biggest recent technical innovation in 8-in. drives (and some say the last) is the half-height drive. Two half-height drives occupy the same space as one standard drive, doubling capacity while retaining media and interface compatibility. Tandon and Shugart are the half-height leaders, but NEC, Matsushita, CDC, Siemens and Qume have half-height units in production. Anyone wanting to remain in the 8-in. market must have one ready soon.

OEM pricing and delivery schedules are the main competitive variables in the 8-in. drive market. Quantity discounts vary among manufacturers, and published



## DISK DRIVES

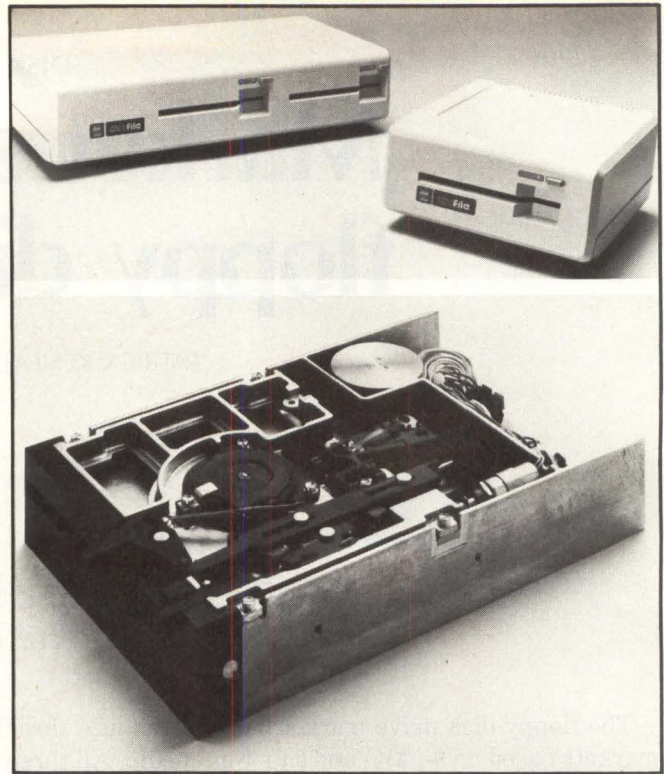
prices do not usually represent true selling prices. End-user prices for 8-in. drives are in the \$800 to \$1200 range, 100-unit quantity prices are roughly \$400 to \$600, 500-unit quantity prices are roughly \$200 to \$400, and quantities of 1000 or more are a bit lower still. Many manufacturers win accounts because they are the only suppliers with production capacity, and some manufacturers cut prices lower than normal when they have excess production capacity.

The major 8-in. drive manufacturers all offer other hard or floppy disk products and can shift production toward those products as the 8-in. market loses steam. Half-height drives have kept the 8-in. industry healthy because they allow drive customers (system integrators) to increase storage without retooling their systems. As a stronger economy allows retooling, many 8-in. buyers will switch to 5¼-in. drives. Capacities and formats for 5¼-in. units are less standardized, but many newer microcomputers can read many 5¼-in. media formats.

### Minifloppy drives flying high

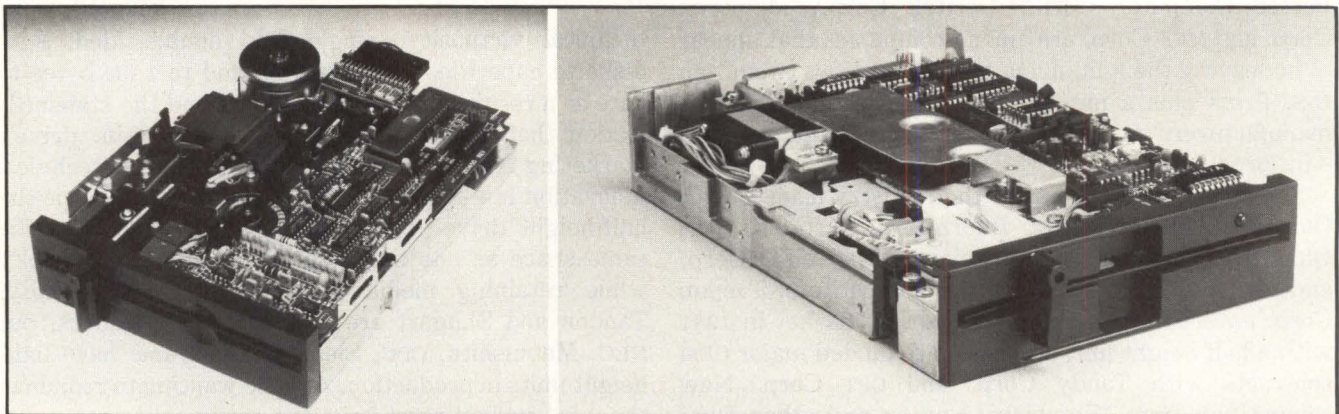
The 5¼-in. diskette (minifloppy) drive market is not as mature as the 8-in. market, although product performance, capacity and price ranges are solidifying. More than \$400 million worth of OEM minifloppy drives were sold in 1982, and the market for them should grow at 30 to 50 percent annually through 1985. Demand for minifloppy drives seems limitless. It supports more than two dozen manufacturers, led by Tandon, Shugart, Micropolis Corp., Micro Peripherals, Inc., and Alps Electric (Apple Computer, Inc.'s OEM supplier).

Minifloppy drives are available in single- or double-sided; single, double or quad recording density; and half- and full-height versions from all the major manufacturers. Single-sided, single-density (48-tpi), full-height drives are the least expensive, and double-



**Two nonstandard minifloppy drives.** Apple Computer, Inc.'s new drives (above) use nonstandard, double-sided, 5¼-in. media to store 871K bytes of data on a single diskette. Designed for Apple III personal computers, the Duofile (left) and Unifile carry end-user prices of less than \$1700 and less than \$1000, respectively. They replace the 140K-byte Apple Disk III and its many emulators. Apple claims the drives were designed for economy, capacity and media reliability, but the switch to nonstandard media has definite marketing implications. Drivetec's new half-height floppies were designed for capacity at the expense of compatibility. The model 320 (below) stores 3.33M bytes on specially manufactured, pre-formatted 5¼-in. diskettes.

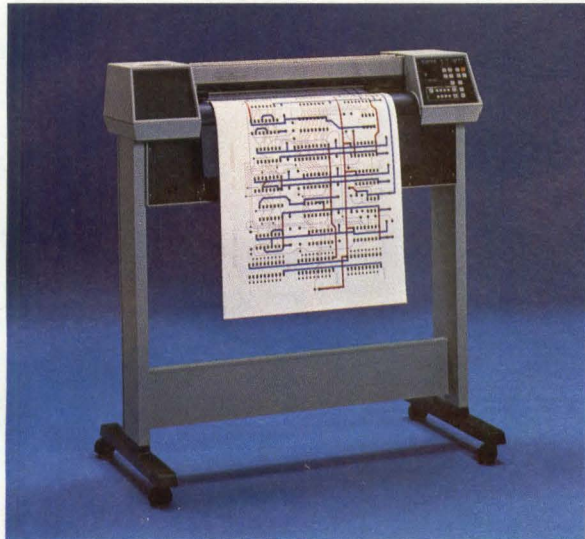
sided, quad-density drives are the most expensive. Half-height minifloppy drives are available from all the major vendors and cost about as much as full-sized drives (Fig. 2). After manufacturers amortize half-height development costs and ramp up production, and after users become less willing to pay premiums for the small drives, half-heights should become less expensive



**Fig. 2. Half-height, 5¼-in. diskette drives** such as these from Tandon (left) and Shugart store 250K bytes, 500K bytes and 1M byte on a single diskette and represent the state of the art in mass-production mini-diskette drives. The Tandon unit measures 1.62 × 5.75 × 8 in., and the Shugart unit measures 1.62 × 5.75 × 8.46 in. Both units use brushless, direct-drive, DC motors and band actuators for 3-msec. track-to-track access time. Both units also sell for less than \$200 in large OEM quantities.



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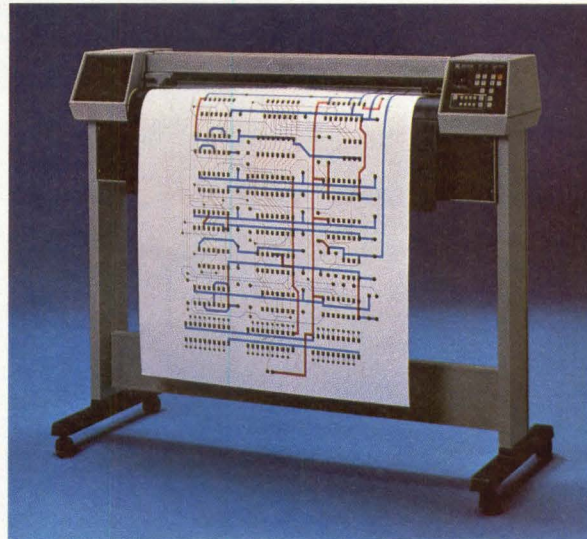
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## DISK DRIVES

than standard minifloppy drives.

Minifloppy transfer rates are standardized at 125K, 250K and 500K bytes per sec., and unformatted capacities are roughly standardized at 250K, 500K, 960K, 1000K, 1600K and 2000K bytes. Capacities vary with track densities (48, 96 and 100 tpi), formatting and the number of recording surfaces. Use of brushless, direct-drive DC motors has increased drive reliability, and stepper-motor-driven, split-band-positioning mechanisms have cut average access times on many minifloppy units from 250 msec. or more to 95 msec. or less. Today's state-of-the-art production minifloppy drive is half as big, three times as fast and eight times more capacious than the minifloppy drives of four years ago.

Price and delivery time competition is not as cutthroat among minifloppy drive vendors as it is among 8-in. drive makers. Large-volume OEM prices for double-sided, double-density drives are in the \$200 to \$300 range but should be much less than \$200 by 1985. Products are more diverse (so competition is less direct), suppliers are just as numerous, and demand from system integrators is greater.

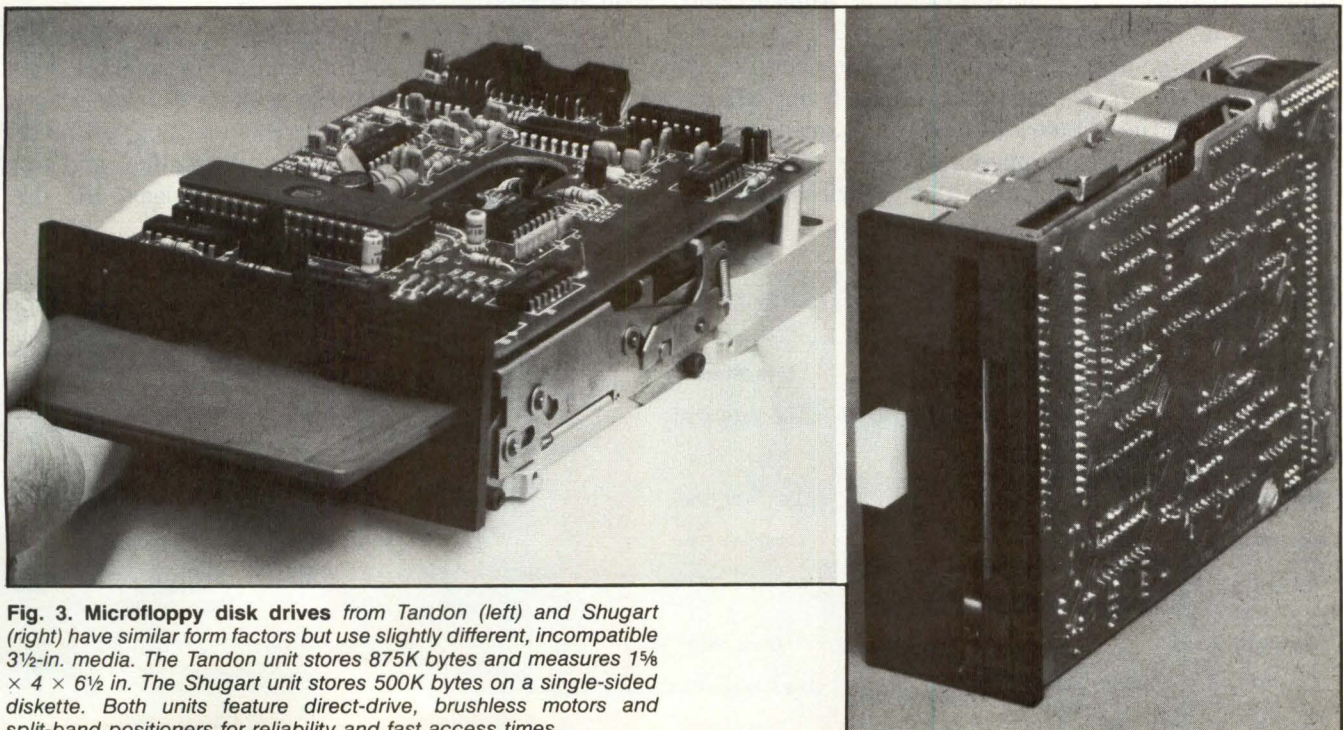
Huge economies of scale and careful manufacturing discipline are necessary for success as a minifloppy drive manufacturer. Tandon, Shugart and MPI manufacture overseas to cut costs, and other manufacturers cut costs heavily on a few big OEMs to achieve economies of scale over their total production runs. Minifloppy drive buyers have more choices than 8-in.

COMPANY NAME	5 1/4" DISKS		8" DISKS	
	UNITS (Millions)	VALUE (Millions)	UNITS (Millions)	VALUE (Millions)
Arber Industries	1.5	\$2.80	2.0	\$4.20
Control Data Corp.	2.0	4.20	4.0	10.20
CRI Inc.	1.0	2.50	.0	3.00
Dennison-Kybe	2.4	6.20	2.6	7.20
Dysan Corp.	9.75	19.50	7.8	19.50
IBM Corp.	3.0	9.00	18.0	57.60
Teijin-Memorex (Japan/USA)	7.4	14.80	7.6	17.50
3M Co.	9.6	19.20	13.0	35.75
Nashua Corp.	1.5	3.00	1.75	4.20
Verbatim Corp.	15.5	27.13	14.1	32.27
Wabash Datatech	3.0	5.40	7.0	16.10
BASF AG	4.5	9.45	4.5	11.70
Pyral/Dypyl (France)	1.0	2.10	3.0	8.25
Papier Industrien (W. Germany)	1.2	3.70	0.3	1.00
Fuji Photo Film (Japan)	0.1	0.30	0.6	1.80
Hitachi Maxell (Japan/USA)	3.75	9.38	3.5	12.25
Others	0.5	1.20	1.3	3.40
<b>TOTALS:</b>	<b>67.70</b>	<b>\$139.86</b>	<b>92.05</b>	<b>\$245.92</b>
Likely Redundancy	5 1/4": 10%;		8": 5.5%	
Range of Actual Production:	5 1/4": Min: 61; Max: 67.7 8": Min 88; Max: 93			

Source: Magnetic Media Information Services

Floppy disk media production topped 150 million units and \$375 million in 1981, according to Magnetic Media Information Services, a Chicago market research firm. Production of 8-in. diskettes rose 38 percent over 1980 levels, while 5 1/4-in. production was up 167 percent. MMIS estimates the 1982 market at 13.5 million units and \$672.4 million and reports that only 349,000 3 1/2-in. diskettes worth \$2.4 million were shipped that year. Sales of 3 1/2-in. media should grow at an annual rate of 97 percent over the next five years, MMIS predicts.

buyers but must shop carefully; it is still a sellers' market.



**Fig. 3. Microfloppy disk drives from Tandon (left) and Shugart (right) have similar form factors but use slightly different, incompatible 3 1/2-in. media. The Tandon unit stores 875K bytes and measures 1 5/8 x 4 x 6 1/2 in. The Shugart unit stores 500K bytes on a single-sided diskette. Both units feature direct-drive, brushless motors and split-band positioners for reliability and fast access times.**



**Microfloppy drives—promises and problems**

Minifloppies may be the hottest selling diskette drives today, but microfloppies are the hottest topic of conversation. The term "microfloppy" refers to four groups of diskette drives distinguished by the type of smaller than 5¼-in. diameter media they use (Fig. 3).

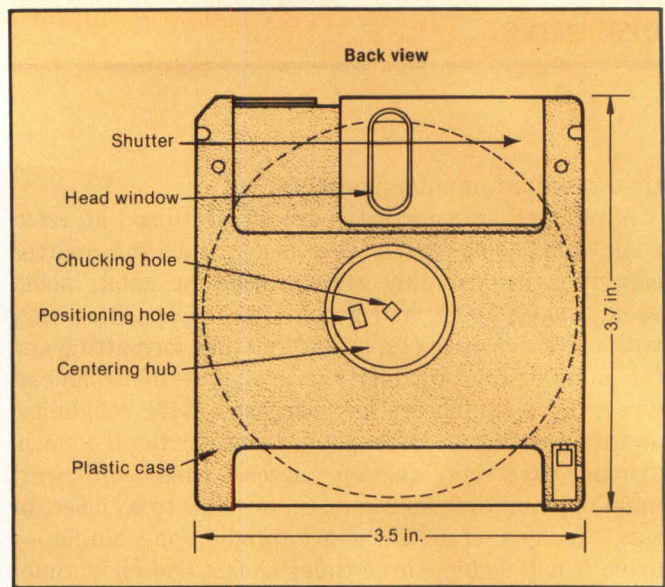
The first group, headed by Verbatim Corp., numbers 20 drive and media manufacturers including Apple, Atari, BASF Systems Corp., Cii Honeywell Bull, Memorex, Irwin/Olivetti, Remex and Shugart. The group, called the Microfloppy Standards Committee, supports a 3½-in. diskette in a rigid case that shares the transfer rate, track density and rotational speed of current minifloppies.

Sony Corp., originator of the microfloppy, is the main member of the second group, which has ambiguous support from Tandon, Hewlett-Packard Co. and others. The Sony diskette is similar to the "committee diskette" in size and hard shell, but is formatted differently (Fig. 4). Sony has its drive in production and has a number of large OEM orders in hand.

The third group centers around Tabor Corp., Westford, Mass., and its 3¼-in. soft-envelope micro disk. Seagate Technology, after reportedly failing to reach a licensing agreement with Sony, has announced plans to build the Tabor drive. Media vendor Dysan Corp., a financial backer of both Seagate and Tabor, is also solidly behind the 3¼-in. diskette.

The last of the four microfloppy drive manufacturer groups is based around Matsushita's 3-in. diskette. Hitachi America, Ltd., Maxell Corp. of America and others favor this standard.

Despite their media differences, the microfloppy drives have much in common. Drives using 3½-in. media, such as the Shugart SA300 (Fig. 3), measure 1.6 × 4 × 6 in. and occupy one-quarter the volume of a full-height minifloppy and store 1M byte without taxing technologies. Their small size has some inherent



**Fig. 4. Back view of a Sony 3½-in. diskette shows a metal centering hub and sliding metal shutter that covers the head window when the diskette is not in use.**

benefits. Raw materials costs are lower, and power consumption is lower, typically less than 10W operating and less than 5W in standby mode. In designing for smallness, vendors cut parts counts and used the latest electromechanical and electronic technologies. Shugart, for example, claims an MTBF of 10,000 power-on hours for its microfloppy drive, 25 percent better than for its standard minifloppy drives.

Sony, Shugart and Tandon all claim OEM prices of less than \$200 for large OEM quantities of production units in the second quarter of 1983, but major OEM customers remain uncommitted, or at least unannounced. Initial units may be priced like current minifloppies between \$250 and \$500.

Five-year revenue predictions in the billions of dollars and success in the minifloppy market have inspired too many vendors to seek early leadership in the microfloppy market. The risks are as great as the rewards for media and drive vendors alike, and OEM customers may have to wait until at least the first round of this high stakes game is played. □

**Diskette Drive Manufacturers**

Manufacturer	City, State	Micro-floppy	Mini-floppy (5¼)	8-inch floppy	Capacities (KB)	Circle #
Advanced Electronic Design, Inc.	Sunnyvale, Calif.			x	1000	300
Alps Electric Co., Ltd.	Tokyo, Japan		x		256, 250, 500, 1000	301
Anderson Jacobson, Inc.	San Jose, Calif.		x		204	302
Apple Computer, Inc.	Cupertino, Calif.		x		140	303
BASF, AG	Mannheim, Germany		x	x	1600 250, 500, 1000	304
Burroughs Corp.	Detroit, Mich.			x	3131	305
C. Itoh Electronics, Inc.	Los Angeles, Calif.		x		1600	306
Caldisk, Inc. (Billings)	Provo, Utah			x	800, 1600, 3200	307



## Diskette Drive Manufacturers

Manufacturer	City, State	Micro-floppy	Mini-floppy (5¼)	8-inch floppy	Capacities (KB)	Circle #
<b>Columbia Data Products, Inc.</b>	Columbia, Md.		x		180	308
<b>Comark Corp.</b>	Waltham, Mass.			x	3200, 512	309
<b>Commodore Business Machines, Inc.</b>	Wayne, Pa.		x		170, 330, 1050, 2100	310
<b>Control Data Corp.</b>	Minneapolis, Minn.		x		125/250 250/500 500/1000 400/800 800/1600	311
<b>Elcomatic, Ltd.</b>	Glasgow, Scotland			x	1600, 3200	312
<b>Innotronics Corp.</b>	Lincoln, Mass.			x	802	313
<b>Iomega Corp.</b>	Ogden, Utah			x	14,000	314
<b>Irwin/Olivetti</b>	Ann Arbor, Mich.		x	x	250, 500, 1000 500	315
<b>Matchless Systems</b>	Gardena, Calif.			x	1300, 2600	316
<b>Matsushita Corp.</b>	Japan	x				317
<b>Memorex Corp.</b>	Santa Clara, Calif.			x	312, 802	318
<b>Micro Peripherals, Inc.</b>	Chatsworth, Calif.		x	x	250, 500, 525, 1050 1600	319
<b>Micro-Sci</b>	Santa Ana, Calif.		x		143, 164, 286, 572	320
<b>Micropolis Corp.</b>	Chatsworth, Calif.		x		500, 585, 960, 1000, 1113, 1170, 1200, 2025, 2175	321
<b>Miltope Corp.</b>	Melville, N.Y.			x	1000	322
<b>Mitsubishi Electronics America, Inc.</b>	Compton, Calif.		x	x	1000, 1600 1600	323
<b>Motorola Semiconductor Products, Inc.</b>	Phoenix, Ariz.			x	500, 1000	324
<b>NEC Information Systems, Inc.</b>	Lexington, Mass.			x	400, 1600	325
<b>Persci, Inc.</b>	Los Angeles, Calif.			x	800, 1600, 3200, 3776	326
<b>Pertec Computer Corp.</b>	Irvine, Calif.		x	x	250, 438 802, 1600	327
<b>Philips Data Systems</b>	Apeldoorn, Netherlands		x		438	328
<b>Qume Corp.</b>	San Jose, Calif.		x	x	250, 1000 1600	329
<b>Remex</b>	Irvine, Calif.		x	x	500, 1000 800, 1600	330
<b>Shugart Associates</b>	Sunnyvale, Calif.		x	x	256, 512, 1000 800, 1600 500	331
<b>Siemens Corp.</b>	Anaheim, Calif.		x	x	250, 500, 1000 800, 1600	332
<b>Sony Corp.</b>	Tokyo, Japan	x				333
<b>Tabor Corp.</b>	Westford, Mass.	x			500	334
<b>Tandon Corp.</b>	Chatsworth, Calif.		x	x	250, 500, 1000, 2000 800, 1600 875	335
<b>Teac Corp.</b>	Tokyo, Japan		x		250, 481, 500, 1000	336
<b>Techtran Industries</b>	Rochester, N.Y.		x		200, 400	337
<b>Toshiba Corp.</b>	Tokyo, Japan		x	x	438, 1094 400, 1600 3000 (prototype)	338
<b>Y-E Data, Inc.</b>	Tokyo, Japan		x	x	500, 1000, 1600 1600	339



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## DISK DRIVES

# Trends in small Winchester disk drives

ANDREW ROMAN, Roman Associates International

*Growing market demands and competition are pushing 5¼- and 8-in. drives into smaller boxes with higher capacities*

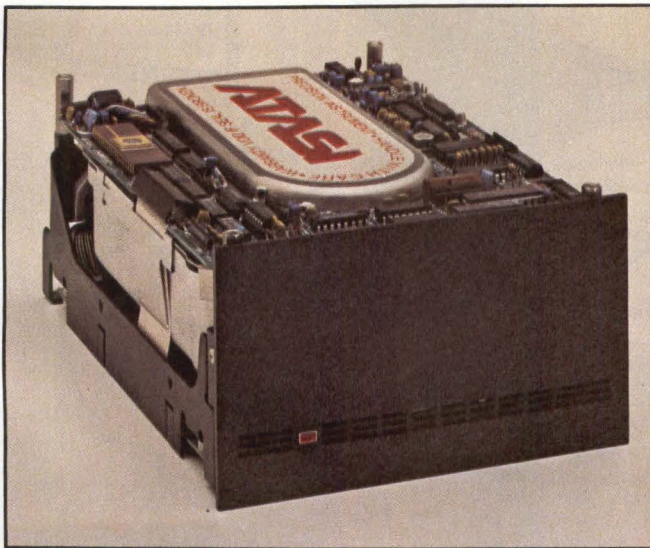
As applications for desk-top computers become more sophisticated, requirements for small Winchester disk drives become more demanding. New disk drive products—many from new companies—are being introduced to address these new market opportunities. Developments in thin-film heads, media and smaller motor components are providing higher storage densities on smaller disks, packaged in more compact boxes. Current products boast improvements in capacity for half-height, removable cartridges and standard fixed 5¼- and 8-in. designs.

### Half-height Winchester

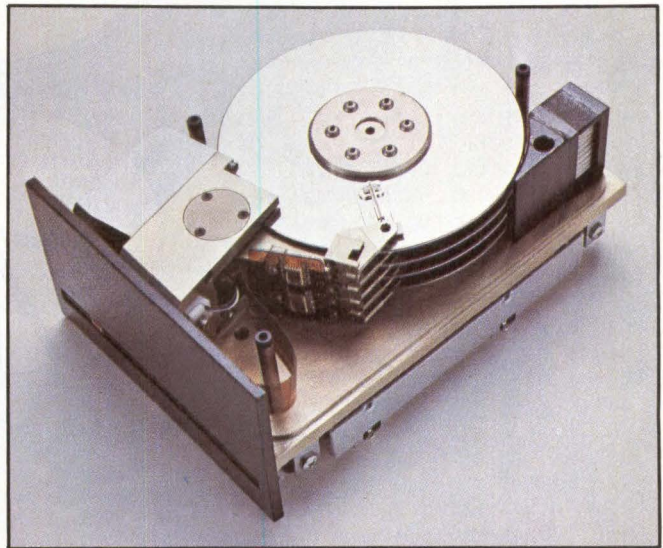
The half-height disk drive trend began last year with half-height floppies, and quickly carried over to the

micro-Winchester industry. These "slim-line" packages provide storage capacities comparable to their full-sized counterparts, but two half-heights can be placed in the space occupied by a single 5¼-in. minifloppy.

Half-height 5¼ Winchester with capacities in the 6M- to 12M-byte range are offered by Seagate Technology Corp., Shugart Associates, Tandon Corp., Miniscribe Corp. and newly formed Microscience International, Sunnyvale, Calif. Another start-up, Cogito Systems Corp., founded by a group of ex-IBM Corp. engineers in San Jose, Calif., will introduce a family of half-height 5¼-in. Winchester this year. Disctron, formed by a merger of Rotating Memory Systems, Inc., and Data Peripherals, introduced a half-height 5¼-in. Winchester offering 42.5M bytes on three platters at



Atasi Corp.'s 5¼-in. 3000 series drive uses a linear voice-coil actuator controlled by a closed-loop servo system, providing 46M bytes of storage and a 30-msec. average access time.



The Vertex V100 series of 5¼-in. Winchester offers as much as 72M bytes and a 30-msec. average access time using a dual-frequency servo system.



the 1982 Comdex in Las Vegas.

New media and head technologies promise to provide lower cost drives with greater capacity in smaller packages. Plated media and low-profile thin-film recording heads are two such technologies. Ampex Corp. and PolyDisc Systems, Inc., are the main suppliers of plated media to Winchester drive manufacturers. But many Winchester disk drive manufacturers are becoming vertically integrated and producing their own plated media. Such companies include Evotek, SyQuest Technology, Tandon, Disctron and long-established manufacturers Memorex Corp. and Control Data Corp.

Cybernex Corp., a year-old start-up in San Jose, Calif., will be among the first to manufacture non-IBM thin-film read/write heads. Cybernex will be joined by

independent thin-film head makers Magnex and Dastek Corp., as well as established head manufacturers Infomag and National Micronetics, Inc., both of which licensed their thin-film head designs from Cybernex.

Thin-film heads developed for 5¼- and 8-in. Winchesters resolve data signals at higher flux densities, which,

*Cartridge Winchesters provide data backup, convenient program/data loading and transportability.*

when combined with higher track densities, increase drive capacities without stacking more platters. Three-platter, slim-line, 5¼-in. Winchesters with capacities exceeding 100M bytes may not be far off. Diameter could shrink as well as height, leading to more drives such as SyQuest's 3.9-in., half-height Winchester. As long as the media is nonremovable, diameter standard-

**THE YEAR OF THE 5¼-IN. WINCHESTER**

By the end of the 1982 Comdex Conference in Las Vegas last December, the 5¼-in. Winchester industry numbered 40 manufacturers, accounting for 125 5¼-in. Winchester products. At the show, 25 new 5¼-in. Winchester products were announced and shown for the first time.

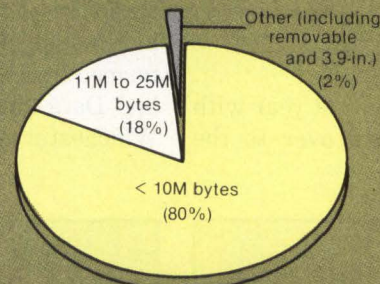
A total of 200,000 5¼-in. Winchester units valued at \$165 million were shipped in 1982. Shipments are projected to increase to 3 million units valued at \$3 billion by 1988. (Cost per megabyte continues to shrink, but higher capacities are pushing drive costs up.) These numbers include shipments for the two main market segments—the OEM and captive markets—and represent a combined annual growth rate exceeding 50 percent.

In 1982, 80 percent of 5¼-in. Winchester disk drive sales revenues were accounted for by drives with storage capacities of less than 10M bytes. Of projected 1988 revenues, 50 percent will be generated by 5¼-in. Winchester products with capacities as high as 25M bytes. The increasing market momentum caused by shipments in the Seagate Technology Corp. ST406/ST412/ST419 product category and those products' multiple second sources will maintain this high volume. In addition, the 3.9-in. Winchesters originated by SyQuest Technology and now second-sourced will account for 13 percent of 1988 sales revenues.

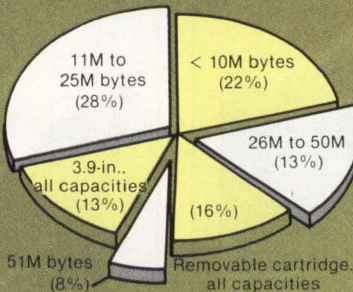
The growth of the 5¼-in. Winches-

ter industry has outstripped that of even the floppy disk industry. Total worldwide floppy disk drive shipments in 1976 accounted for only 175,000 units, valued at \$65 million, four years after Memorex Corp. and Shugart Associates announced the first independent OEM floppy disk drive design,

5¼-in. Winchester product mix 1982 Total sales: \$165 million



1988 Total sales: \$3.75 billion

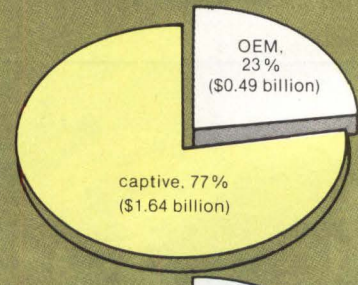


*The product mix for 5¼-in. drives will change over the next six years from one favoring drives with capacities of less than 10M bytes to one favoring higher capacity drives. Removable and 3.9-in. drives will also take a larger share of the market. Figures shown above are for 5¼-in. fixed disk drives except where noted.*

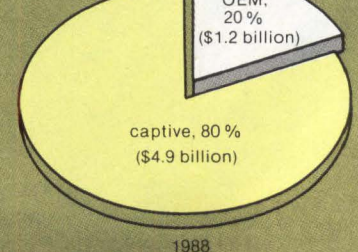
following IBM Corp.'s introduction of the floppy in 1971. In contrast, Seagate shipped 65,000 ST506 drives in the first full year of the drive's availability.

The 8-in. Winchester disk drive market also took four years to develop. In 1979, one year after IBM introduced the first 8-in. Winchester, OEM shipments totaled less than 10,000, valued at \$18 million. In 1982, OEM 8-in. Winchester shipments accounted for 175,000 units, valued at \$300 million. This market should increase to \$1.2 billion by 1988, including 9- and 10½-in. Winchesters.

8-in. Winchester market 1982



1988



Source: Roman Associates International  
**The 8-in. Winchester market will almost triple over the next six years to more than \$6 billion.**



# IT'S HERE... IT'S NEW!

## A 5¼ INCH CARTRIDGE DISK DRIVE

### FOR

# \$495\*

That's right. You can now have a 5 megabyte Winchester 5¼" Cartridge Disk Drive for ONLY \$495.

The new Western Dynex Model WD505 Cartridge Disk Drive is an extraordinary memory system... offering all the advantages of removable and interchangeable media, and the precision of microprocessor controlled supervisory functions, including:

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- Automatic data track calibration for each cartridge inserted
- Read/write and data recovery optimization
- Cartridge insertion and removal

The Model WD505 is a convenient low-cost memory solution for business, school and personal computer systems, and it offers expandability to 20 megabytes (4 drives) as your system grows. And perhaps more important, it provides virtually unlimited off-line storage with full cartridge interchangeability between drives.

And that's not all! The Model WD505 solves all the problems of both floppy disks and fixed disk Winchester drives. Reliability, data integrity and media durability is a great enhancement over the best of floppy systems. And as a backup to fixed disk Winchester drives, the WD505 is the ultimate answer. Other features include:

- Standard ANSI packaging... compatible with 5¼" fixed disk Winchester and mini-floppy drives
- Standard ST506 interface
- Soft sectoring, with variable format capability
- Automatic self-calibrating tracking
- Open loop positioning



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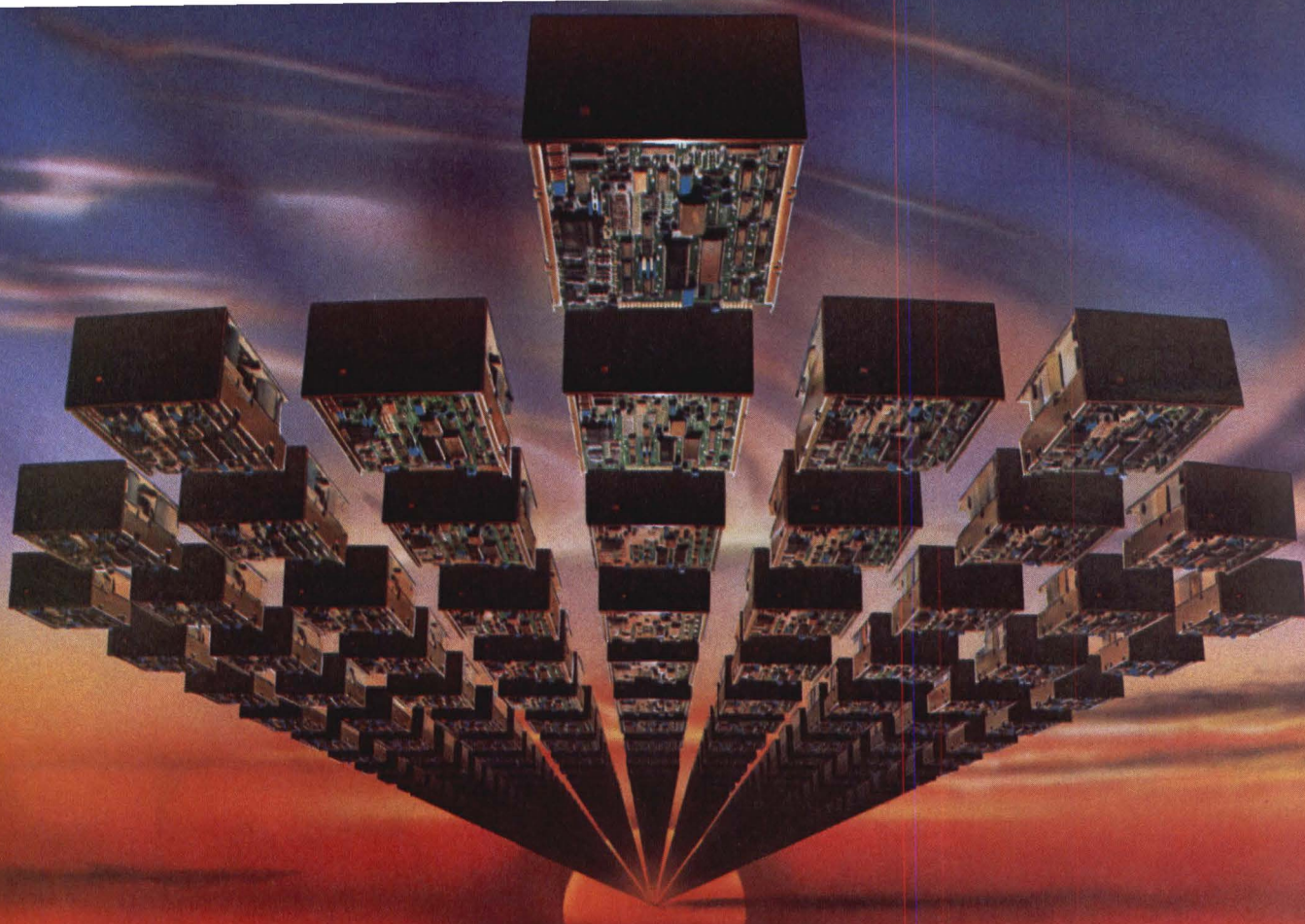
Western Dynex Corporation  
3536 West Osborn Road  
Phoenix, Arizona 85019  
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Order today! And remember, you can depend on Western Dynex, a company with more than 10 years of Cartridge Disk Drive manufacturing experience.

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**DYNEX**  
CORPORATION

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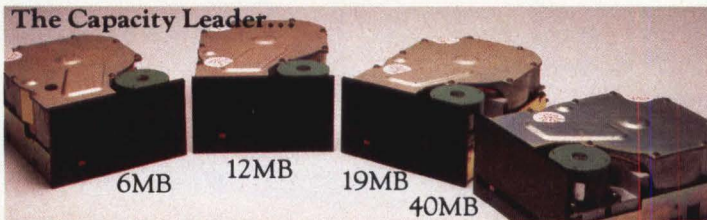


# 250 billion bytes delivered...

Reliable bytes, too. You've told us that. By the way you've ordered our high capacity 5 $\frac{1}{4}$ " Winchester drives. Again and again. By now we've delivered more high capacity drives than any other supplier. And we've increased our production capacity to 2,000 drives a day. Just to accommodate the demand.

But don't worry. It hasn't gone to our head. We're still just as careful of quality as ever. That care has given us the industry's lowest rejection rate. And the highest performance rating.

Whichever capacity you choose — 6MB, 12MB, 19MB or 40MB — you can always be confident that the last byte will be as good as the first. Call or write today for complete product and pricing information. 9216 Eton Avenue, Chatsworth, CA 91311 (213) 709-6445 TWX 910-494-4834



**Computer Memories, Inc.**

Ft. Worth, TX (817) 332-7859 / Irvine, CA, (714) 553-8880 / Springfield, MA, (413) 783-2386 / In Europe: Pangbourne Berks, UK, 07357-4120, Telex 849910. For small quantities, call Schweber Electronics, (800) 645-3040.

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ization is not as important an issue.

Cartridge Winchesters provide data backup, convenient program/data loading and transportability. A major step in removability has been initiated with introductions of 5¼-in. removable cartridge drives from DMA Systems, Inc., Seagate, Western Dynex Corp., Memorex and Athenaem Technology, Inc., the first Boston-area small Winchester start-up.

The new DMA model 5/15, introduced at Comdex,

features 19.5M bytes of fixed and 6.5M bytes of removable storage, while the Athenaem drive provides 12.75M bytes of fixed and 12.75M bytes of removable storage. These drives all incorporate the ANSI standards for cartridge dimensions established by independent media manufacturer Dysan and second-sourced by Memorex. There are not, however, corresponding standards for data interchangeability, so one manufacturer's drives can't read data written on a cartridge by another manufacturer's drive.

Several new 8-in. Winchesters featuring removable cartridge drives were unveiled at the November Comdex. Newly formed Amcodyne, Longmont, Colo., demonstrated its 8-in. Winchester featuring 25.8M

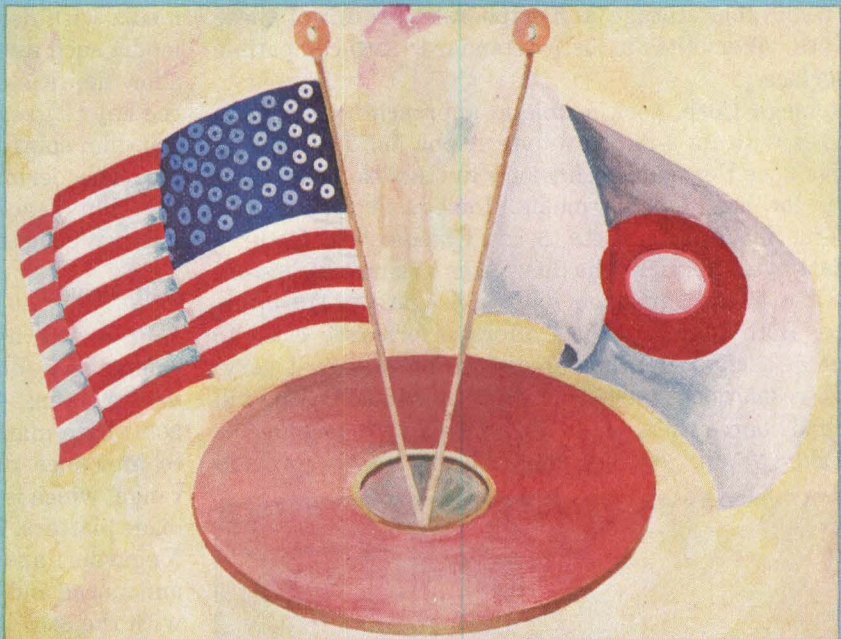
**SMALL WINCHESTER TRENDS IN JAPAN**

Japanese companies shipping large-volume production units of 5¼-in. Winchesters include Mitsubishi, NPL, Fujitsu, TEAC (Seagate licensee), NEC and Nippon Electric Industries' Densai Division. A total of 90 percent of these drives are shipped to domestic customers or used internally.

The state of 5¼-in. disk technology in Japan is one year behind that of U.S. vendors. Some Japanese vendors' products store 6M bytes on two platters, compared to one platter for most U.S. vendors, with some storing as much as 20M bytes on three platters. All of these drives feature low-cost stepper-motor actuators and standard oxide-coated media. NEC, Fujitsu and Hitachi have developed plated-media technology and may incorporate it into their 5¼-in. drives when the market opportunity arises.

Missing in the 5¼-in. Winchester fray are established disk drive manufacturers Y.E. Data, Toshiba, Panasonic, Sony, Tokyo Electric Co. and Hokushin. These small Winchesters moved so fast in the U.S. during the past 30 months that many Japanese manufacturers feel that the market is too fluid for them.

Fujitsu, NEC, Hitachi and Mitsubishi will offer 8-in. Winchesters in the 160M-byte range to the U.S. market. All will offer the SMD interface, and aim at Control Data Corp.'s large, diversified customer base. The most unique drive in this category, effectively competing against both high-performance 8- and 14-in. Winchesters, is the 10½-in. Fujitsu Eagle, with a storage capacity of 474M bytes. More than 6000 units have been shipped since the product's introduction in 1981 (MMS, February, 1981, p. 111).



*Illustration by Mark Fallon*

Large computer companies such as Fujitsu, NEC and Hitachi are producing their own IBM-type Winchester heads and media (developed for their IBM-compatible 14-in. drives) and incorporating them in their own drives. Others, such as TEAC, Nippon Electric/Densai and Mitsubishi, purchase these critical drive components from these suppliers as well as the same industry suppliers used by U.S. manufacturers. NPL, 50 percent owned by Fujitsu and 50 percent by Hitachi, obtains its small Winchester drive components from its two parent companies.

The Fujitsu disk drive manufacturing plant in Kumagaya produces low-cost 8- and 14-in. Winchesters through highly advanced factory automation. Within four months after production start-up in June, the build

rate for 8-in. Winchester products had been ramped up to within 66 percent of maximum capacity. Automatic radio-controlled carts feed sub-assembly components to the disk drive assembly lines, while automatic handlers position the drives into and out of automated burn-in and test racks. After final test, the handlers and carts transport the finished Winchester for crating and shipping.

It seems likely that Japanese vendors will attempt to establish a leadership role for themselves in some segment of the disk drive market. For now, however, Japanese disk drive manufacturers still look to U.S. companies for technology and market leadership and will continue to develop and supply Winchester disk drives on a second-source basis.



bytes of fixed and 25.8M bytes of removable capacity, using cartridges compatible with the ANSI 8-in. standard. CDC's new Lark II also features 25.8M bytes of fixed and 25.8M bytes of removable storage, while Digital Equipment Corp. is expected to announce its Aztec 8-in. Winchester drive soon. The Aztec uses a proprietary cartridge that is not mechanically compatible with the ANSI standard. This ANSI cartridge was adopted earlier by Century Data Systems, Inc., in its model C2048 announced at the 1982 National Computer Conference, with 16M bytes of fixed and 32M bytes of removable capacity. Vermont Research unveiled its 8-in. model 8520 with 11M bytes of fixed and 11M bytes of removable storage at Peripherals '82. All of these drives offer the industry-standard SMD-compatible interface.

Iomega Corp. took a unique approach to cartridge drives with its 8-in., 10M-byte Alpha 10. The Iomega drive uses Bernoulli technology to stabilize head flight over low-cost flexible media. Iomega showed a new 5¼-in. model, the Beta 5, at Comdex. It features 6.38M-byte capacity. The drive uses a removable 5¼-in. flexible media cartridge with a Seagate ST412 interface. Both Iomega drives offer performance close to that of a rigid Winchester disk using standard very-high-resolution 8- or 5¼-in. flexible media. Dysan will second-source the 8-in. Iomega media and cartridge.

Like 5¼-in. drives, many 8-in. drives provide



**Cogito Systems' Cogitator 912** 6M- or 12M-byte half-height 5¼-in. Winchesters use a linear actuator with IBM 3380-type-head-suspension ramp-loaded manganese-zinc read/write heads.

physical cartridge compatibility, but not read/write compatibility. Development of an industry standard along these lines is mandatory if the cartridge drive industry is to continue its encouraging growth.

### High-capacity 5¼-in. drives

Increased competition between the 40 5¼-in. Winchester disk drive manufacturers accounts for 125 disk drive models introduced in the three years since Seagate originated the industry.

Second-wave competitors entered the fray with higher performance 5¼-in. drives featuring capacities ranging from 35M to 140M bytes. Such products open applications for 16- and 32-bit microcomputers used for high-resolution graphics, local-area networks and other multitasking/multi-user markets.

Closed-loop rotary, voice-coil actuators with servo-control information pre-recorded on a dedicated surface precisely position read/write heads over standard oxide media with densities of 960 tpi and 10,000 bpi. Plated media such as that used by Evotek and SyQuest could allow densities exceeding 2000 tpi and 25,000 bpi. But the key to greater densities on less real estate may be thin-film sputtered media designed for vertical recording. The performance of these media, enhanced with thin-film heads, should set new standards for the micro-Winchester industry in the next few years.

### 8-in. drives

Propelled up past the 100M-byte range by the competitive onslaught of the high-capacity, 5¼-in. drives, 8-in. Winchesters are now aiming at the 200M-byte mark. Several manufacturers are preparing to announce drives targeted close to the 200M-byte range, which is accomplished by stacking standard 8-in. oxide platters. Fujitsu America, Inc., Micropolis Corp., Megavault and NEC Information Systems, Inc., have announced and will soon ship such 8-in. Winchesters, all with the SMD interface.

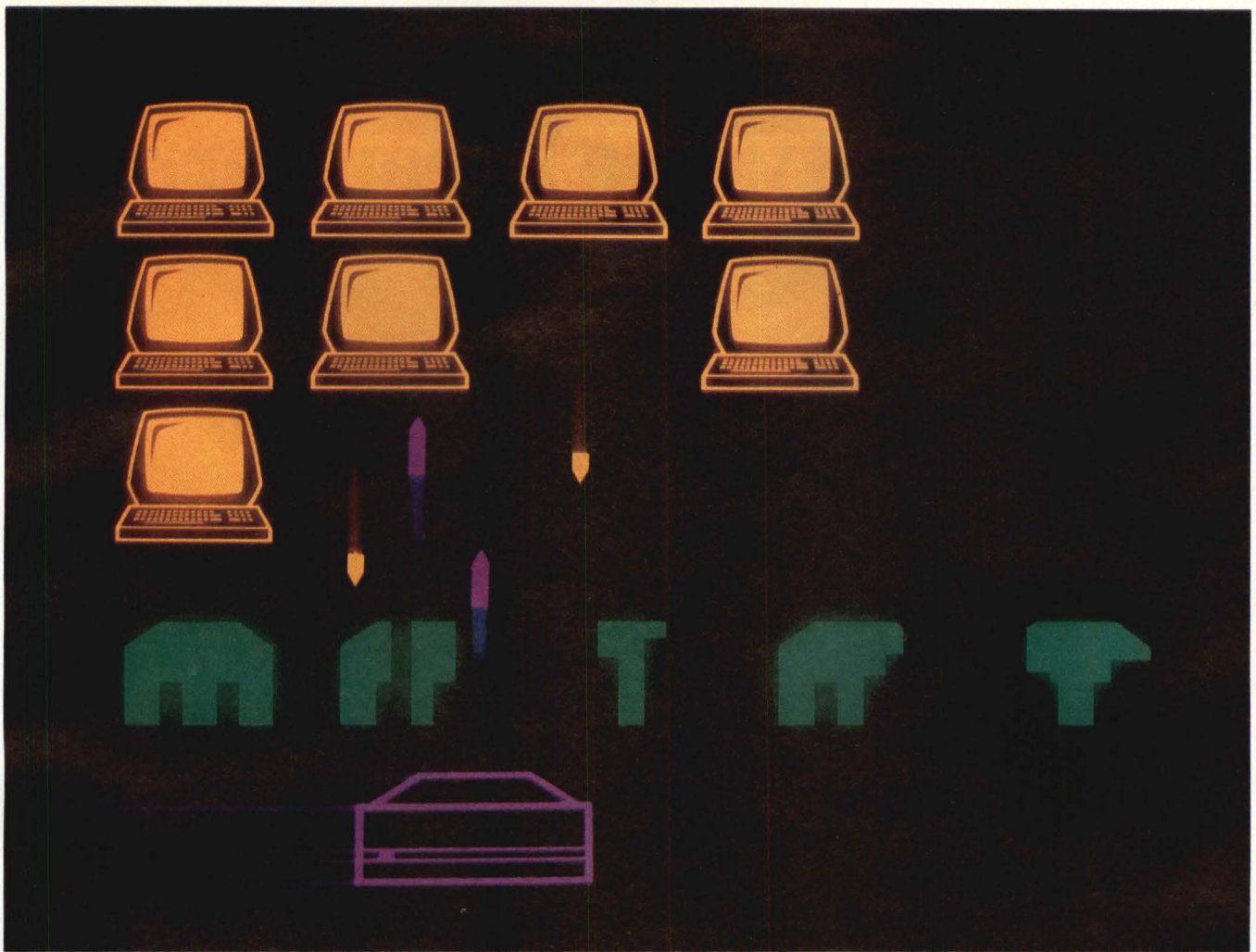
The most significant recent product introduction was CDC's model 9715 last June at NCC. This 165M-byte fixed storage drive broke the 8-in. floppy form factor barrier, both with its 230-mm. (9-in.) diameter media and drive box dimensions of 10½ × 8¾ × 24 in. A companion drive featuring removable media with a three-platter cartridge for backup stores 92.9M bytes and mounts beside the fixed version in a standard 19-in. rack-mount slot 10½ in. high.

New entrants to the small Winchester battle will continue to emerge, but the competition will be much heavier. □

**Andrew Roman** is an independent technical and marketing consultant to the disk drive industry. He has held engineering and marketing management positions with NCR Corp., Control Data Corp., Pertec Computer Corp. and Diablo Systems, Inc.

The following tables, compiled by Andrew Roman Associates International, list specifications for 5¼- and 8-in. Winchester disk drives.





# DON'T LET 5 1/4" WINCHESTERS SHOOT DOWN YOUR MULTI-USER SYSTEM PLANS

Now you can design truly high performance systems with the VERTEX V100 5 1/4" family; 31MB, 52MB, 72MB capacity; 30 msec average access time; industry standard mounting, interface and transfer rate.

There was a time when "high performance system" meant "big disk system." Not anymore. The low cost VERTEX V100 family brings you big disk performance, all right. But in a compact 5 1/4" format. What's more, your system is prob-

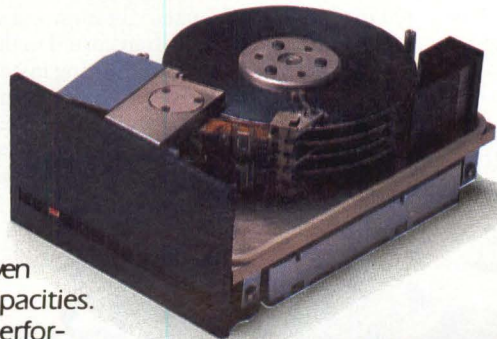
ably already designed for the V100 family since it uses the industry standard interface and 5 Mb/secs transfer rate.

The V100 family is actually the first of a series of VERTEX drives designed for even higher performance and capacities. That means you get peak performance today with superior design integrity. And each VERTEX drive is backed by a team that has been responsible for the design and

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manufacture of over 3,000,000 disk drives. So while VERTEX is a new company, our production and quality assurance programs have been fine-tuned to deliver highly reliable products, on time. You can plan on it!

Don't delay your high performance system plans any longer. Call Norm Hayes, Director of Marketing, today at (408) 942-0606. Or write VERTEX, 2150 Bering Drive, San Jose, CA 95131.



**VERTEX**  
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# IMI reinvents the 5¼" Winchester. And backs it with a 2-year warranty.

If our new 5000H Series drives weren't the most reliable 5¼" Winchesters ever built, we wouldn't give them an unprecedented 2-year warranty.

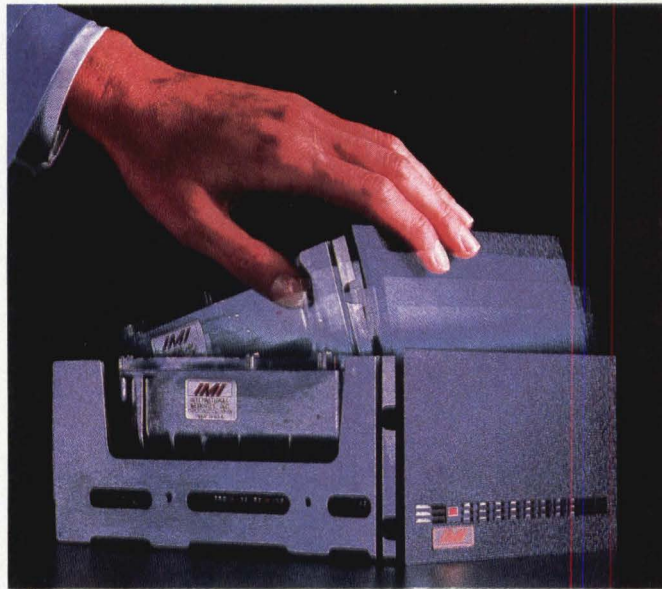
Don't expect to use it, though. 5000H Series drives are made to withstand the everyday abuse known as "normal system usage." And to give continuously superior performance in even the most demanding applications.

So the overwhelming odds are that the 2-year warranty will expire long before the drive ever does.

## THIN-FILM PLATED MEDIA PRESERVES DATA INTEGRITY, INCREASES STORAGE CAPACITY.

To ensure that 5000H drives withstand harsh treatment without sacrificing data integrity, the media is thin-film plated. Thin-film plating is orders of magnitude more shock resistant than ferric oxide coatings and many times harder. Because it's not easily damaged, data is not easily lost, and the drive remains in service.

Thin-film plated media also allows greater bit densities, as much as 10,700 bpi. This has enabled IMI to up the unfor-



matted storage capacity of the 5021H drive, for example, to 21 Mbytes.

And to improve data integrity even further, we've maintained industry standard formats and transfer rates with lower track densities.

## NEW 2-PIECE SHOCK-MOUNTED CHASSIS EXTENDS SERVICE LIFE.

To protect the heads and disks, we've recessed the head/disk assembly inside a rigid, die-cast frame enclosure. Integral shock mounts at the center of gravity insulate the head media interface from the environment.

Besides reducing acoustical noise, this 2-piece design minimizes vibration and shock loads transferred to the heads and disks during installation and use. Even the printed circuit boards utilize the shock-mounted design to lessen stress on the components.

## NEW THERMALLY STABLE DESIGN ENSURES OPTIMAL HEAD POSITIONING.

5000H Series drives have a deeply finned die-cast base and cover that increase both the stiffness of the structure and the surface area for heat transfer.

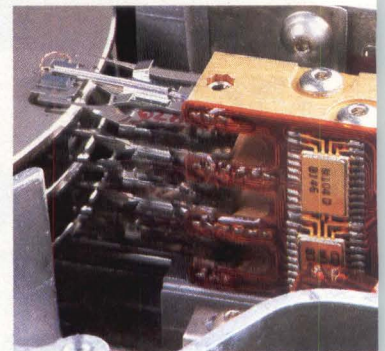
When thermal distortion of the head/disk assembly is minimized, head positioning is optimized. And the combination of temperature stability and lower track densities substantially reduces the potential for off-track errors.



**NOW FASTER. TIME**  
**68 MSEC**  
(INCLUDES SETTLING TIME)  
**ACCESS TIME**

## HEAD-MOUNTED PREAMPLIFIER PROVIDES MAXIMUM NOISE IMMUNITY.

Only IMI puts the read/write preamplifier on the head stack, where it greatly reduces EMI/RFI noise susceptibility. This, coupled with the inherently higher signals of plated media (>50%) and the shielding of the all metal frame, yields the best signal to noise ratio in the industry.

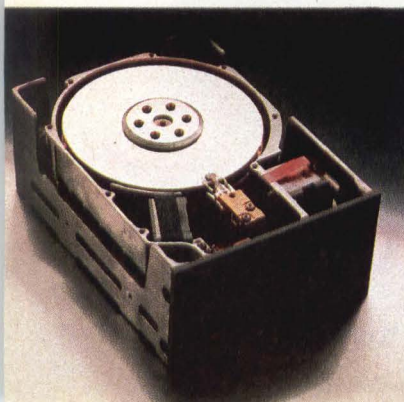


## A FULL LINE OF HIGH PERFORMANCE 5¼" WINCHESTERS.

Although the unformatted storage capacity ranges from 6.38 Mbytes to 21 Mbytes, depending upon the drive model and interface, all 5000H Series drives feature:

- 68 msec access time.
- 303 tpi.
- 3600 rpm.

For specification sheets, call or write: International Memories Incorporated, 10381 Bandy Drive, Cupertino, CA 95014. (408) 446-9779. TWX: 910-338-7347



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**We're at it again.**

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### 5¼-in. Winchester specifications

Company and model	Unformatted capacity (M bytes)	No. of disks/ no. of r/w heads	Bytes per track	Tracks per in./ bits per in.	Avg. positioning time (msec.)	Actuator type	Data-transfer rate (K bytes/sec.)	Interface type	OEM price (Qty. 100)	Comments
Ampex										
Pyxis 7, 13	6.67, 13.3	1/2, 2/4	10,417	360/8720	90	Stepper	625	ST506/ST412	\$660, \$735	Rodime licensee
Pyxis 20, 27	20, 26.6	3/6, 4/8	10,417	360/8720	90	Stepper	625	ST506/ST412	\$885, \$1025	
Atasi										
3020, 3033	19, 33	2/3, 3/5	10,416	800/8780	30	Linear voice coil	625	ST412	\$1920, \$2300	Linear closed-loop servo composite M <sub>n</sub> Z <sub>n</sub> r/w heads
3046	46.3	417	10,416	800/8780	30	Linear voice coil	625	ST412	\$2660	
Athenaeum										
Aegis 10/10	25.5	2/4	10,420	690/9074	35	Linear voice coil	625	ST506/ST706		12.7M bytes removable, 12.7M bytes fixed. Both drives feature closed-loop servo-controlled linear voice coil
Aegis 30	38.25	3/6	10,420	690/9074	35	Linear voice coil	625	ST506/ST412		
BASF										
6182	6.38	2/4	10,416	254/7690	61	Stepper	625	ST506/ST412		Not marketed in U.S.
6184	9.57	3/6	10,416	254/7690	92	Stepper	625	ST506/ST412		
Cogito Systems										
CG906	6.38	1/2	10,416	345/8841	85	Stepper	625	ST506/ST412		New slim-line series measures 1.625-in. high
CG912	12.76	2/4	10,416	345/8841	85	Stepper	625	ST506/ST412		
Computer Memories										
CM5412, 5619	12.7/19.1	2/4, 3/6	10,416	355/8650	130	Stepper	625	ST506/ST412	\$940, \$1190	Closed-loop servo positioner
CM5640	40	3/6	10,416	690/9650	40	Stepper	625	ST506/ST412	\$1680	
Control Data										
9415-19	19	2/3	10,080	800/8730	50	Rotary voice coil	605	CDC, ST506	\$1620	Closed-loop servo positioner
9415-32	32	3/5	10,080	800/8730	50	Rotary voice coil	625	CDC, ST506	\$1965	
Cynthia Peripheral										
D505, D510	6.38, 12.7	2/4, 2/4	10,416	255/7690	170	Stepper	625	ST506/ST412	\$1350*	Manufactured under Seagate license; 1 fixed, 1 removable
D520	25	2/4	10,416	860/9200	40	Stepper	625	ST706/DMA		
DMA Systems										
5R, 5/5	6.5, 13	1/2, 2/4	10,890	454/8617	40	Linear voice coil	625	ST706	\$1565, \$1800	Removable media
5/10, 5/15	19.5, 26	2/4	10,890	908, 1156 TPI	40	Linear voice coil	625	ST706	\$1395, \$1450*	Removable media
26F, 39F	26, 39			908, 1156 TPI	40	Linear voice coil	625	ST506/ST412	\$990, \$1250*	Fixed media
Disctron										
D507, D514	638, 12.75	1/2, 2/4	10,417	383/8944	77	Stepper	625	ST506/ST412	\$905, \$1140	Data separator
D519, D526	19.13, 25.5	3/6, 4/8	10,417	383/8944	77	Stepper	625		\$1305, \$1460	PCB available
Evotek										
ET5510, 5520, 5530, 5540	7, 15, 23, 31	1/2, 1/2, 2/4, 2/4	10,416	367/9825	49	Stepper	625	ST506/ST412	\$1275, \$1475, \$1975, \$2375	Plated media made by Evotek
ET5810, 5820, 5830, 5840	12, 25, 38, 51	3/6, 3/6, 4/8, 4/8	17,220	367/16,250	49	Stepper	1025	ST506/ST412	\$1375, \$2075, \$2375, \$2675	
Fujitsu										
M2233	13.3	2/4	10,416	254/8020	95	Stepper	625	ST506/ST412	\$875	Also available with SA400 interface
M2234	20	3/6	10,416	300/10,200	95	Stepper	625	SA4000	\$1050	
Hitachi										
DK501-2, -3	10, 13.3	3/6, 4/8	10,416	254/7800	78	Stepper	625	ST506		

\* Quantity 1000    \*\* Quantity 500    \*\*\* Quantity 2500



### 5¼-in. Winchester specifications

Company and model	Unformatted capacity (M bytes)	No. of disks/ no. of r/w heads	Bytes per track	Tracks per in./ bits per in.	Avg. positioning time (msec.)	Actuator type	Data-transfer rate (K bytes/sec.)	Interface type	OEM price (Qty. 100)	Comments
International Memories										
5012H, 5018H	12.7, 19.1	2/4, 3/6	10,416	303/9706	68	Stepper	625	ST506/ST412	\$800, \$900	On-board data separator, plated media, closed-loop servo
5014H, 5021H	15.9, 23.9	2/4, 3/6	11,459	303/10,700	120	Stepper	687.5	IMI bus ST506,	\$890, \$990	
5040H	41.25	3/6	10,417	606/10,300	68	Stepper	625	IMI		
Irwin Olivetti										
1510, 1516	12.2, 16	1/2	9950	900/924	33	Rotary voice coil	675	Irwin	\$2035, \$1406	Includes 6.38M-byte tape cartridge; plated disk, embedded servo
1416	16	1/2	9950	900/9950	34	Rotary voice coil	675	Irwin	\$2212	
562/12, 562/13	7.5, 11.2	2/1, 3/1	10,417	254/7820	84	Stepper	725	ST506/ST412	\$880, \$1075	
Matsushita Communications										
SA604, SA606	6.6, 10	2/1, 3/1	10,416	256/7900	75	Stepper	625	ST506		Shugart licensee, not sold in U.S.
Maxtor										
XT 1065, XT 1105	66, 105	4/7, 6/11	10,416	980/11,155	30	Rotary voice coil	625	ST506/ST412	\$1520, \$2100	Closed loop
XT 1140	143	8/15	10,416	980/11,155	30	Rotary voice coil	625	ST506/ST412	\$2690**	
Memorex										
306, 310	6.6, 10	2/1, 3/1	10,416	254/8020	95	Stepper	625	ST506/ST412	\$750, \$920	Manufactured by NPL
Micropolis										
1303, 1304	34.6, 51.9	2/1, 3/1	10,416	960/9400	38	Rotary voice coil	625	ST506/ST412	\$1313, \$1024*	Closed-loop servo
Microscience International										
HH612	12.76	1/4	10,416	648/9680	85	Stepper	625	ST506/ST412		Two heads per surface, dual micro-processors
Miniscribe										
2006, 2012	6.4, 12.8	1/2, 2/4	10,416	402/8280	85	Rack and pinion	625	ST412	\$600, \$675	Buffered seek, half-height, temperature compensated
3006, 3012	6.4, 12.8	1/2	10,416	588/10,000	85/155	Rack and pinion	625	ST412		
4010, 4020	10, 20	1/2, 2/4	10,416	588/8575	120	Rack and pinion	625	ST412	\$690, \$825	
Mitsubishi										
4863-2, -3	6.6, 10	2/4, 3/6	10,416	256/7900	75	Stepper	625	ST506		
NEC										
DT 210	6.38	2/4	10,416	200/8935	102	Stepper	625	ST506/ST412		
New World Computer										
Micro-Disk V 4/0, 2/2	4, 2	1/8, 2/16	13,000	250/9000	28	Stepper	782	ST506, SA1000	\$906, \$1006	2M bytes in removable HDA
Micro-Disk V 4/2, 44	6, 8	2/16, 2/6	13,000	250/9000	28	Stepper	782	ST506, SA1000	\$1196, \$1436	4M bytes in removable HDA
Nippon Electric-Densei										
RD-5067, RD-5100, RD-5133	6, 10, 13	2/4, 4/8	10,416	254/8200	95	Stepper	625	ST506		Not marketed in U.S.
Nippon Peripherals										
NP05-6, -10	6.6, 10	2/4, 3/6	10,416	254/8020	175	Stepper	625	ST506		Distributed by Memorex
Priam										
Diskos 502	55	4/7	10,416	960/9000	35	Linear voice coil	625	ST412		

\* Quantity 1000    \*\* Quantity 500    \*\*\* Quantity 2500



# The 100<sub>MM</sub> Winchester. Removable. Half Size. Half Price. Full Performance.

It's here. Winchester capacity and performance at half the size, half the price. And yes, available in removable or fixed disc drives.

The SyQuest 100mm (3.9") SQ306 packs five megabytes (formatted) in half the height of a 5¼" Winchester. And when the Q-Pak™ cartridge is full, just slip in another one. It's the best of both worlds—the reliability of Winchester with the portability of removable cartridges.

## A better drive.

**SyQuest drives give you a better fit.** Mount SyQuest drives almost anywhere. Under a keyboard. In your terminal. Fit two in one minifloppy space. SyQuest drives are only 1.625 inches high, 4.8 inches wide, and 8 inches deep.

**Easy integration.** The SQ306 has the same pin-outs, timing, data transfer rates, and track/sector formatting as industry-standard 5¼" Winchester drives. Use standard Winchester controllers and interfacing procedures, standard minifloppy DC power supplies.

**Better price/performance.** SyQuest delivers five megabytes with proven Winchester heads, positioning, brushless motors and air filtration. Buffered seek reduces average seek time to 75 msec. But the cost is half of comparable 5¼" Winchesters.



## Q-Pak™ —a better cartridge.

**Better reliability.** Closed-loop servo with imbedded digital servo (**DigiLok™**) ensures cartridge interchangeability while allowing variable sectoring. **Chromaflex™** graphite coated thin film metallic alloy discs protect against contamination. No long purge cycle required.

## Available now.

**SyQuest is shipping.** Second sources are available. So order your evaluation units today. For more product information, circle our readers' service number. For delivery and pricing information, write or call Larry Sarisky, SyQuest Technology.

## It Fits.



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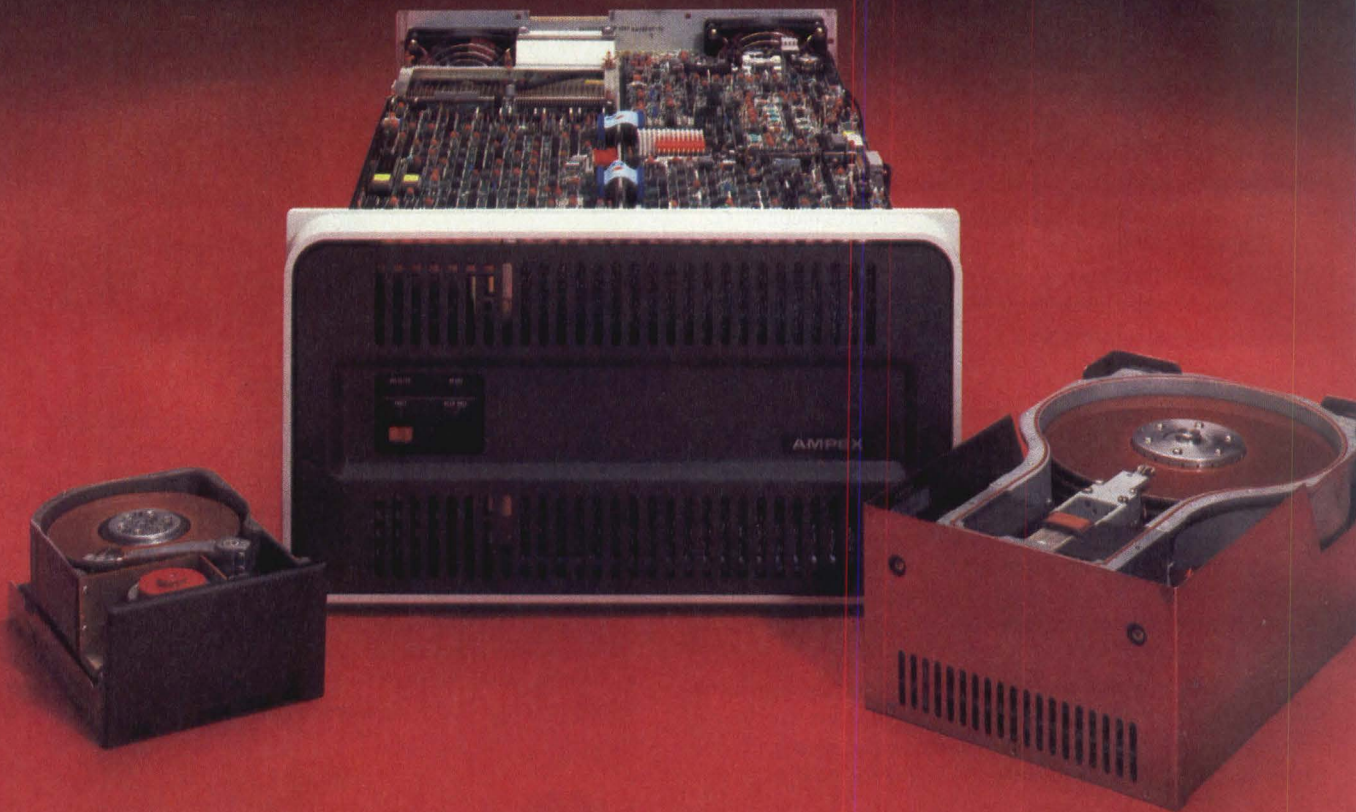
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# WE'VE GOT IT ALL



## FROM 7MB TO 330MB IN 5¼", 8" AND 14" WINCHESTER FAMILIES.

Ampex's Winchester families deliver the performance you need in today's competitive marketplace. There's 5¼" Pyxis with up to 27MB; 8" Scorpio with up to 83MB; and 14" Capricorn with up to 330MB. All offer the features you want, like automatic disk and head locking; industry-standard interfaces and packaging; power-up self-test and diagnostics; and capacity expansion. None requires any preventive maintenance.


Our Winchester disk drives are backed by a continuing Ampex commitment to leading-edge technology research, automated processes, and vertical

integration beginning with heads and media; by a highly professional worldwide service and support organization; and by manufacturing capacity in excess of a half-million square feet located in four countries.

That's why you can count on Ampex to deliver whatever you need in Winchester disk drives, today and tomorrow.

Ampex Corporation, Memory Products Division, 200 North Nash Street, El Segundo, CA 90245. 213-640-0150. TWX: 910-343-6243.

### AMPEX

Ampex Corporation • One of The Signal Companies   
CIRCLE NO. 98 ON INQUIRY CARD



### 5¼-in. Winchester specifications

Company and model	Unformatted capacity (M bytes)	No. of disks/ no. of r/w heads	Bytes per track	Tracks per in./ bits per in.	Avg. positioning time (msec.)	Actuator type	Data-transfer rate (K bytes/sec.)	Interface type	OEM price (Qty. 100)	Comments
Quantum										
Q520, Q530, Q540	21, 32, 42	2/4, 3/6, 4/8	10,416	591/9200	45	rotary coil	625	ST412		Temperature compensated servo
Rodime										
R0201, 202, 203	6, 13, 20	2/4, 3/6	10,416	360/8720	90	Stepper	625	ST506/ST412	\$720, \$890, \$1060	Made in Scotland
R0204, 206, 208	26, 40, 53	3/6, 4/8	10,416	600/10,200	90	Stepper	625	ST506/ST412	\$1285	
Seagate										
ST406, 412, 419	6, 12, 19	1/2, 2/4, 3/6	10,416	345/9074	85	Stepper	625	ST412	\$850, \$1030, \$1250	Manganese zinc composite heads, half-height, removable cartridge
ST206	6.38	1/2	10,416	345/9074	85	Stepper	625	ST412		
ST706	6.38	1/2	10,416	270/10,202	100	Stepper	625	ST706		
Shugart										
SA604, 606	6, 10	2/4, 3/6	10,400	256/7900	99		625	ST506	\$1090, \$1275	Half-height
SA706, 712	6.67, 13.3	1/2, 2/4	10,416	360/9036	99		625	ST412		
Syquest										
SQ 306F	6.38	1/2	10,416	435/12,000	75	Stepper	625	ST412	\$600	3.9-in. diam. plated disk
SQ 306R	6.38	1/2	10,416	435/12,000	75	Stepper	625	ST412	\$600	3.9-in. diam. disk, removable, half-height
Tandon										
TM501, 502, 503	6, 12, 19	1/2, 2/4, 3/6	10,416	345/9074	206	Stepper	625	ST412	\$705, \$890, \$1055	Buffered seek closed-loop servo
TM703	31	3/5		600/10,000	85	Rotary voice coil	625	ST412		
TEAC										
SD506, SD412	6, 12	2/4, 2/4	10,417	345/9074	170	Stepper	625	ST506/ST412		Seagate licensee; marketed only in Far East
Texas Instruments										
525/61	6.38	1/2	10,416	400/9200	115	Stepper	625	ST412	\$820	Plated media
525/122	12.76	2/4	10,416	400/9200	115	Stepper	625	ST412	\$1055	Plated media
Vertex										
V130, V150	30.8, 51.4	2/3, 3/5	10,416	960/9920	30	Rotary voice coil	625	ST412		Thin-film media, composite manganese zinc r/w heads
V170	72	4/7	10,416	960/9920	30	Rotary voice coil	625	ST412		
Western Dynex										
WD 505	6.38	1/2	10,416	345/9022	45	Stepper	625	ST412	\$875	Removable media

### 8-in. Winchester specifications

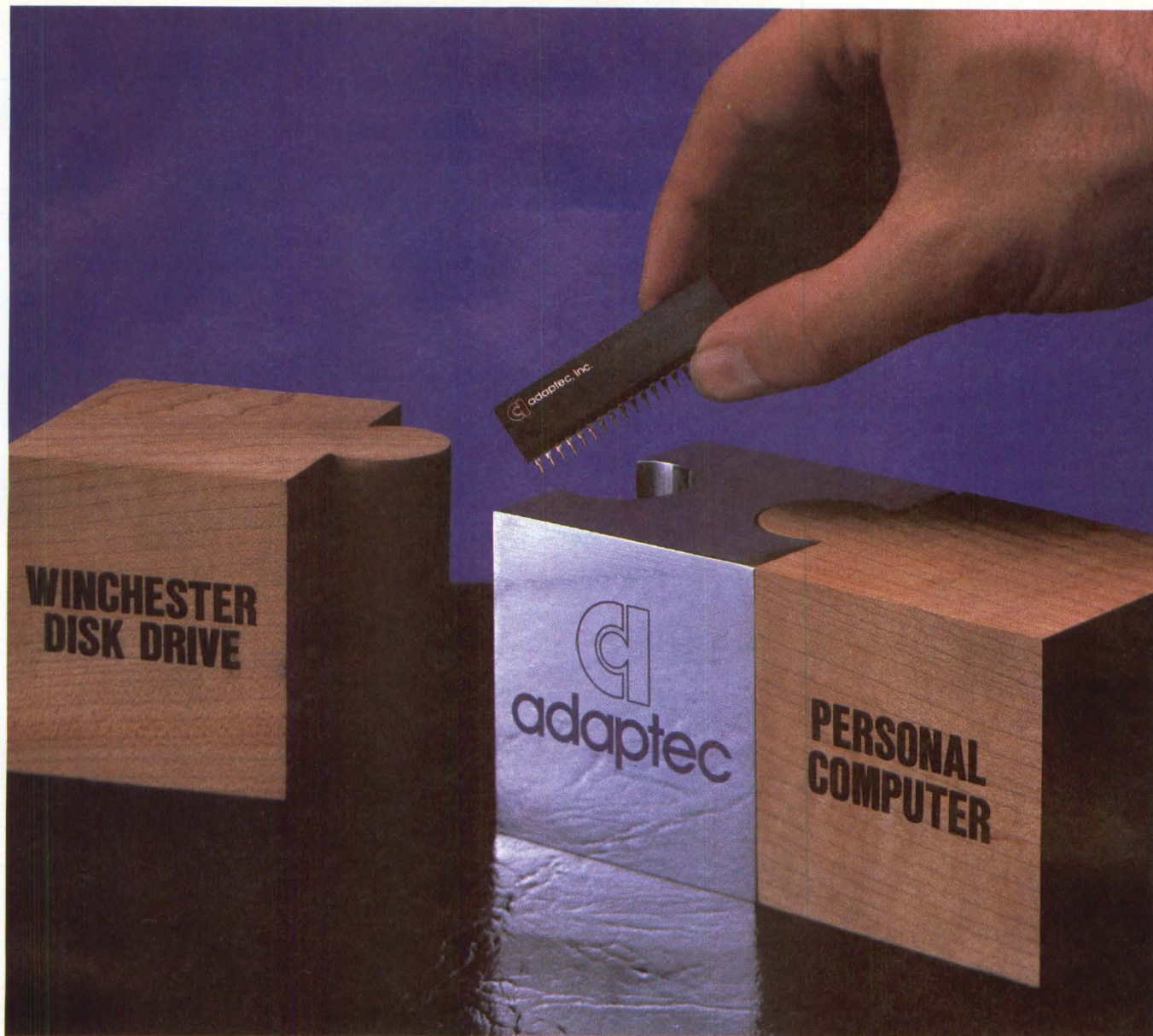
Company and model	Unformatted capacity (M bytes)	No. of disks/ no. of r/w heads	Bytes per track	Tracks per in./ bits per in.	Avg. positioning time (msec.)	Actuator type	Data-transfer rate (K bytes/sec.)	Interface type	OEM price (Qty. 100)	Comments
Amcodyne										
Arapahoe 7110	51.6	2/4	20,160	550/10,000	35	Linear voice coil	1229	SMD		Removable 8-in. ANSI cartridge
Ampex										
Scorpio 48, 84	49.7, 82.9	2/3, 3/5	20,160	826/10,104	32	Linear voice coil	1209	SMD	\$2,460, \$3445	
Century Data Systems										
C2048	50.19	3/6	20,160	480/9873	30	Linear voice coil	1209	SMD	\$2920	Removable 8-in. ANSI cartridge
* Quantity 1000	** Quantity 500	*** Quantity 2500								



### 8-in. Winchester specifications

Company and model	Unformatted capacity (M bytes)	No. of disks/ no. of r/w heads	Bytes per track	Tracks per in./ bits per in.	Avg. positioning time (msec.)	Actuator type	Data-transfer rate (K bytes/sec.)	Interface type	OEM price (Qty. 100)	Comments
Cii Honeywell Bull Cynthia D140, D145	24	2/4	12,800	500/4750	50	Linear voice coil	920	SASI	\$2970, \$3390	Removable 10½-in. diam. Fixed 10½-in. diam.
Cynthia Peripheral D160-8	145	4/8	12,800	500/4750	50	Linear voice coil	920	SASIL		
Control Data 9410-24, 32, 40 9457 Lark II	24, 32, 40 50	2/1, 3/4, 3/5 2/4	13,440 20,672	554/6800 715/10,161	50 35	Rotary voice coil Linear voice coil	806 1209	SMD, ISI, Lark, Finch SMD, ISI, Lark	\$1820, \$2045 \$2280 \$3440	Variable sectoring Removable 25M-byte cartridge Removable pack; 3 disks 9-in. diam. Fixed, 9-in. diam.
9710 (RSD)	82.9	3/5	20,160	550/10,000	30	Linear voice coil	1209	SMD	\$4960	
9715 (FSD)	165.9	6/10	20,160	550/10,000	30	Linear voice coil	1209	SMD	\$4910	
Disctron DP100 Lynx	10.6	1/2	13,440	478/6968	60	Linear voice coil	875	SA1000, LMD	\$1960	Removable 8-in. ANSI cartridge Fixed media
DP400 Puma	46.4	2/4	13,440	640/8335	60	Linear voice coil	875	SASI, SA1000, LMD	\$2250	
D1600	157.5	4/7	13,440	960/10,780	30	Linear voice coil	1209	SMD		
Fujitsu M2302, M2303	23.7, 47.5	2/4, 4/8	24,320	196/12,360	70	Rotary stepper	1200	SA4000	\$1850	
M2311K, M2312K	48.2, 84.4	3/4, 4/7	20,480	720/9550	20	Rotary voice coil	1229	SMD	\$2925, \$3400	Closed-loop servo control
M2351A Eagle	474.2	6/10	28,160	880/12,790	18	Rotary voice coil	1859	SMD	\$8800	Compact 10½-in. diam. disks
Hitachi DK811-4, -8	48, 89	4/6, 6/11	12,800	480/7495	25	Rotary voice coil	904	SMD		
Hokushin Electric CD8010P	11.5	2/4	15,151	180/7475	73	Stepper	900			Distributed by Priam in the U.S.
IBM (OEM) 676	38.6	2/4	21,700	523/10,312	40	Linear voice coil	1250	SASI	\$2750	S/23 drive, closed-loop servo Piccolo drive
680	64.5	6/11	16,384	450/8530	27	Rotary voice coil	1031		\$5500	
International Memories 7720, 7740	20, 41.9	2/3, 3/5	10,800	300/6200	35	Linear voice coil	648	IMI or ANSI	\$1475, \$1825	
8740, 8757	41.9, 58.7	3/5, 4/7	10,800	600/6200	50	Linear voice coil	648	IMI or ANSI		
8100	94.13	4/7	10,416	800/6588	39	Linear voice coil	625			
Kennedy 6172, 6173	24, 40	2/3, 3/5	13,444	500/6542	40	Linear voice coil	800	ANSI, SMD	\$2395, \$2555	Acquired from BASF
7300-1	41.9	3/5	20,160	560/9420	30	Rotary voice coil	1209	ANSI, SMD	\$2560	
7300-2	82.9	3/5	20,160	960/942	30	Rotary voice coil	1209	ANSI, SMD	\$3195	
Megavault MV 20L, 34, 48L	20, 34, 48	2/3, 3/5, 4/7	10,416	478/6000	45	Rotary voice coil	625 or 542	ST412 SA1000	\$2020, \$2200, \$2410	Sealed aluminum HDA; AC or DC
* Quantity 1000	** Quantity 500	*** Quantity 2500								





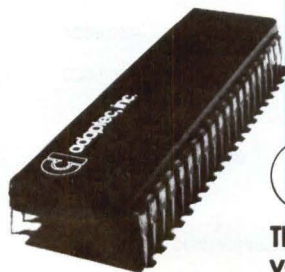
# ADAPTEC'S AIC-100: YOUR PC CONNECTION

**The Opportunity Window:** The Personal Computer marketplace is the fastest growing, most competitive market in the computer system and drive industry. Product opportunity windows close almost as fast as they open. And more than one company, finding their window closed, has wound up closing their doors. Adaptec's AIC-100, The Winchester Controller Chip,<sup>™</sup> is designed to make sure you hit your opportunity window quickly, powerfully and with minimum cost. The results just might be a competitive edge that shatters your competition.

**The Winchester Controller Chip:** The AIC-100 is a silicon gate NMOS device which provides the major portion of the hardware necessary to build a powerful Winchester disk controller. A few "glue" chips can complete the design of your choice. Or, you can get to market even faster by incorporating Adaptec's own Data Separator and FIFO Buffer controller chips.

On-chip 32 bit ECC, software selectable sector sizes and up to 10 Mbit/sec data rate capability are just a few of the AIC-100's features. Just as important, you get the full support and design assistance of the Adaptec team, experts in system, controller and LSI technology.

For more information about the AIC-100, and other Adaptec products please call Don Rector, vice president of marketing at (408) 946-8600. Or write Adaptec, 1625 McCarthy Boulevard, Milpitas, CA 95035.



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The best controller connection  
you can make ... or buy



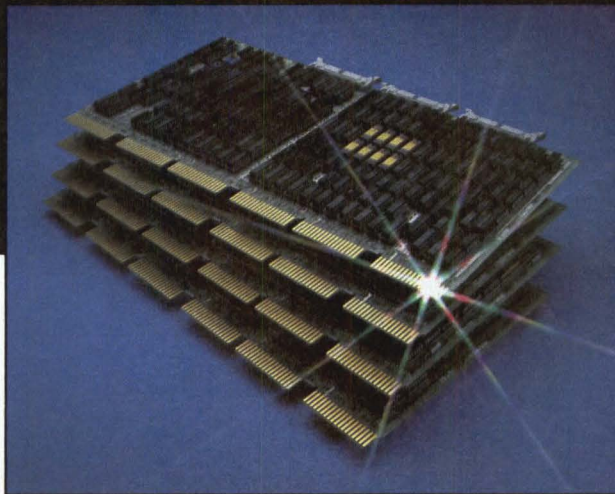
### 8-in. Winchester specifications

Company and model	Unformatted capacity (M bytes)	No. of disks/ no. of r/w heads	Bytes per track	Tracks per in./ bits per in.	Avg. positioning time (msec.)	Actuator type	Data-transfer rate (K bytes/sec.)	Interface type	OEM price (Qty. 100)	Comments
MV 26, 44, 62	26, 44, 62	2/3, 3/5, 4/7	13,545	478/7750	45	Rotary voice coil	812.5	SMD, ANSI	\$2390, \$2600, \$2820	SMD or ANSI I/O with PCB swap
MV 48, 83, 116	48, 83, 116	2/3, 3/5, 4/7	20,160	600/11,500	45	Rotary voice coil	1209	SMD, ANSI	\$2930, \$3190, \$3450	SMD or ANSI I/O
MV 212	212	4/7	20,160	960/11,500	45	Rotary voice coil	1209	SMD, ANSI		
Memorex										
101, 102	11.7, 23.4	1/2, 2/4	12,000	195/6100	70	Rotary stepper	1200	SA400	\$1450, \$1700	Manufactured by Fujitsu
213, 214	48.2, 84.4	3/4, 4/7	20,480	720/9550	20	Rotary voice coil	1229	SMD	\$3310, \$3430	
Micropolis										
1221, 1222, 1223	9, 26, 45	1/1, 2/3, 3/5	15,360	478/8623	42	Rotary voice coil	921		\$2048, \$2481, \$2896	Optional intelligent interface PCB
1202, 1203	26.8, 44.6	2/3, 3/5	15,364	478/8623	42	Rotary voice coil	921	ANSI	\$2192, \$2607	
1404, 1406	80, 160	3/5, 6/10	20,160	960/9287	26	Rotary voice coil	1209	SMD		
1403, 1405	100, 200	3/5, 6/10	20,800	960/11,380	28	Rotary voice coil	1248	ANSI		
Microscience International										
HH-612	12.8	1/2	8192	648/9680	85	Stepper	625	ST506	\$700***	Closed-loop servo
Mitsubishi										
M2860-2	50.72	4/7	13,440	480/7300	35	Linear voice coil	806	SMD		
M2860-3	85.37	4/7	20,160	546/10,900	30	Linear voice coil	1209	SMD		
NEC										
D-2220, 2230	25.5, 42.5	3/3, 3/5	20,480	480/8824	30	Rotary voice coil	1200	SMD	\$2375, \$2850	
D-2246	85	4/6	20,480	720/9040	25	Rotary voice coil	1200	SMD	\$3300	
Nippon Electric-Densei										
RD-8087, 8223	7.4, 22.3	1/1, 2/3	11,340	478/6424	45	Rotary voice coil	680	Proprietary		Not marketed in U.S.
RD-8731, 8520	37.1, 52	3/5, 4/7	11,340	478/6424	45	Rotary voice coil	680			Not marketed in U.S.
Priam										
3450	35.2	3/5	13,440	480/6670	42	Linear voice coil	800		\$2325	
7050, 804	70.49, 105.7	3/5	20,160	960/10,000	40	Linear voice coil	1209	SMD	\$3240	
Quantum										
Q2020, 2030, 2040	21, 32, 40	2/4, 3/6, 4/8	10,400	345/6600	60	Rotary torque	543	SA1000	\$2100, \$2450, \$2800	
Q2080	85.45	4/8			60	Rotary torque	543		\$2800	
Shugart Associates										
SA1002, SA1004	5.3, 10.6	1/2, 2/4	10,400	172/6270	70	Band stepper	543	SA1000	\$1140, \$1400	
SA1104, SA1106	20.3, 33.9	2/3, 3/5	10,400	500/600	35	Rotary voice coil	543	SA1000	\$1920, \$2300	Closed-loop servo
Texas Instruments										
WD 800-18, -43	18, 43	2/3, 4/7	9288	478/6500	40	Rotary voice coil	602	DS990		Sold only with TI 990 CPU
3M										
8431, 8432	10, 20	1/2, 2/4	17,920	219/8649	65	Rotary stepper	933.3	ANSI	\$1525, \$2735	
8533	60	2/4	17,920	693/8555	29	Rotary voice coil	933.3	ANSI	\$3380	
Toshiba										
MK80F-10, -20, -30	15, 23, 38	2/3, 2/3, 3/5	20,160	450/8824	40	Rotary voice coil	1210	SMD		Not marketed in the U.S.
MK182F, MK184F	83, 116	3/5, 4/7	20,160	900/9000	40	Rotary voice coil	1210	SMD		Not marketed in U.S.
Vermont Research										
8010	11	1/2	8192	500/6000	33	Linear voice coil	500	ANSI, SASI	\$2850	Removable 8-in. ANSI cartridge
8520	22	2/4	8192	500/6000	42	Linear voice coil	500	ANSI, SASI	\$3850	One fixed, one removable

\* Quantity 1000    \*\* Quantity 500    \*\*\* Quantity 2500



# Discover The OEM Array Processor.



**Designed for the OEM.** Finally — Mini-MAP! A powerful array processor board set designed for the system integrator. Mini-MAP — brought to you by CSPI, the array processor specialists with fourteen years of experience and over 500 worldwide MAP installations. A perfect fit for PDP-11 based systems. Four hex boards that plug into your PDP-11 backplane, consume only 125 watts of power and provide full 32-bit floating point precision.

**Shared Memory.** Mini-MAP interfaces directly to UNIBUS for simplified programming and unprecedented throughput. The PDP-11 and array processing unit share memory to eliminate host/array processor DMA transfers and to minimize overhead.

**Arithmetic Power.** The wide dynamic range and precision of 32-bit floating point arithmetic, along with 7 MFLOPS of number crunching power, offers cost/performance advantages for OEMs. For example, a 1024 point Real FFT is done in 4.2 milliseconds — that's Mini-MAP math.

**Software Support.** Mini-MAP supplies: a scientific subroutine library of 150 FORTRAN callable routines . . . an exclusive MCL/FORTRAN compiler and linker for combining subroutines into convenient host-callable modules . . . a relocatable assembler for creating applications subroutines . . . and a full set of user-friendly debugging tools and diagnostics.

**Modularity.** Mini-MAP is expandable. You can select additional memory boards beyond the basic 64 KByte data memory, for up to 16 MBytes. And we can supply a wired backplane for your PDP-11 or provide a self-contained development system in a DEC\*-compatible enclosure complete with power supply and UNIBUS cables.

**Get The Facts.** Find out why Mini-MAP is the most cost-effective number crunching solution for your next product development. Call or write for complete specifications or for applications assistance.

\*DEC, PDP-11 and UNIBUS are trademarks of Digital Equipment Corp.

## Mini-MAP™

- 32-bit floating point precision
- 4 PDP-11\* Hex boards
- Shared-memory UNIBUS\* interface
- 150 FORTRAN-callable arithmetic routines
- Compiler/Assembler/Linker/Debugger
- Up to 16 MBytes of memory
- 4.2 msec for a 1024 point Real FFT
- \$14,700. for basic configuration in OEM quantities of 50

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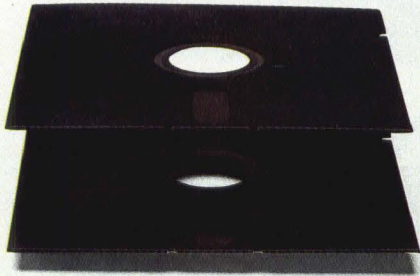
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# A "true" Winchester memory

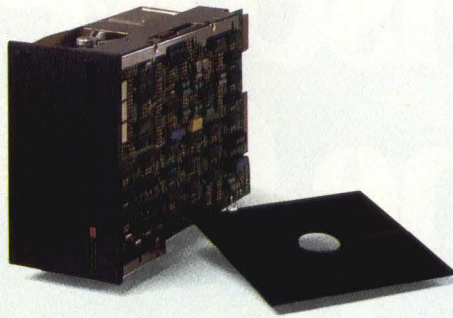
## Dual floppies are ok...

*but* microcomputers have already outgrown low-capacity, poor reliability, slow-access-time floppies. And what about tomorrow—as system software and data bases continue to expand? Will any floppy-based system be able to cope?



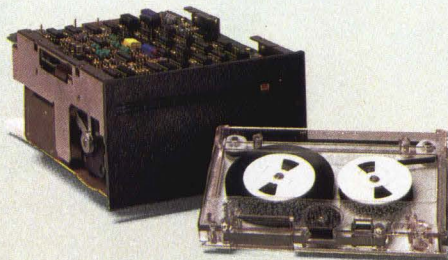
## Winchester with floppy is better...

*but* you haven't removed the limitations of floppies. In fact, they become even more of a time consuming burden, as stacks of floppies accumulate. System reliability and maintenance are compromised. It's really just a glorified floppy memory system.



## Winchester with tape... is as good as floppies...

*but* tape cartridges aren't really right—except for routine archiving. Non-random-access, poor reliability tape cartridge drives are notorious for high cost of ownership. Access time is extremely slow. The whole system is now reduced to the tape-drive level.



## The system solution is DMA Systems' all-in-one 5¼" Winchester with two "half-high" disks—one fixed, the other removable.

Here's a memory system that makes sense instead of problems. The Micro-Magnum™ fixed/removable disk drive has mass storage, data portability, and backup in one device.

The Micro-Magnum 5/5 is a highly reliable 5¼" fixed Winchester—backed by an equally reliable 5¼" industry-standard removable Winchester cartridge.

With 6.5 MBytes fixed and 6.5 MBytes removable, the Micro-Magnum drive holds 13.0 MBytes (5-and-5 MBytes, formatted). That's enough capacity to handle almost any application.

Equally important, the Micro-Magnum's access time is just 40 milliseconds.



# system with no buts about it.

## The right kind of removability and security.

If you're going to use a Winchester for primary memory, why back it up with anything else?

Unlike floppies, the Micro-Magnum's cartridge matches the fixed disk's capacity one for one. Unlike streaming tapes, the Micro-Magnum cartridge provides random access.

Unlike *both* floppies and tapes, the Micro-Magnum provides the same access time, the same data rates, the same zero maintenance schedule for both fixed and removable files.

And a full disk-to-disk backup takes less than 90 seconds.

## The right way to protect data.

The Micro-Magnum features a unique retractable head that never touches the disk. There's also a self-sealing clean air system that pre-

vents contaminants from reaching the data—even after thousands of cartridge insertions.

And the Micro-Magnum features an embedded servo for reliable cartridge interchange and positioning accuracy. Why wait until the old open loop systems are obsolete?

## Just the right size.

The Micro-Magnum is precisely matched to standard mini-floppy front panel dimensions. The space-saving fixed/removable concept uses only one of your front panels—unlike other combinations which use two. And its interface is designed so that existing 5¼" Winchester drive controllers can easily be adapted for use.

## The bottom line.

The bottom line is... "we are shipping!" Other 5¼" removable drive manufacturers promise delivery. Our class 100 manufacturing facility is producing. We're delivering.

The Micro-Magnum fixed/removable disk drive is a "true" Winchester memory system... without any ifs, ands, or buts.

For more information write DMA Systems, 601 Pine Avenue, Goleta, CA 93117. Or call us at (805) 683-3811, Telex 658341.

**DMA**  
**SYSTEMS**

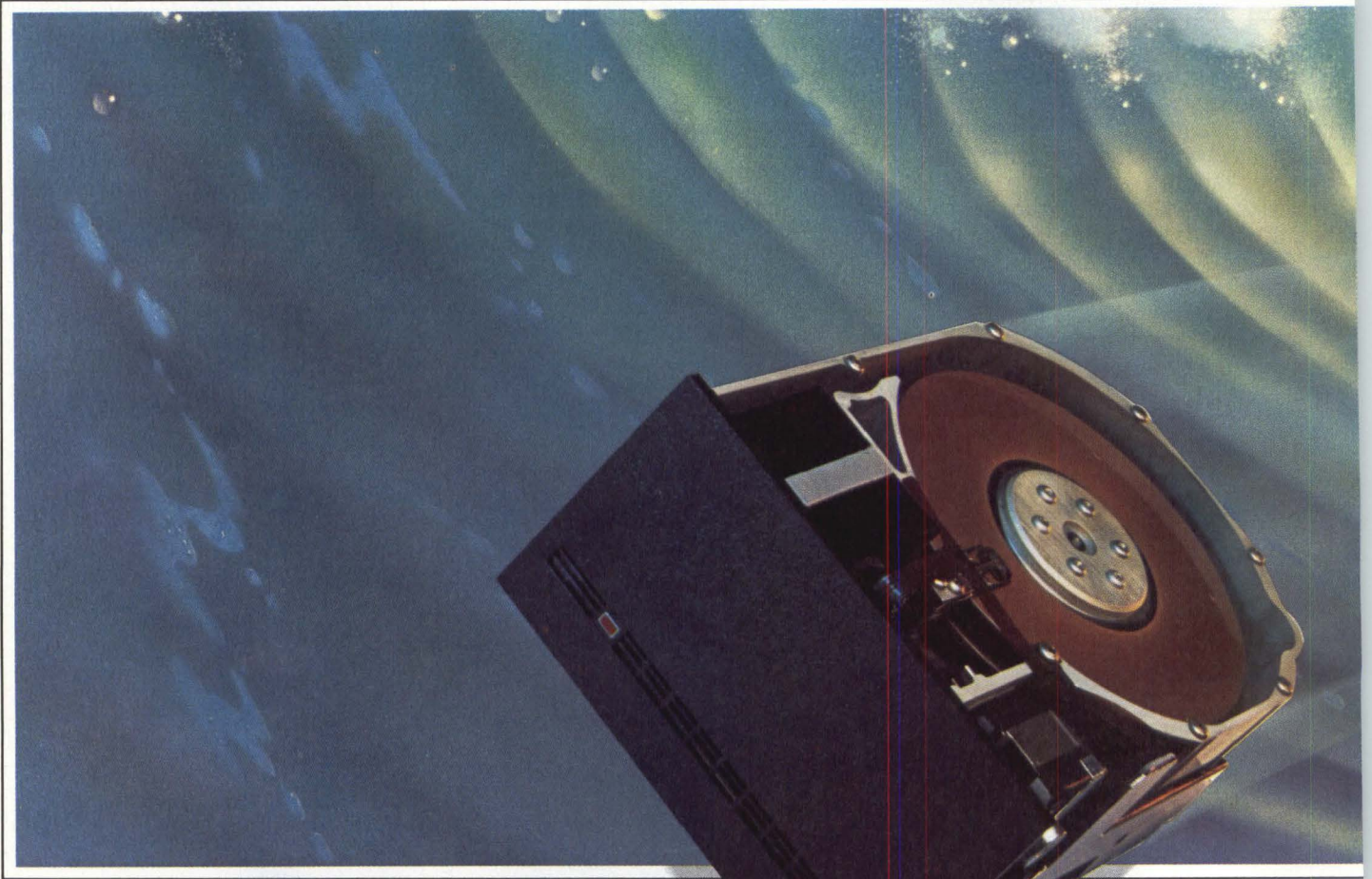
**Just what the industry needs.**



CIRCLE NO. 102 ON INQUIRY CARD



# The Seagat



**Seagate's ST400 Series is the most popular family of Winchester disc drives ever offered. And no wonder. These 5 1/4" Winchesters deliver more value for your money. More quality. More reliability. More performance. And all at a better price.**

The ST400 Series offers the right capacities. 6.38, 12.76 or 19.14 megabytes (unformatted). All use the same

industry-standard ST506 controller and matching mini-floppy form factor for easy upgrade.

**The right features.**

All use manganese-zinc heads, advanced stepper motor, metal band actuator, open loop head positioner, and patented air flow spindle pump. An onboard microcomputer provides buffered seek and fast step algorithm for an average seek of 85 milli-

seconds, including settling time.

**The right quality.**

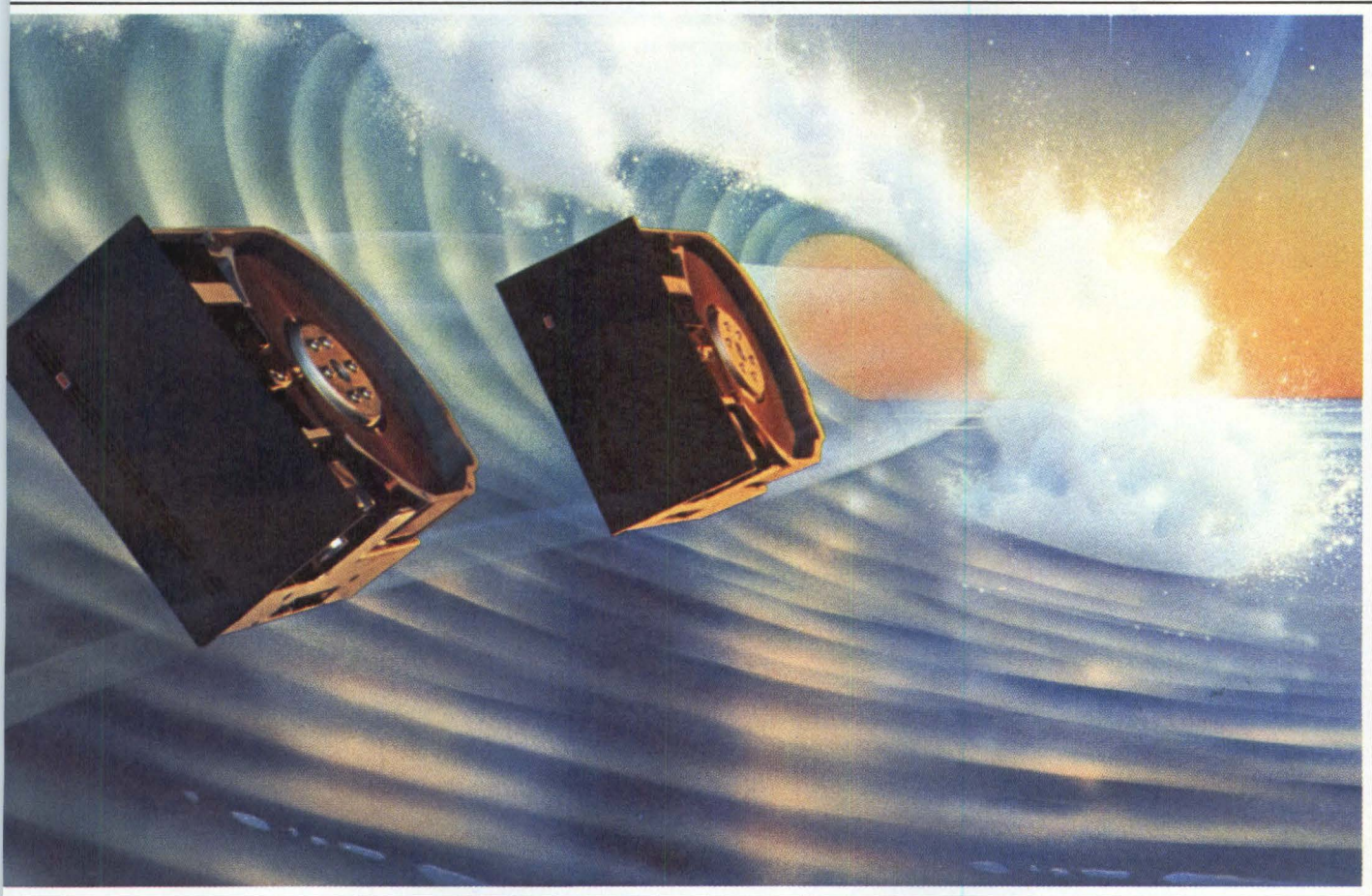
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**Formatted capacity (MB)**  
**Average access time (ms)**  
**Price\***

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5	10	15
85	85	85
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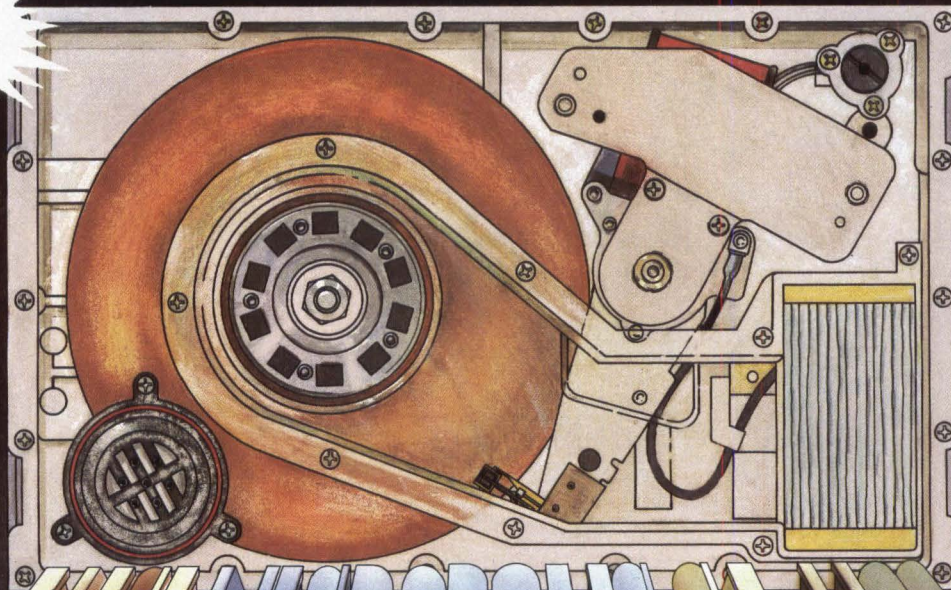
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	1220	1200ANSI	1200SA
Unformatted Capacity (Mbytes)	44.6	44.6	34.3
Average Access (ms, 1/3 stroke)	42	42	45
Data Transfer Rate*	7.375	7.375	4.333

\*Mbits per second.

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CIRCLE NO. 104 ON INQUIRY CARD



## DISK TECHNOLOGY

# Increasing disk densities with perpendicular recording

BENNETT DY, Century Data Systems, Inc.

*By aligning regions side-by-side, rather than end-to-end, storage densities can be increased more than 40 times*

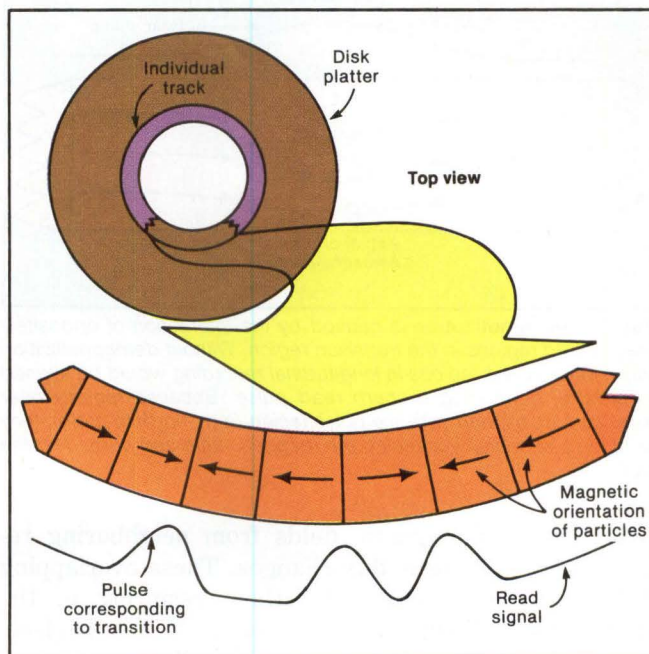
The growing demand for smaller disk drives with greater storage capacities has manufacturers looking for ways to increase disk recording density. Devices using longitudinal recording technology, in which magnetized regions line up end-to-end, are fast approaching practical density limits. A quantum jump in recording density may come from perpendicular recording techniques, in which regions line up in parallel, vertical to the disk. Perpendicular recording technology can potentially overcome some of the inherent limiting characteristics of magnetic recording, yielding dramatic increases in data storage at a competitive price.

### Longitudinal recording limits

Disks record data bits through flux changes, the change in a magnetic field associated with a reversal in the orientation of magnetized regions comprising a disk medium. The more flux change a disk can align along a given length of track, the higher the recording density.

During the past 30 years, linear recording density in available drives using longitudinal recording (Fig. 1) has increased from 100 flux changes per in. to more than 10,000 fepi. This progress has resulted from decreasing the distance over which a single flux change occurs. But two magnetic phenomena limit any further increase in longitudinal recording density: demagnetization and peak shift.

Demagnetization (Fig. 2) is the misalignment of



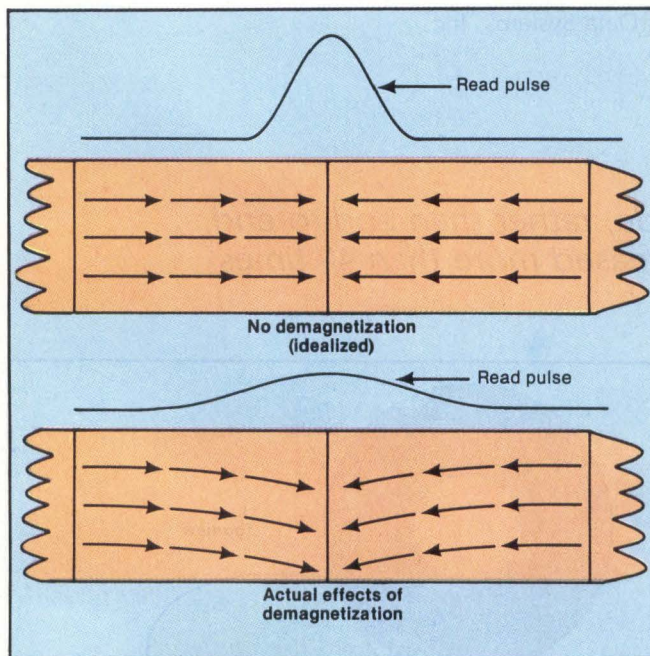
**Fig. 1. Longitudinal recording** stores information on the disk through flux changes, or reversals in the magnetic orientation of "bit cells" along the track. During read operation, the read head detects voltage pulses generated by passing over these flux changes. Magnetized regions are aligned parallel to the surface of the disk in longitudinal recording.

magnetized regions caused by the repulsion of like poles, as when two magnets lined up north pole-to-



north pole twist until they are aligned north-to-south. In magnetic recording, flux changes are recorded by reversing the orientation of magnetized regions. For longitudinal devices, this requires aligning regions near the point of transition with like poles facing. Demagnetization causes these regions to twist; no matter how sharp the transition made by the recording head, demagnetization causes the transition region to spread when the magnetizing field is removed. Using available processes and materials, demagnetization limits reading density to approximately 30,000 fcpi.

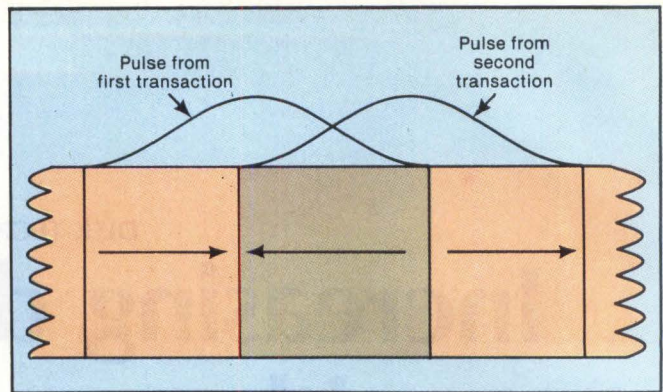
The second factor limiting linear recording density is peak shift (Fig. 3). Peak shift is caused by the



**Fig. 2. Demagnetization** is caused by the interaction of oppositely magnetized regions in the transition region. Without demagnetization (top), magnetized regions in longitudinal recording would be aligned in parallel, generating a sharp read pulse. Because regions near transition are aligned with like poles facing (e.g., north to north), they tend to twist away, weakening the magnetic field and spreading the pulse.

overlapping of magnetic fields from neighboring regions of regions near flux changes. These overlapping fields interfere with each other, resulting in the displacement of the transition points. If this displacement is greater than the size of a bit cell—the length of track in which 1 data bit is stored—the data become unreadable. Because demagnetization spreads transitions in longitudinal recording, peak-shift problems are significant. If peak shift were the only limiting factor, the best known magnetic medium would have a density limit of approximately 28,000 fcpi.

The 30,000-fcpi demagnetization and 28,000-fcpi peak-shift limits represent theoretical possibilities.



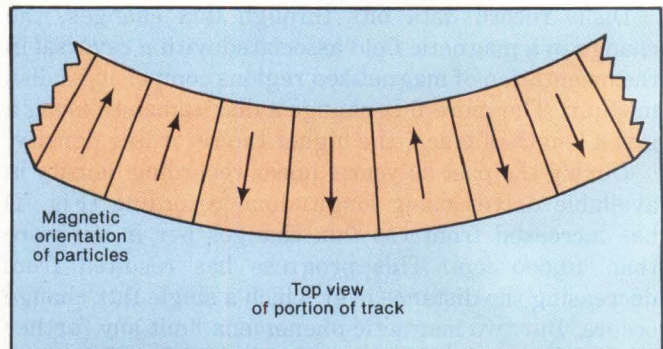
**Fig. 3. Peak shift** results from overlapping of pulses from neighboring flux changes. The overlapping pulses combine, displacing the apparent location of the transition. Peak shift is a problem in longitudinal recording as demagnetization creates wide pulses.

When other design constraints such as noise and temperature are considered, longitudinal recording will likely reach its practical limit at about 25,000 fcpi. This limit can be stretched by using better magnetic materials for the media in conjunction with thin-film heads, but such improvement will be minimal rather than a doubling or tripling of current densities.

### Perpendicular recording

In perpendicular recording (Fig. 4), the magnetized regions of the media are oriented perpendicularly to the disk, compared to the orientation of regions parallel to the disk in longitudinal recording. This perpendicular arrangement minimizes the effects of demagnetization and peak shift, allowing greater recording densities than those attainable with longitudinal techniques.

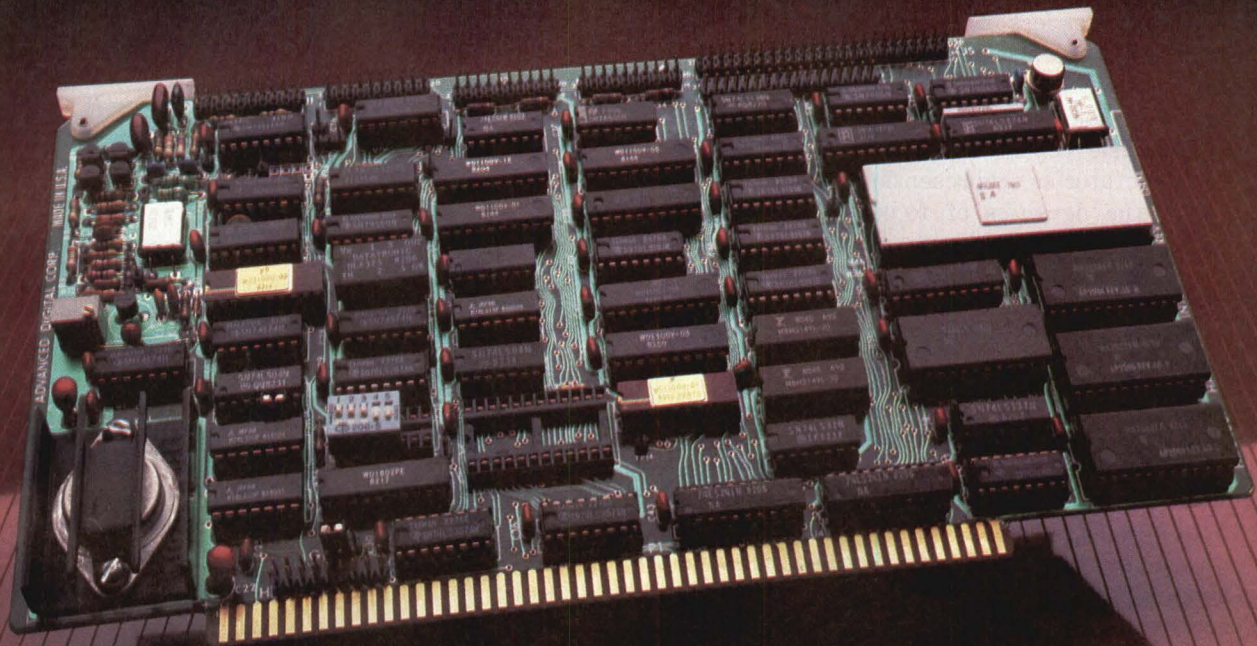
As with longitudinal recording, flux changes in perpendicular recording are recorded by reversing the orientation of magnetized regions. But while this reversal aligns particles end-to-end, with like poles facing each other in longitudinal recording, the regions near a transition in perpendicular recording media are aligned in parallel, without bringing like poles into proximity (Fig. 5). Thus, the regions near a transition do not tend to twist away from the appropriate orientations in perpendicular recording; this lack of demagnetization keeps transition distance nearly as short as that generated by the recording pulse from the head.



**Fig. 4. Perpendicular recording** stores information in the same way as longitudinal recording, except regions are aligned perpendicularly to the surface of the disk rather than parallel to the surface.



# Hard Disk is Easy to Control



## With Advanced Digital's Error Correcting Controller!

Advanced Digital has solved the problem of hard disk control with the HDC-1001, a unique, error-correcting, microprocessor-based hard disk controller board for S-100 based computers. Now, control of up to four 5¼" or four 8" Winchester drives is a snap.

Occupying only one slot in the S-100 chassis, the HDC-1001's unique error-correcting capabilities will detect and correct errors before you're even aware of them. In addition, you get up to 8-Bit single burst correction, multiple burst detection, programmable correction/detection span, and much, much more.

Look at these outstanding features:

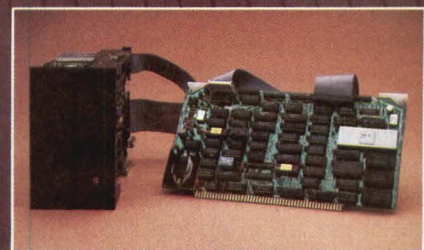
- Built-in data separator
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Because these transitions are sharp, there is less overlap between neighboring pulses, and thus less interference (Fig. 6). Without interference, there is little significant shifting of the transition point; that is, peak shift becomes less of a problem.

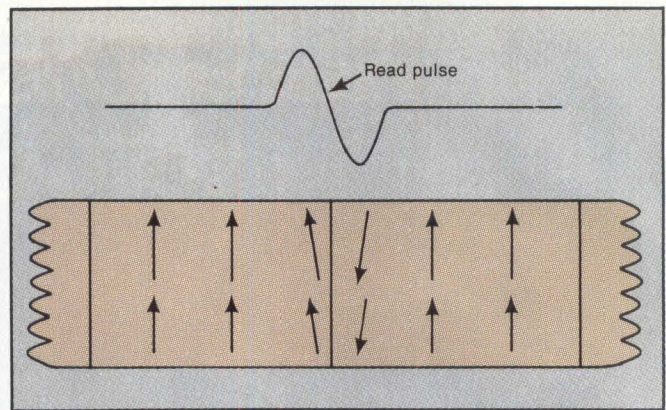
Dramatic increases in density have been obtained through perpendicular recording. Densities of 100,000 fpci are now reported commercially feasible, while 440,000 fpci has reportedly been achieved by some Japanese laboratories, representing an increase of 44 times over the densities of 10,000 fpci on available longitudinal recording devices.

### Cost and competition

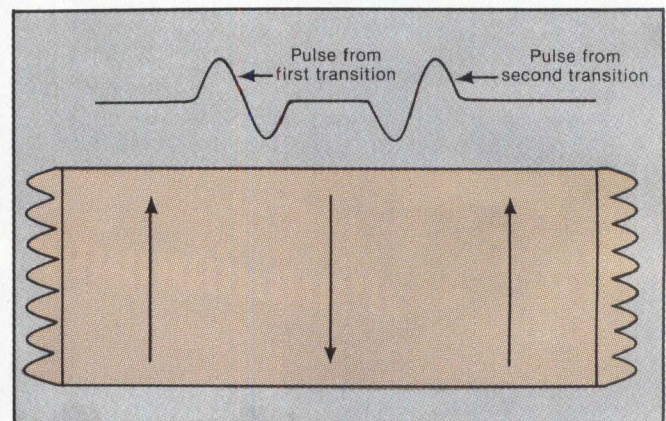
While cost per byte for perpendicular recording may eventually prove to be much less than with the longitudinal recording process, media costs may be greater. Some researchers believe that a specially designed head with a medium of perpendicularly oriented regions is required to take full advantage of the attributes of perpendicular recording; others believe that a regular thin-gapped ring head is sufficient to achieve higher density.

There are also two paths being followed with regard to disk media. Some believe that a single, 5- to 10- $\mu$ m layer of magnetic material is sufficient to obtain excellent results, while others believe that two-layer media are required: a top layer of perpendicularly oriented material for recording and a bottom layer for a magnetic sink, resulting in an approximately 30-percent increase in media cost. Eventual cost over performance factors for different combinations of heads and media in the market will settle these points. If the number of published papers is a measure of accomplishment in perpendicular-recording research, then Japanese corporations can be credited with most R&D in this field, with about eight Japanese companies involved. U.S. companies may not be that far behind though. One in San Jose, Calif., is reportedly prepared to market a 5 $\frac{1}{4}$ -in., rigid perpendicular disk this year, a Minneapolis company is reported to be exploring this technology for small floppy media, and a San Diego head manufacturer has achieved an experimental result of more than 100,000 fpci using perpendicular recording. The next five years will probably see a number of high-performance disk drives incorporating perpendicular recording in different forms.

One technology likely to compete with perpendicular recording is optical recording, with which densities of 25,000 markings per in. (comparable to fpci) have been recently achieved in a laboratory. This linear density is low compared to perpendicular recording, but the tracks per in. in optical recording is much higher—as much as 12,500 tpi has been reached, 10 times that of magnetic recording. When translated into areal densi-



**Fig. 5. Reduced demagnetization in perpendicular recording** is the result of regions aligning side-by-side rather than end-to-end. Regions near transition are not aligned with like poles facing as they are in longitudinal recording, and do not tend to move out of alignment. Read pulses in perpendicular recording are, therefore, sharper. Perpendicular recording pulse is shaped different from longitudinal pulse because of different orientations in magnetic fields.



**Fig. 6. Peak shift is less significant in perpendicular recording** because pulses are sharper, and do not overlap as they do in longitudinal recording.

ty, optical recording has reached 300 million bits per sq. in., comparable to perpendicular recording. Optical recording devices, however, can write only once on a given surface. This write-once-only characteristic may be a drawback for many applications, but for some it is an advantage. For archival and tight security files, for example, write-once media is preferred.

Recent research has discovered that with Terbium Dysprosium Ferrite noncrystalline film media, both write and erase functions are feasible. The media, however, is still far from record-stable in field environments. In contrast, perpendicular recording uses magnetic media that is well understood, erasable and field stable. Optical recording will give perpendicular recording stiff competition when researchers develop a stable erasable optical medium. Until then, perpendicular recording has significant advantages over optical, as well as longitudinal, technology. □

**Bennett Dy** is read-write technology manager at Century Data Systems, Inc., Anaheim, Calif. He was previously advanced technology manager at Burroughs Corp.



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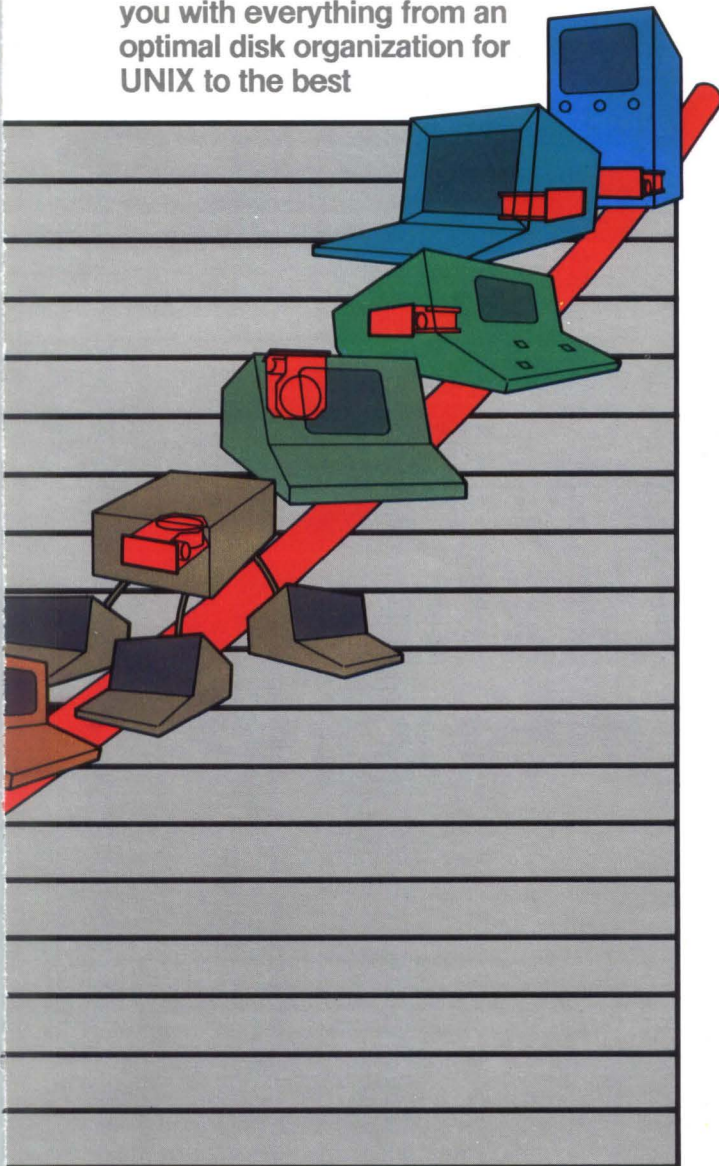
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# The U

**Head Landing Zones:** Our high storage density gives us extra space for head landing zones on every disk platter. Use the zones during power down or shipping to protect the integrity of your recorded data.

**Plated Media for Survivability:** Our thin-film media is three times harder than conventional ferric oxide. Perfect for withstanding the thousands of start/stops inherent in desktop applications.

**Comfortable in Harsh Environments:** A specially sealed shaft, pressure equalization port, and proprietary air filtration system eliminate the chance of contamination under the bubble. Evotek drives are remarkably adaptable to harsh environments like factories. Or offices.

**Smooth Drive Performance:** Military grade shock mounts protect your drive during shipping. They also mean you won't be embarrassed the first time someone pounds your keyboard a little too enthusiastically. Or sets your product on a tabletop a little too carelessly.

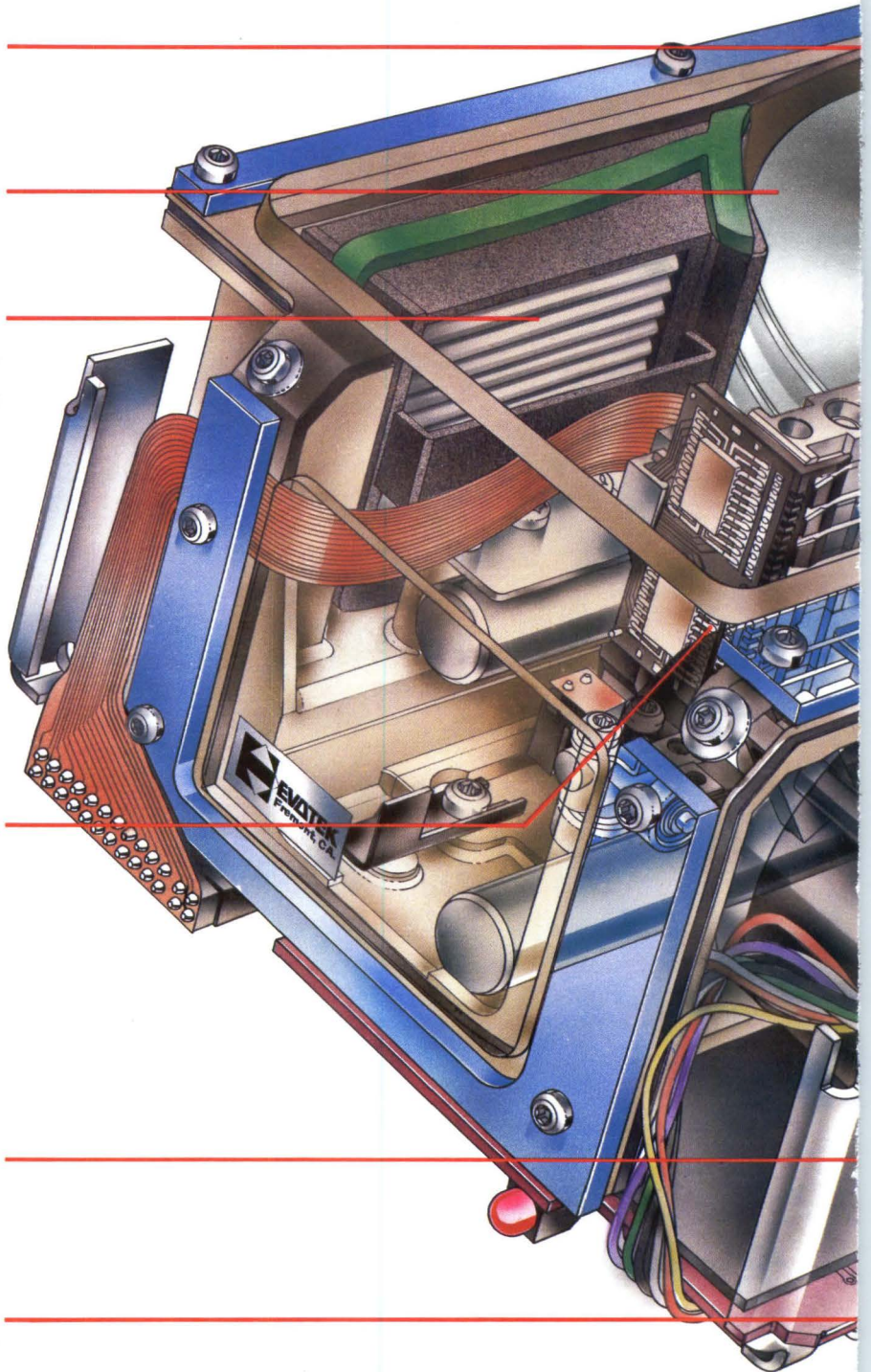
**Plug and Play:** Evotek drives conform to industry standards like ST506. They're compatible with a wide range of popular 5¼-inch controllers, including the one you're using now.

**Quick Access Time:** A linear actuator and microprocessor control give us an access time of 49 ms, including settling. That's twice as fast as many other Winchesters, and critical for swapping, data collection, and telecommunications applications.

**Extra Capacity:** Our wide bandwidth read/write channel lets you expand your storage capacity with a simple controller change. Switch from MFM encoding to the popular Run Length Limited (RLL) codes and increase capacity from 51.7 to 73.3 mbytes.

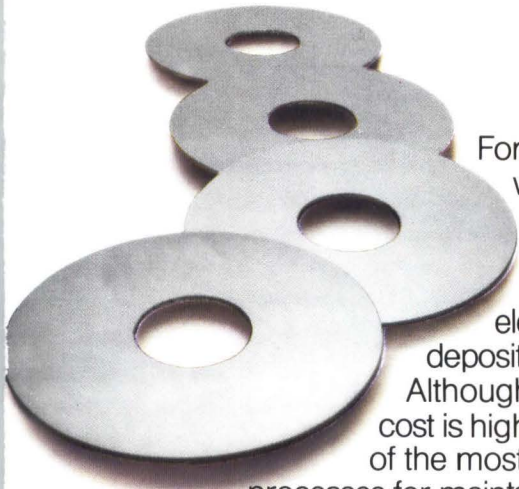
**Intelligence:** An on-board microprocessor controls head positioning and compensates for thermal expansion and contraction of the platters. In an office, a factory, or the field, no matter what the application, your system will take the heat. And the cold.

**Faster Data Transfer:** Two families of drives give you a choice of two transfer rates. Choose the standard 5.0 mbit/second rate, or our faster, IBM-compatible 8.2 mbit/second rate (ideal for graphics and local area network applications).





# The



For example, we're one of the few lines to use electrolytic deposition.

Although its initial cost is high, it's one of the most accurate processes for maintaining film thicknesses in the 750 Angstrom range.

Automated disk handling equipment will be standard throughout the industry in six to 12 months. We're using it today to cut contamination losses and improve yields by 60%.

And we're the only 5¼-inch plated media maker using track by track testing instead of the faster, but less accurate, "fly by" method.

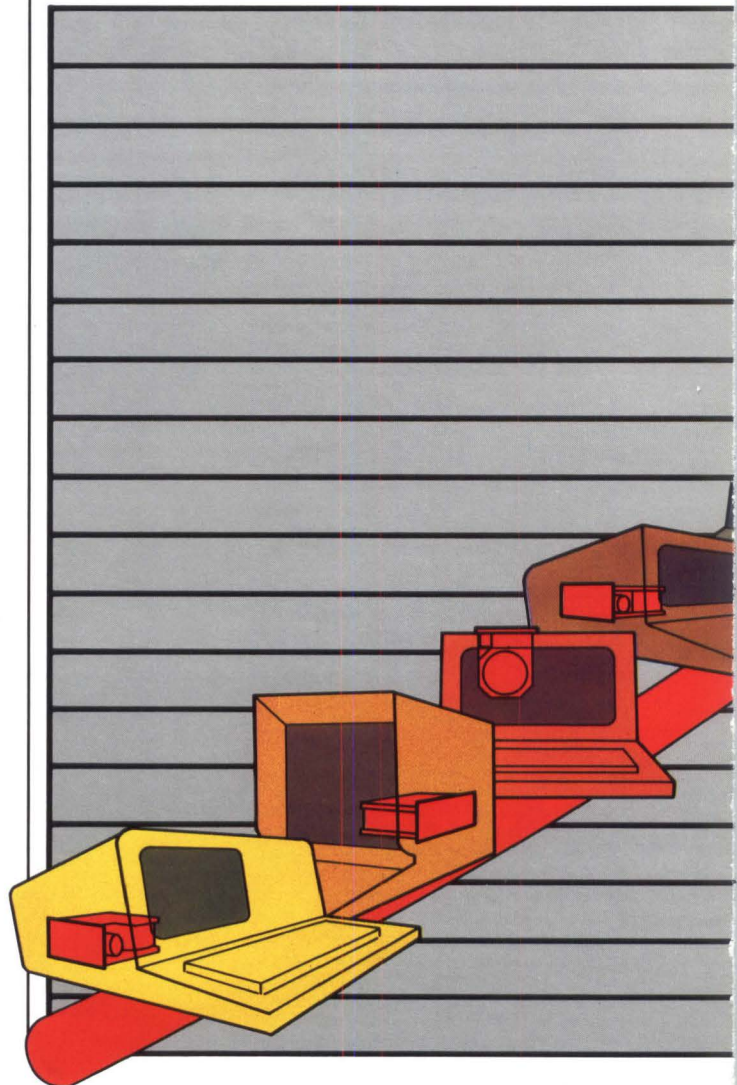
Our quality and consistency earned us an invitation to second source a leading 14-inch thin-film media supplier. And, after careful evaluation, we accepted them as our second source. Which assures you of a continued supply of media and drives.

There are easier ways to build our product. But none which are as consistently reliable. And reliability over time is our goal. Because our business relationship may begin with a promise, but it endures through performance.

**The reward for choosing Evotek? Time and money.**

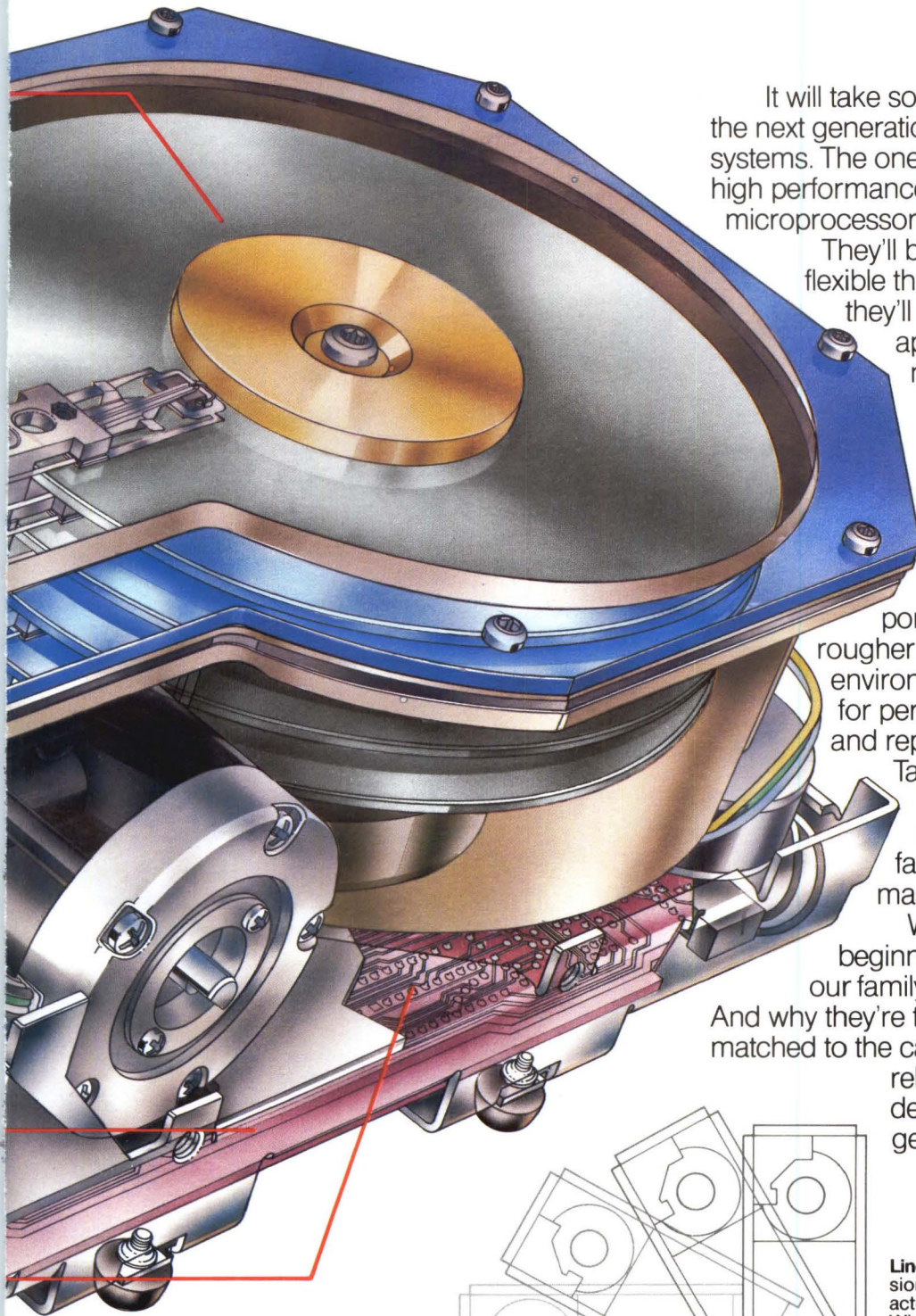
Evotek drives, along with high performance 16-bit and 32-bit micro-processors, are opening up opportunities for supermini performance in desktop packages. And they're finding their way into powerful, personal graphics workstations, and compact, yet sophisticated, medical equipment.

History has proven that the first





# Upside.



It will take something special to build the next generation of microcomputer systems. The ones that will revolve around high performance 16-bit and 32-bit microprocessors.

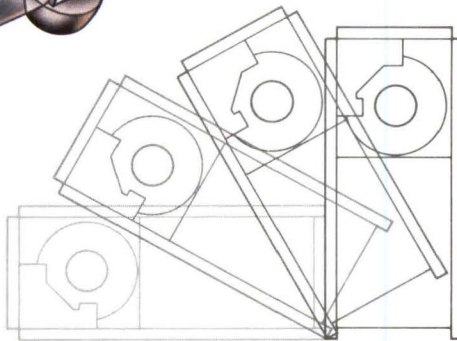
They'll be more powerful and flexible than today's systems. So they'll be pressed into new applications, not used to make today's applications go faster.

They'll improve throughput by a factor of four. So they'll be hungrier for data, and less prone to wait for it.

They'll be more portable. So they'll face rougher handling and harsher environments, without the time for periodic maintenance and repair.

Taking advantage of this market requires a new set of tools. Including smaller, faster, more rugged mass storage.

Which, from the very beginning, is how we designed our family of 5¼-inch Winchesters. And why they're the only drives uniquely matched to the capacity, performance, reliability, and availability demands of the next generation of applications.



**Linear Actuator for Flexibility:** Our precision designed, six-bearing linear actuator is borrowed from 14-inch Winchester technology. It's driven by a five-phase microcontrolled stepper motor, and the combination lets you mount Evotek drives at any angle. Our design fits your design.



# The Risk.

A pre-production drive is a promise. That every production unit you receive will work in exactly the same way as the drive you first evaluated.

Now anyone can

make a prototype. Or a promise. But to deserve your business, a company ought to be willing to commit hard resources to take the risk out of your relationship.

Which is why we've invested \$12 million in a production facility where 70% of our drive assembly (including Class 100 clean room operations) is performed through robotics. It's money well spent.

Robotics, for example, allows us to use a single torque screw to anchor disk platters to the spindle. That eliminates a minor alignment problem in 10 mbyte disks which becomes catastrophic in high performance 50 mbyte applications.

But robotics is only a start.

To maintain quality over time, we borrowed a well-known principle of electronics—feedback.

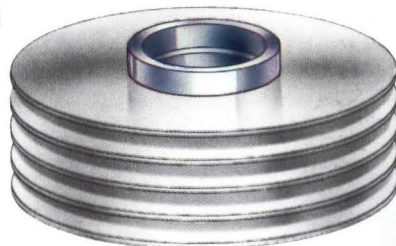
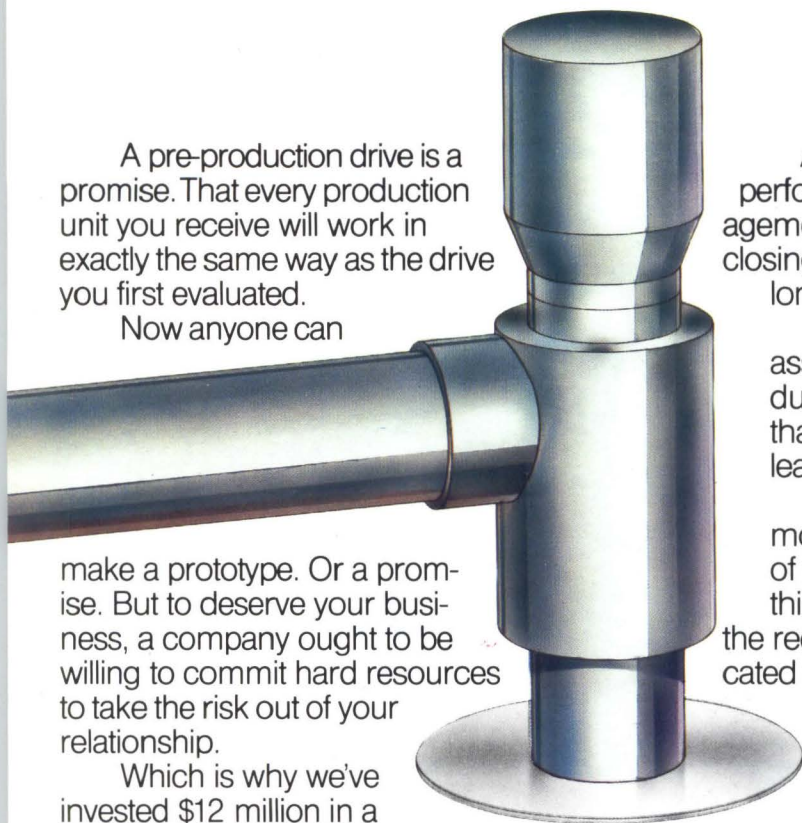
At full capacity, our facility builds hundreds of thousands of drives a year. Yet each drive is completely assembled by a single person. And then tested on the spot.

Assemblers get a measure of their performance with every drive. And management can fine tune the operation faster, closing the loop of problems today, not long after they've been forgotten.

But more importantly, our approach assures you of a consistency of production across the board. Consistency that's the hallmark of manufacturing leaders around the world.

Nowhere is that consistency more critical than in the manufacture of thin-film (plated) media. Because the thinner and purer the media, the higher the recording density. And the less complicated the read/write electronics.

So we operate the largest 5¼-inch plated media line anywhere. Besides giving us absolute control over quality, our in-house facility lets us take advantage of the latest manufacturing techniques sooner.





## DISK DRIVES

# Wringing higher performance from 5¼-in. Winchester

FRANK C. GIBEAU and STANLEY F. BROWN, Atasi Corp.

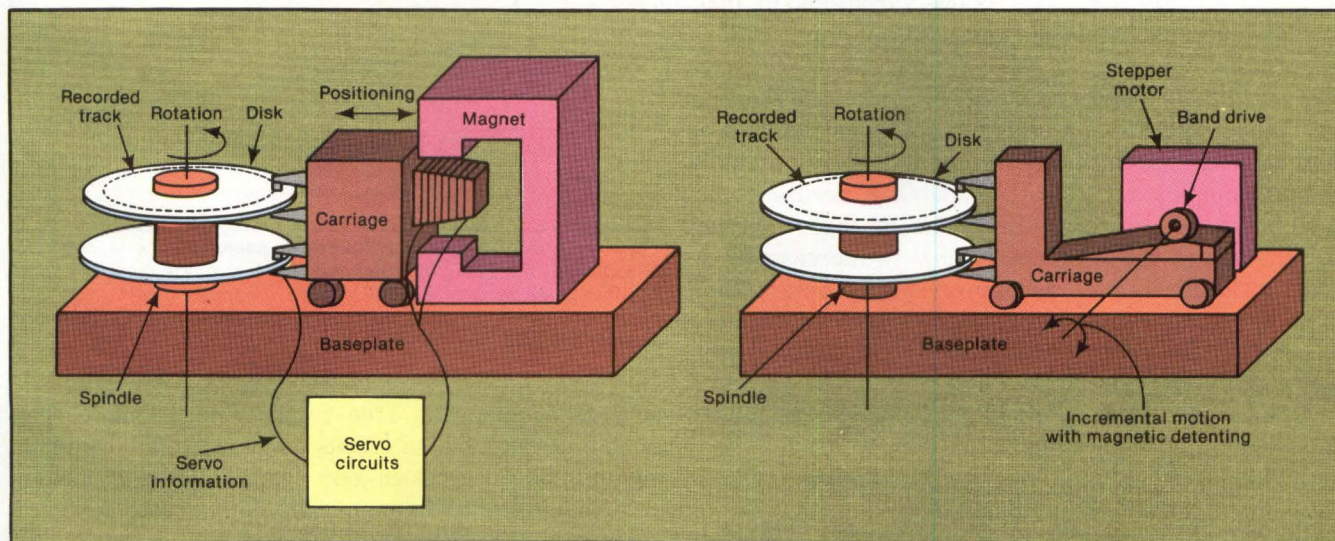
*Closed-loop servo-positioning system improves drive capacity and access time*

Existing mechanical positioning-system designs and the desire among suppliers to maintain compatibility with the ST506 interface place inherent limitations on the capacity and access times of 5¼-in. Winchester fixed-disk drives. These limitations place an apparent ceiling on technological improvement and the effectiveness of such products in supporting evolving computer systems. By replacing the traditional open-loop stepper-motor positioning system with a closed-loop servo-positioning system, normally found only in larger disk drives, manufacturers are producing 5¼-in. drives with greater capacity and lower access times. Suppliers can also achieve additional capacity by abandoning the ST506 interface and incorporating bit-density related technologies to increase capacity. These improvements

will enable 5¼-in. drive manufacturers to supply products allowing multi-user, multitasking applications and to expand into territory presently staked out by 8-in. disk drives.

### Old technologies reach their limits

Current 5¼-in. disk drive products combine rigid disks like those in 8- and 14-in. drives with the stepper-motor technology used in today's floppy disk positioning systems. The use of open-loop stepper technology allowed the development of a low-cost random-access device that provided a sixfold increase in capacity over current floppy disk drives. It also was one of the few positioning systems that could be designed into the small 5¼-in. package.



**Fig. 1. Closed-loop servo and open-loop stepper techniques center read/write heads over a track in different ways.** A closed-loop servo system uses servo information from the disk to modify current in a voice-coil-driven carriage. An open-loop stepper system uses a motor-driven band drive to move the carriage in discrete steps. Because a closed-loop servo can continuously vary head position, it can compensate for tracking variations from thermal distortion and vibration.

◀ **CIRCLE NO. 106 ON INQUIRY CARD**

MINI-MICRO SYSTEMS/February 1983



These first-generation rigid disk drives meet many users' needs, but the open-loop positioning system and the ST506 interface, which permits only 10.4K bytes per track, create serious limitations. There are only three ways to increase the capacity of these units while maintaining the ST506 interface: to add disk surfaces, which makes it difficult to maintain the standard 5¼-in. disk drive size and provide reliability; to use more disk surface by increasing the actuator stroke, which is limited by the usable magnetic surface of the disk; or to record more data tracks per inch.

Unfortunately, the stepper-motor positioning mechanism, as a classical open-loop servo system, has inherent positioning inaccuracies that restrict the number of tracks per inch that can be reliably recorded. These systems do not provide feedback information on position errors and consequently cannot correct for static or dynamic dimension variations that occur within the disk drive.

*The stepper-motor positioning mechanism has inherent positioning inaccuracies that restrict the number of tracks per inch that can be reliably recorded.*

Major causes of positioning problems include thermal distortions in the units that occur between initial power on and maximum operating temperature, thermal distortions caused by variations in ambient temperature, thermal deflection resulting from internally generated heat or externally applied heat, the inability of the open-loop servo to follow variations in disk rotation, carriage bearing tolerances and long settling time.

Despite these limitations, various open-loop stepper designs with both rotary and linear actuators have been implemented. Each design is an attempt to solve a unique, complex set of cost, availability, accuracy and manufacturing problems. But none of these stepper designs solves the problem of how to increase track density significantly to get more capacity on a 5¼-in. disk drive. Open-loop stepper-motor positioning systems using the popular four-phase incremental motor can achieve only about 3000 tracks in a four-disk unit, and are thus limited to about 30M bytes in an ST506 interface-compatible drive.

**Closed-loop servo positioning**

Reliably achieving more than 4000 tracks in a 5¼-in. drive with four disks requires the use of a closed-loop servo-positioning system. High-performance drives employing a linear or rotary voice-coil actuator can

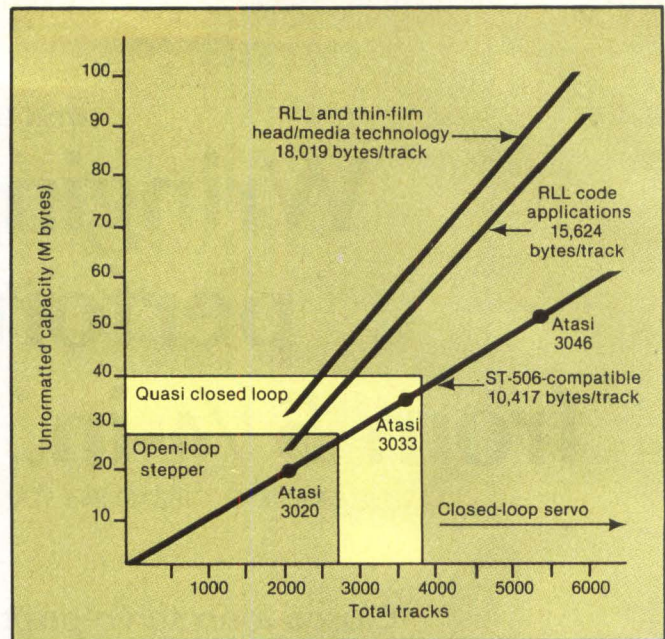


Fig. 2. Capacity versus number of tracks for different head-positioning and recording schemes shows the limited capacities of open-loop stepper and quasi-closed-loop techniques. Run-length-limited coding, especially when combined with thin-film technology, provides a higher capacity to number of tracks ratio than ST506-compatible coding.

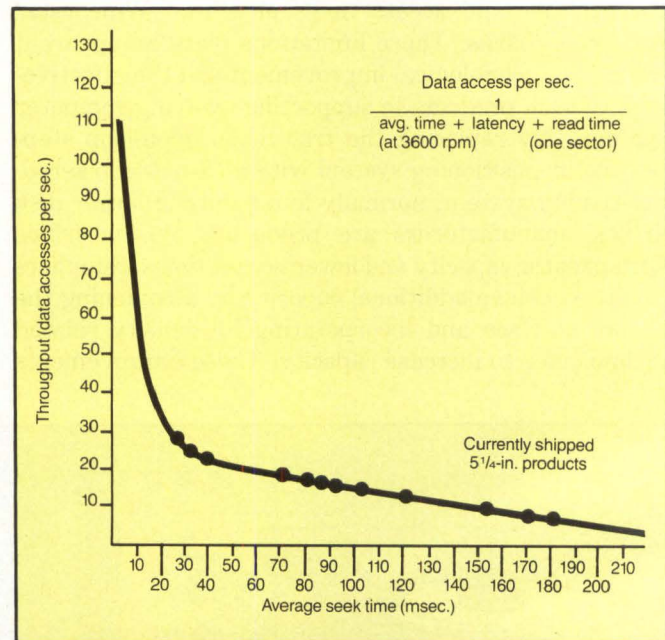


Fig. 3. Throughput versus average seek time is a nonlinear relationship with throughput defined as the average number of data accesses per second. The relationship changes most rapidly with seek times of less than 70 msec., the lower limit of most open-loop stepper systems.

achieve as many as 1100 tracks per in., more than double the number of tracks available in an open-loop system. Because closed-loop systems provide position feedback, they can dynamically compensate for environmental variations (Fig. 1).

The implementation of closed-loop servo systems makes it possible to build 5¼-in. disk drives with capacities equivalent to current stepper-motor models,



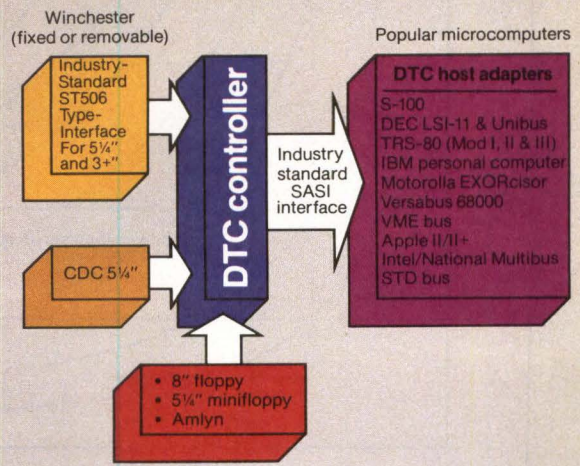


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 East Coast (617) 275-4044



## DISK DRIVES

but with fewer disks. For example, a 5¼-in. disk drive employing an open-loop stepper-motor positioning system might achieve a capacity of about 20M bytes by incorporating three disks. A closed-loop servo system could achieve the same capacity with only two disks. A third disk would boost the closed-loop drive capacity to more than 30M bytes.

*High-performance drives employing a linear or rotary voice-coil actuator can achieve as many as 1100 tracks per in., more than double the number of tracks available in an open-loop system.*

Capacity can be increased further by abandoning the ST506 interface and employing such technologies as run-length-limited coding and thin-film head/disks (Fig. 2).

Increasing the capacity of 5¼-in. drives satisfies only

half the challenge. Users who demand high capacity in smaller drives typically demand short access times as well. A major benefit of the closed-loop servo voice-coil positioning system is its inherently faster seek time. In a 5¼-in. drive with a 30M-byte capacity, it is possible to reduce the industry-standard 75- to 80-msec. average access time to about 30 msec.

### Closed loop speeds access

Equally important to data capacity is data availability, which is a direct function of throughput measured at the disk drive interface (Fig. 3). Closed-loop positioning technology provides micro-Winchesters with the access speeds necessary for high-performance systems.

Drive throughput can be measured in terms of the average number of random head arm accesses per second, derived by taking the reciprocal of the sum of average positioning time, average latency time and read time. Average seek times greater than 70 msec. provide the 4½- to 12-data-access-per-sec. throughput achieved by open-loop stepper positioning systems. Closed-loop servo systems permit average seek times of 30 msec. or less, providing throughput of 26 data accesses per sec. or more.

Because capacity and throughput are generally considered to be equally important in most applications, a reasonable definition of performance could be based

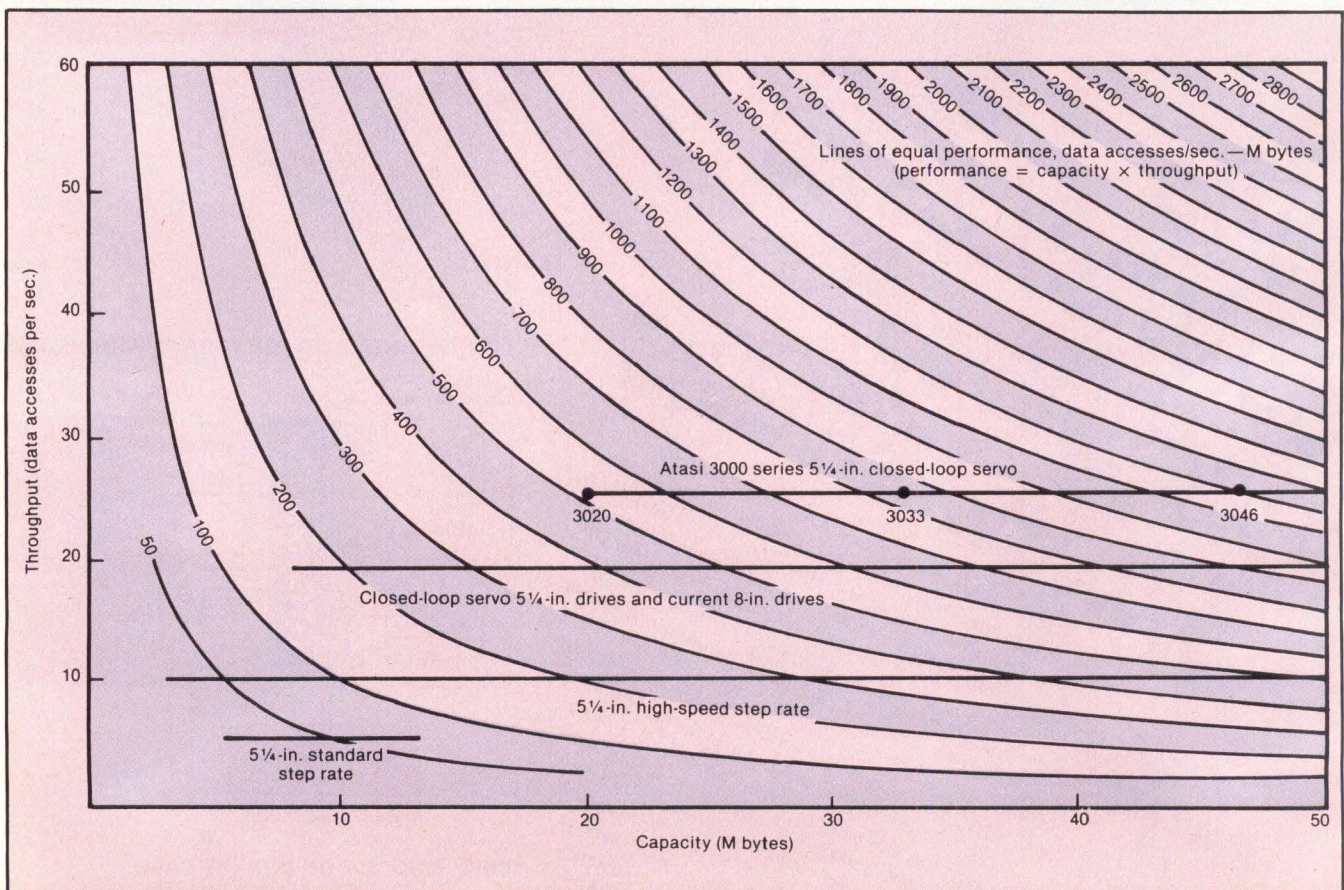


Fig. 4. Throughput versus capacity for small Winchesters shows higher throughput of closed-loop servo devices. Curves represent lines of equal performance, with performance defined as the product of throughput and capacity.



# Check The Chart Before You Choose Your New 16-Bit Computer System.

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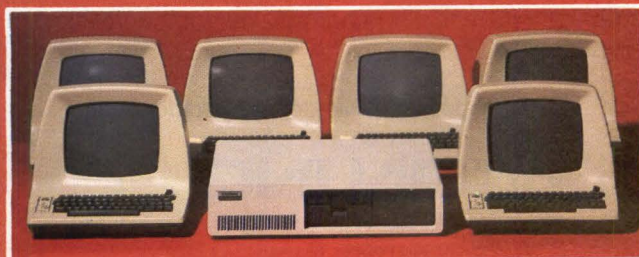
Our standard 16-Bit 8088 hardware configuration provides 128K RAM with parity, two RS-232 serial ports, Centronics parallel printer port, interrupt and DMA controllers, dual floppy disks with 640K storage, Winchester disk and keyboard interfaces, and eight IBM-PC compatible expansion slots . . . and lists for only \$2995. Winchester hard disk configurations, featuring cache buffer controllers for enhanced disk access performance are also available, starting at \$4995.

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MAIN FEATURES	CDP-MPC	IBM-PC*	OTHERS
Microprocessor	16-Bit 8088 8-Bit Z-80 (Opt)	16-Bit 8088	?
USER Memory	128K-1 Mbytes	16K-256 Kbytes	?
IBM-PC Compatible Expansions Slots Beyond Professional Configuration <sup>1</sup>	8 Slots	0	?
Resident Floppy Disk Storage	Dual 320K (std)	Dual 160K (Opt) Dual 320K (Opt)	?
Resident Cache Buffer Hard Disk Storage	5M/10M	—	?
<b>OPTIONAL OPERATING SYSTEMS (Supported by Company)<sup>2</sup></b>			
MS-DOS (PC-DOS)	Yes	Yes	?
CP/M 86	Yes	Yes	?
MP/M 86	Yes	—	?
OASIS-16	Yes	—	?
XENIX	Soon	—	?
<b>OPTIONAL HARDWARE EXPANSION BOARD (Supported by Company)</b>			
RS-232 Communications	Yes	Yes	?
B/W and Color Display Controller	Yes	Yes	?
Expansion Memory	Yes	Yes	?
Z-80 CP/M-80 Board	Yes	—	?
Cache Buffer Hard Disk	Yes	—	?
Time/Calendar Board	Yes	—	?
IEEE Bus Controller	Yes	—	?
8" Floppy Disk System	Yes	—	?
8" Hard Disk System	Up to 40 Mbytes	—	?
Tape Cartridge System	Yes	—	?

<sup>1</sup>For comparison purposes, typical professional configurations consist of 16-Bit 8088 Processor, 128K RAM with Parity, Dual 320K 5-inch Floppies, DMA and Interrupt Controller, Dual RS-232 Serial Ports, Centronics Parallel Port and Dumb Computer Terminal or Equivalent.

<sup>2</sup>Columbia Data Products also supports CP/M 80\* with an optionally available Z-80 CP/M Expansion Board.

\*As advertised in BYTE Magazine, August 1982.

## COLUMBIA

### DATA PRODUCTS, INC.

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## DISK DRIVES

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on the combination of the two. Performance is no longer a function of storage capacity alone. It is the product of capacity times throughput (Fig. 4).

### Higher performance wins new markets

The performance required from a disk drive in a small system depends on the application and the category into which it falls. Disk drives in single-user, single-task applications are generally used for data

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*In a 5¼-in. drive with a 30M-byte capacity, it is possible to reduce the industry-standard 75- to 80-msec. average access time to about 30 msec.*

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storage. Capacities can be relatively small, and access times can be relatively slow because the drive need perform for only one user. Disk drives based on open-loop stepper-motor positioning systems are more than adequate in such applications, which typically require capacities of less than 20M bytes and access times of 75 to 80 msec.

Multi-user, multitasking systems, on the other hand, are used in applications in which many users require access to a common database. Capacities, therefore, must be high, and, because many users must have access to that data, access times must be short. Disk drives with capacities of less than 30M bytes and access times greater than 40 msec. are unsuitable for such file-server applications. For example, a typical single-user workstation such as a stand-alone word processor requires about 3½ to 5 random data accesses per sec. A stepper-motor Winchester drive with positioning times from 70 to 150 msec. can readily satisfy this requirement for one or two workstations, which would require a maximum of 7 to 10 random data accesses per sec. For three workstations, however, the practicality of such disk drives becomes marginal, and for four stations, system performance is seriously degraded.

Consequently, as manufacturers of 5¼-in. disk drives produce high-performance drives in such small packages, they will begin to encroach on 8-in. drive territory. This incursion will become even more pronounced as 5¼-in. suppliers abandon the use of standard interfaces and explore other technologies designed to increase disk drive performance. □

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**Frank C. Gibeau** and **Stanley F. Brown** are president and vice president, respectively, of Atasi Corp., San Jose, Calif.

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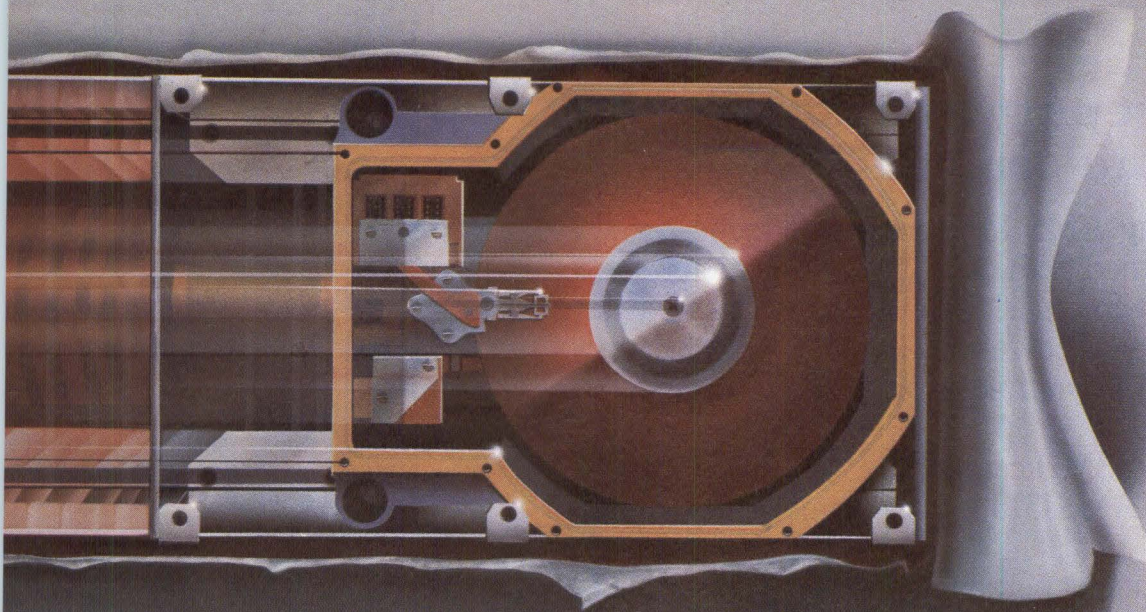
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Size	Model	Capacity (MB)	Access Time
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	7050	70	42 ms
	804	105	42 ms
5¼"	502	50	35 ms

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## It isn't just plug-compatible, it's software-compatible.

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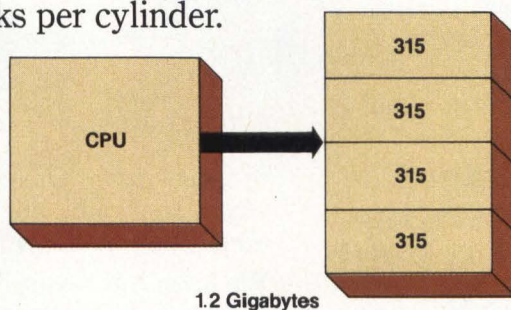
Plus you get more than twice the reliability and eliminate preventive maintenance so the on-going cost of ownership is less, too.

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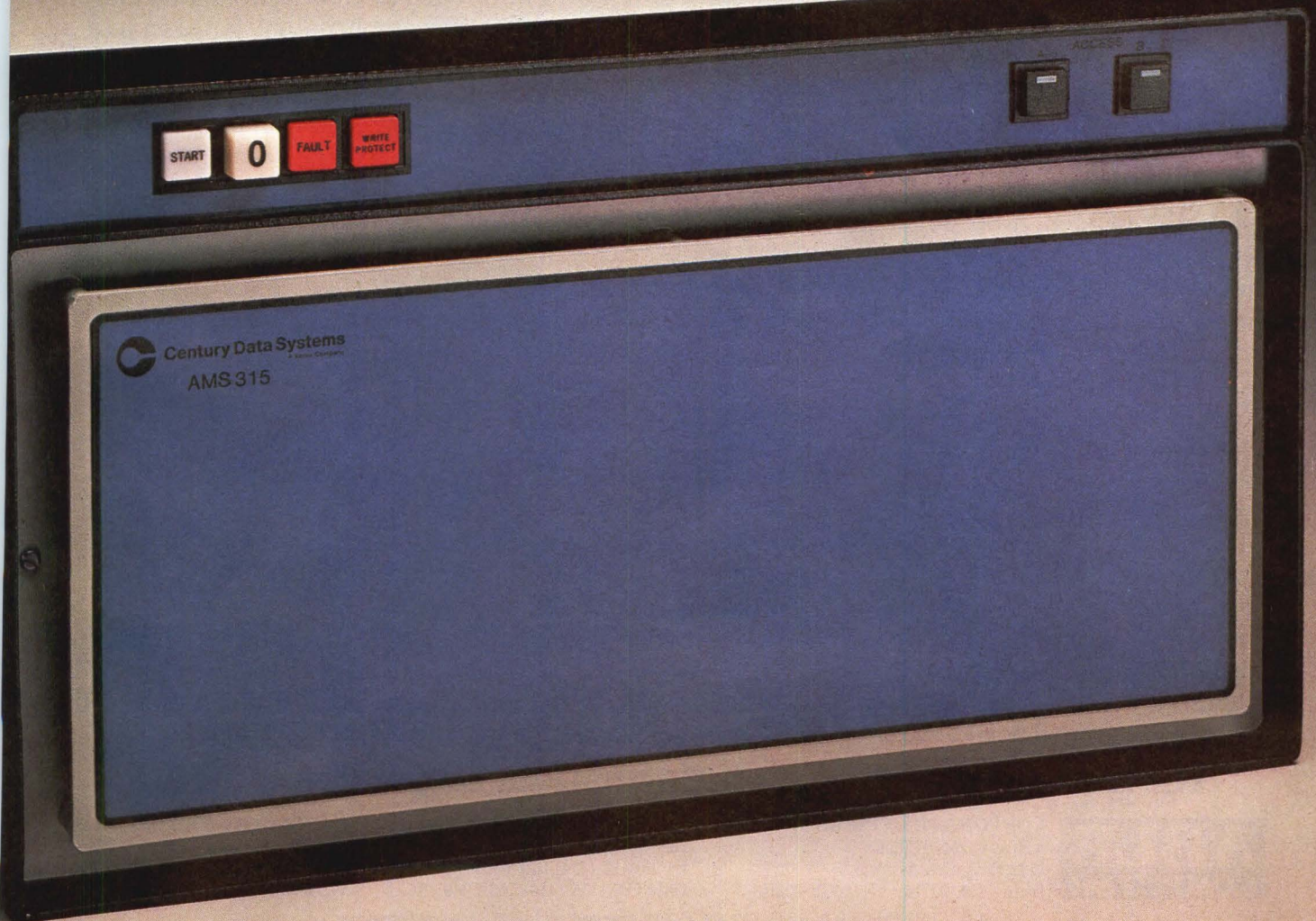
*Stack four AMS 315s for 1.2 gigabytes of Winchester storage in about the same space as your 300-MB removable pack drive.*

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Finally, a Winchester that goes head-to-head, track-to-track, cylinder-to-cylinder, byte-to-byte with 300-MB removable pack drives.

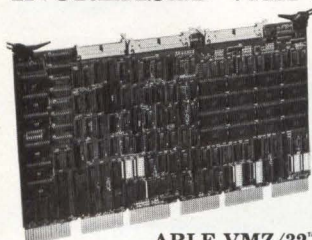




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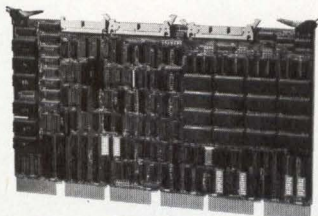
Here's an asynchronous microcontroller with programmable DMA, fully transparent to VAX/VMS as two 8-line DMF 32's and contained on a single board. Priced

below the DZ11-E, it outperforms DZ or DH devices under VMS v.3, has interrupt-driven modem control on every line, and includes an output throttle which lets peripheral devices optimize their own data rate.

## #1 UNIBUS DMA.

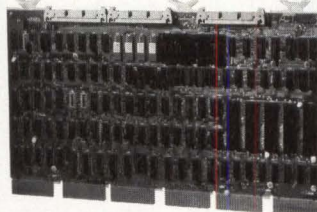
Then there's our DH/DM, the original multiplexer which puts 16 lines with modem control on a single board. This popular device meets UNIX VAX system

needs for DMA communications requirements, serves UNIBUS systems equally well, and beats them all for MTBF, throughput and



ABLE DH/DM™  
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& DM11 replacement

price. Other features include on-board diagnostics, modem control on all lines, superior on-board silo depth and variable prom-set. **SYNC/ASYNCH FLEXIBILITY.**



ABLE DV/16™  
16-line DV11 replacement

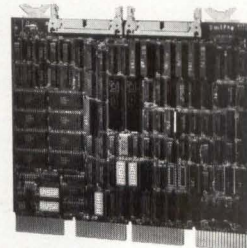
A controller for the PDP-11 user, the DV/16 contributes microprocessor-derived flexibility, which permits mixing of sync and async lines in combinations of 4 or 8 lines with modem control and full system software compatibility. It takes less than half the space of a DV11 and uses word transfer instead of byte DMA to gain a 2 to 1 speed advantage or permit operation in half the bandwidth required for data transfers.

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## DISK DRIVES

# Less can be more with half-height disk drives

GERALD H. KILTZ, Shugart Corp.

*New floppies and Winchesters boast better specs in addition to slimmer profiles*

Half-height 5¼-in. floppy and rigid disk drives allow designers to place two standard-capacity drives in the space of one drive. While reduced size is a major feature of these drives, the height-saving design changes required to reduce a standard-height drive by half can result in other benefits. Shugart Corp.'s SA455/465 half-height minifloppy drives and SA706/712 half-height 5¼-in. Winchester drives incorporate designs that provide greater head positioning accuracy and cooler operation with fewer components.

### Greater positioning accuracy

The SA706/712 and SA455/465 achieve higher head positioning accuracy than earlier models. In the SA706/712 series, higher accuracy is a result of improved stepper and spindle motors and a streamlined head actuator carriage; in the SA455/465 series, it results from use of a better clamping mechanism, as well as refined motor designs.

The stepper motor used in the SA706/712 is a 16-pole, rather than an eight-pole, design. The increased number of poles allows the rotor to step at a 0.9-degree-per-track angle, half the 1.8-degree step angle in earlier motors, providing more torque to the read/write head. This greater torque results in less hysteresis, or magnetic lag, in the motor, and thus less of a difference between the intended and actual positioning of the read/write heads. The greater positioning accuracy allows an increase in track density from 256 to 360 tpi, doubling capacities over Shugart's first generation of 5¼-in. rigid disk drives.

A new "mini-slider" head also helps the SA706/712 handle increased bit density. These heads have a ferrite core more than 50 percent smaller than earlier Winchester heads (Fig. 1). In combination with a highly



Shugart's new half-height drives include the SA455/465 minifloppies (left) and the SA706/712 series of rigids (right). The SA455 and 465 offer 0.5M and 1M byte, respectively, while the SA706 and 712 offer 6M and 13M bytes. Both series feature improved positioning accuracy and greater reliability over earlier models. The two drives can be combined with Shugart's SA1620 intelligent controller for as much as 7M bytes of on-line storage and backup, in a standard minifloppy-sized package.

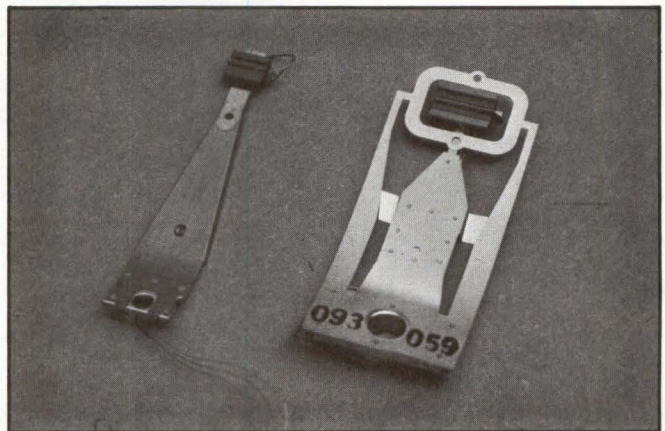


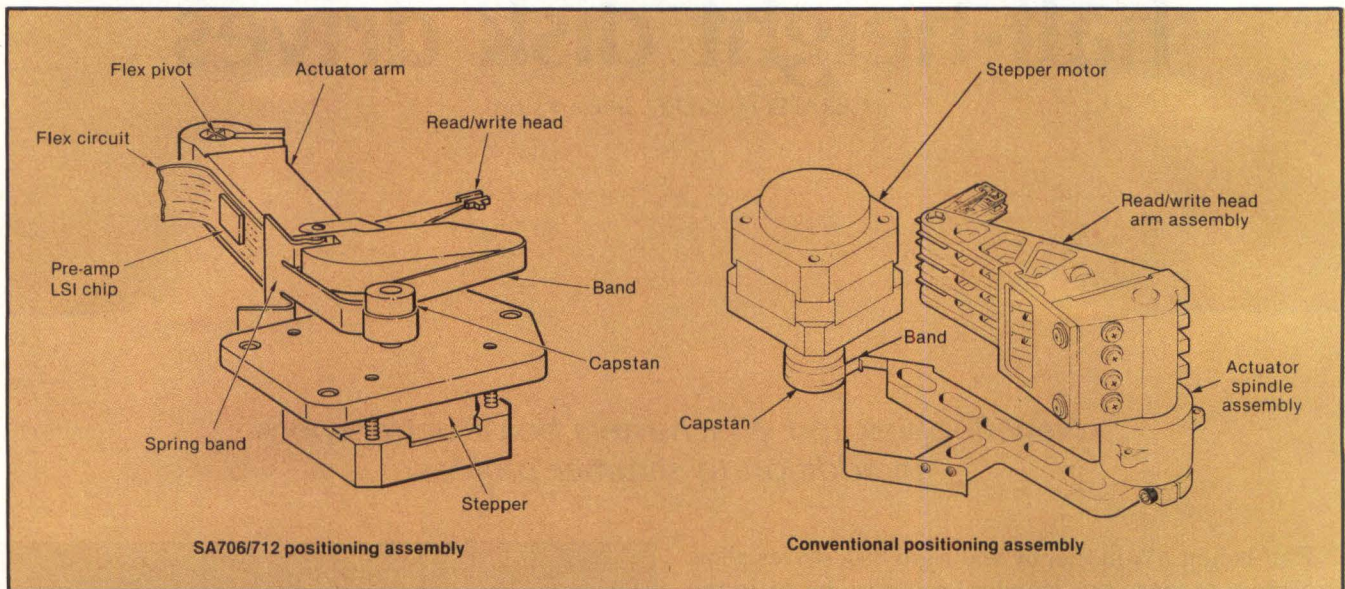
Fig. 1. Mini-slider heads (left) have a core that is about 50 percent smaller than those in previous Winchester heads (right). The flexure provides greater stability than earlier models, allowing heads to fly closer to the disk for better tracking and higher densities.



## DISK DRIVES

stable, stainless-steel flexure design, the mini-slider head flies closer to the disk than previous read/write

heads and is therefore less likely to read the signal from a neighboring track. Mini-slider heads have enabled Shugart to increase the bit density from 7900 flux changes per in. in the full-height SA600 series to 9036 fepi in the SA706/712 series. In addition, a smaller landing/shipping zone is required with the mini-slider



**Fig. 2. Comparison of SA706/712 and conventional positioning assemblies** shows how step pulses are more directly transmitted in the SA706/712 design. In conventional designs, pulses are sent from the motor through a secondary arm and actuator spindle. In the SA706/712, pulses are transmitted from the band directly to the head actuator carriage by mounting the capstan over the motor.

## DESIGNING FOR THE ASSEMBLY LINE

The SA455/465 minifloppies and SA706/712 5¼-in. Winchester drives are designed to be built on progres-

sive assembly lines, in which work moves in one direction, without returning to the same station. In

nonprogressive, or "unbalanced" lines, parts and sub-assemblies are returned to a materials handler after each assembly step is completed. The materials handler then must send the parts along the line to the next workstation. Nonprogressive systems are generally slower and require more handling of the work. In addition, progressive lines can more easily be adapted to automation.

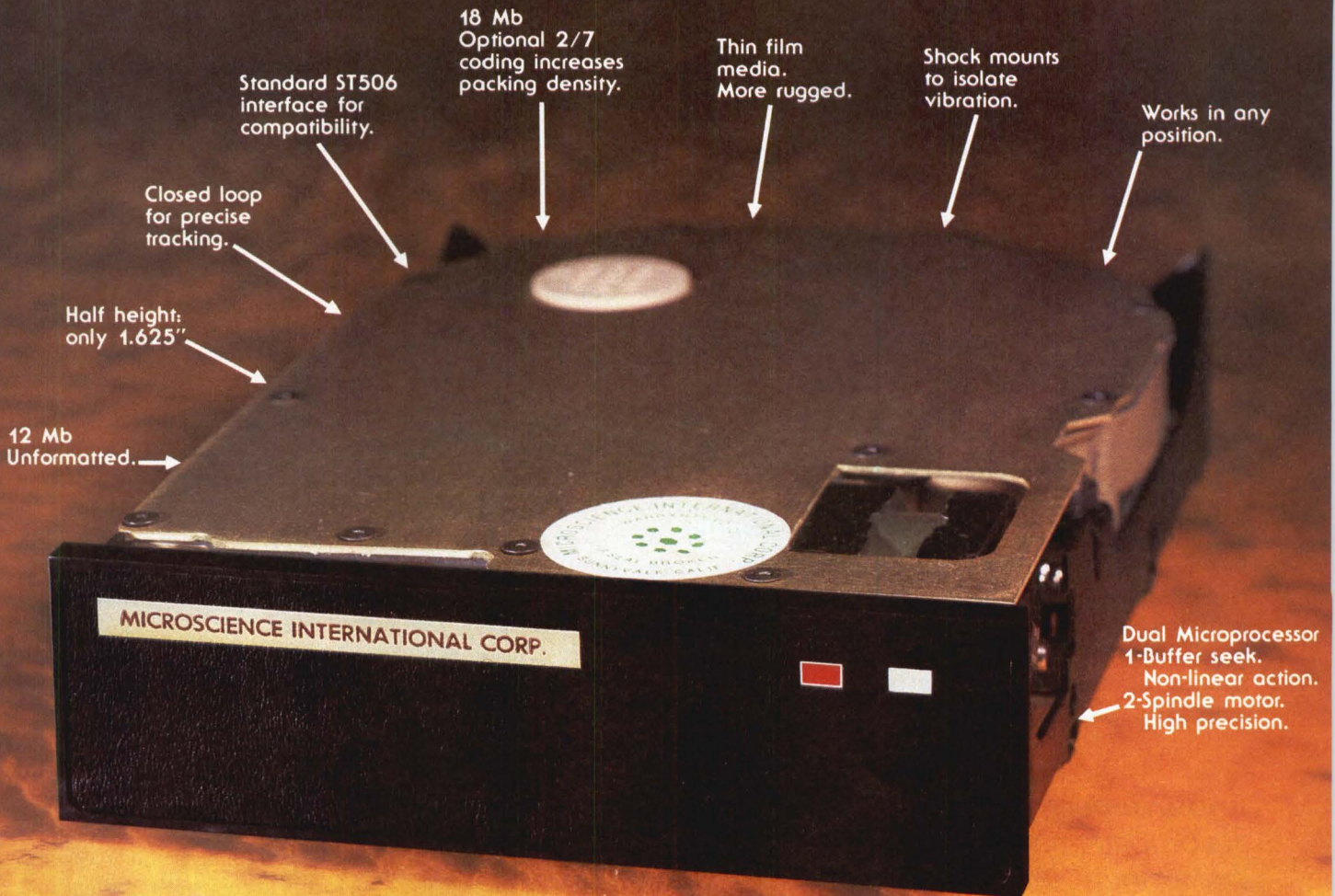
The SA455/465 series has a block-built design: the plane of the casting is turned only once during assembly, rather than the six or seven times required with earlier minifloppies. After the DC spindle motor is installed, other components can be added without shifting the casting, further speeding the manufacturing process. The SA706/712 series are built in Class 100 clean tunnels in conjunction with progressive assembly lines. When combined with a highly automated system for moving parts, each tunnel can build 100,000 drives per year.



**Class 100 clean tunnel assembly line** produces Shugart 5¼-in. rigid disk drives. Automated conveyor system provides single-direction movement of the drive from unassembled components to final testing. Each tunnel can produce 100,000 drives per year.



# Microscience International Introduces 5¼" HALF-HEIGHT WINCHESTER



## The most cost-effective disk drive on the market

Your computer's memory capacity has just about doubled with Microscience's innovative half-height disk drive—the Model HH-612. Using half the space of conventional 5¼" Winchester drives, the HH-612 allows you to mount two drives with up to 25 Mb into the same area that held a 6.4 Mb unit.

Equally important are the HH-612's advanced features shown above. While only 1.625" high, this compact drive, using a rugged, thin-film media, can provide 10 Mb of formatted ST506-compatible storage, or alternate unformatted packing densities of 12 Mb and, with 2/7

MINI-MICRO SYSTEMS/February 1983

coding, 18Mb.

On the mechanical side, the HH-612 is shock mounted to reduce vibration; on the electronics side, dual microprocessors make it unique in the disk drive field. Superb tracking comes from a close loop positioning system, and rapid access time is achieved with a highly-innovative non-linear buffer seek program.

The second microprocessor maintains precise spindle motor velocity to exacting tolerances. The result is a compact, cost effective drive that will give high reliability at a lower cost per drive.

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If you need more detailed information about how the HH-612 can fit into your computer, write or call us. Evaluation units are available to qualified OEM's.

 **Microscience  
International  
Corporation**

575 E. Middlefield Road  
Mountain View, CA 94043  
(408) 737-9158 Telex 176224

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Patent Pending

Most of the HH-612 special features, not found in other drives, are included in the base price.

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## DISK DRIVES

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heads, allowing 40 additional data tracks on each surface.

New HAC assembly and spindle motor designs also contribute to higher positioning accuracy. Step pulses are transmitted directly from the capstan, positioned above the motor, to the HAC. In previous models, the capstan was under the motor; step pulses were

---

*The SA706/712 rigid disk drive series retains the data safety and reliability features of earlier units.*

---

transmitted to an arm beneath the HAC, then to the actuator spindle and finally to the HAC (Fig. 2). A four-pole, three-phase spindle motor supplies a more consistent level of torque to the spindle, reducing the potential for speed variation and eliminating the possibility of a zero-null position, in which no torque is applied, when the drive is started.

---

*Improvements in component design accompany significant reductions in component sizes.*

---

In the SA455/465 series, the dynamic clamping mechanism brings the collet that holds the media against the drive straight down on the spindle. Previous designs brought the collet down at an angle, sometimes causing the diskette to wobble slightly while spinning, providing the potential for positioning errors. Single-piece spindle and spindle motor construction increases positioning accuracy through reduced tolerances, while elimination of the belt, pulley and bearings reduces "run-out," an elliptical rather than a circular spindle rotation. The reduced internal friction of the new stepper motor in the SA455/465 also reduces average access time from the 150 to 275 msec. in current minifloppies to 94 msec.

These improvements in component design accompany significant reductions in component sizes. In the SA455/465, the brushless, direct-drive DC motor is more than 60 percent smaller than previous motors, while the spindle motor in the SA706/712 series is more than 50 percent smaller than those used in earlier 5¼-in.

drives. The stepper motor in the SA706/712 series is 60 percent smaller than those used in the first generation of 5¼-in. rigid disk drives, and the HAC is streamlined as well.

---

*In the SA706/712 series, higher accuracy is the result of improved stepper and spindle motors and a streamlined head actuator carriage.*

---

### Cooler operation

The SA455/465 and SA706/712 drives dissipate less heat than their larger predecessors, although they have the same power requirements. The SA465 dissipates 12.5W when operating and 3.6W in standby, about half the amount of other drives. The SA706/712 spindle motor dissipates one-third less heat because it has less air to turn than in larger drives.

The SA706/712 rigid disk drive series retains the data safety and reliability features of earlier units, including built-in four-point shock mounts, automatic spindle and actuator locks and a dedicated head-landing/shipping zone. These features are especially important in half-height drives because they are likely to be used in desk-top and portable systems that are moved frequently.

Use of custom LSI circuitry reduces the number of board components as well as the size of the board used in both series. Read/write operations are controlled by an LSI chip, and in the SA706/712, a second LSI chip mounted on the HAC performs signal preamplification, buffering data as it is read and reducing the signal-to-noise ratio.

Surface-mounted device electrical components and IC chips in the SA706/712 series also reduce board size. The SMDs are about 50 percent smaller than earlier components and chips and are soldered without leads to the top of the board, rather than the underside, creating additional space. In the SA455/465, Himec packages reduce board size by performing functions previously requiring several chips.

Finally, the band actuator used in the SA455/465 series is held under spring tension to compensate for contraction of the band during manufacturing and shipping operations. The tension also has a damping effect on the band, resulting in quieter operation, an important consideration for drives used in office systems. □

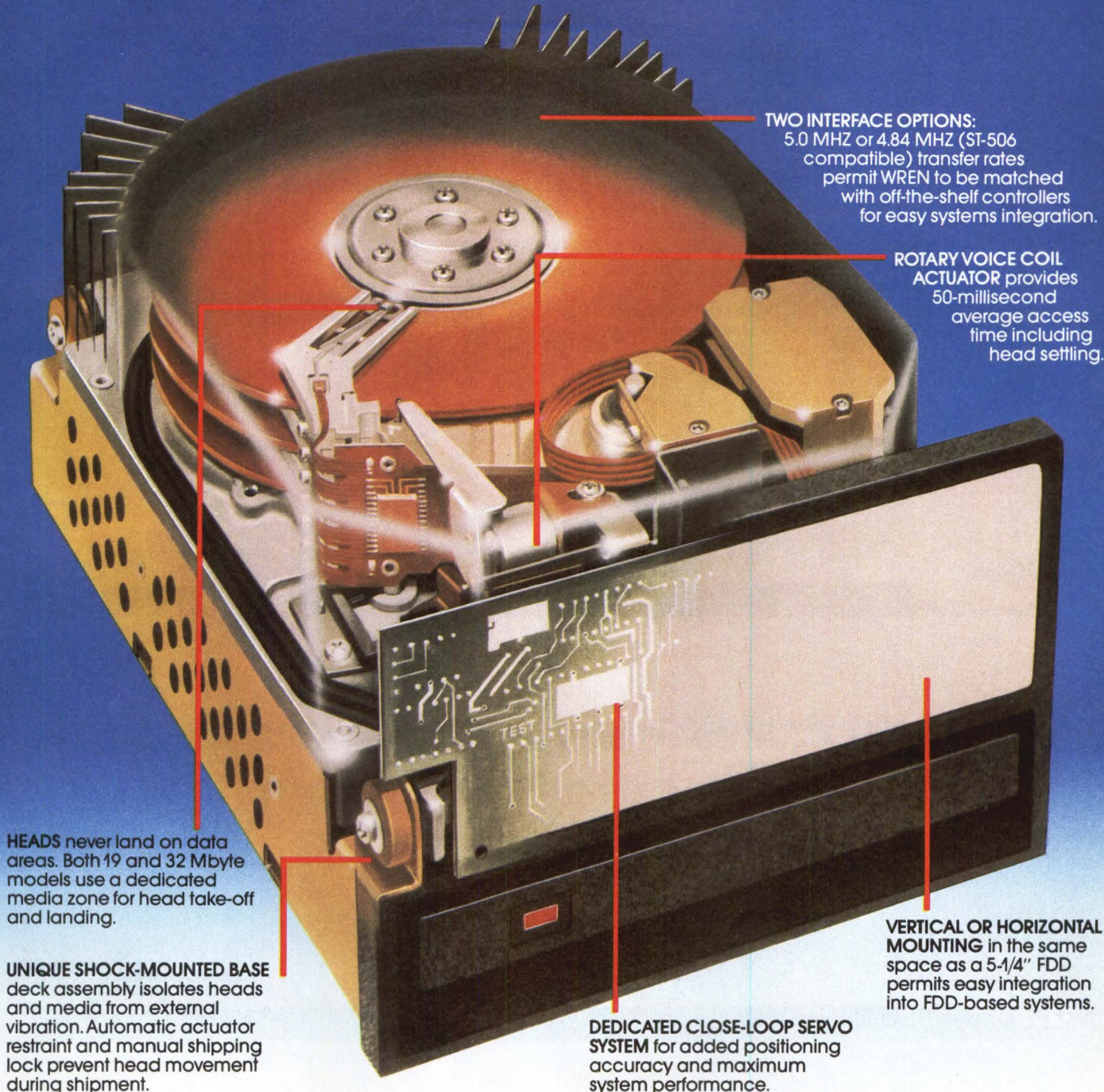
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**Gerald H. Kiltz** is product marketing director at Shugart Corp., Sunnyvale, Calif.

---



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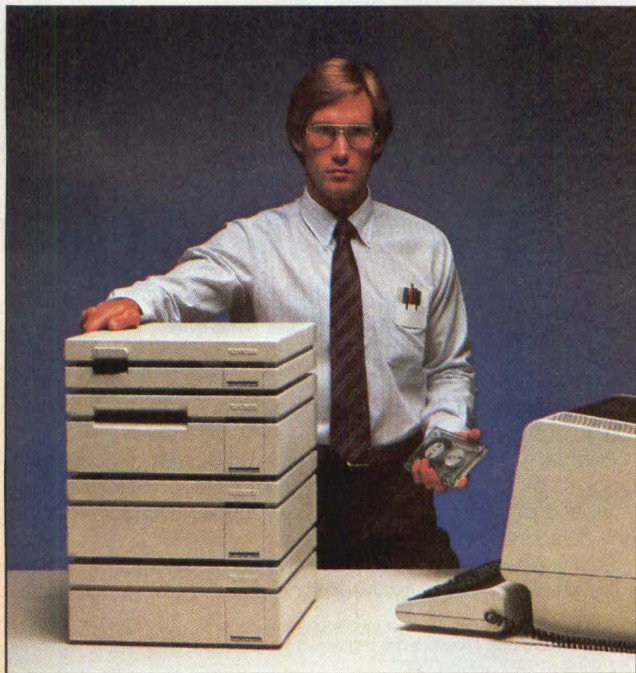
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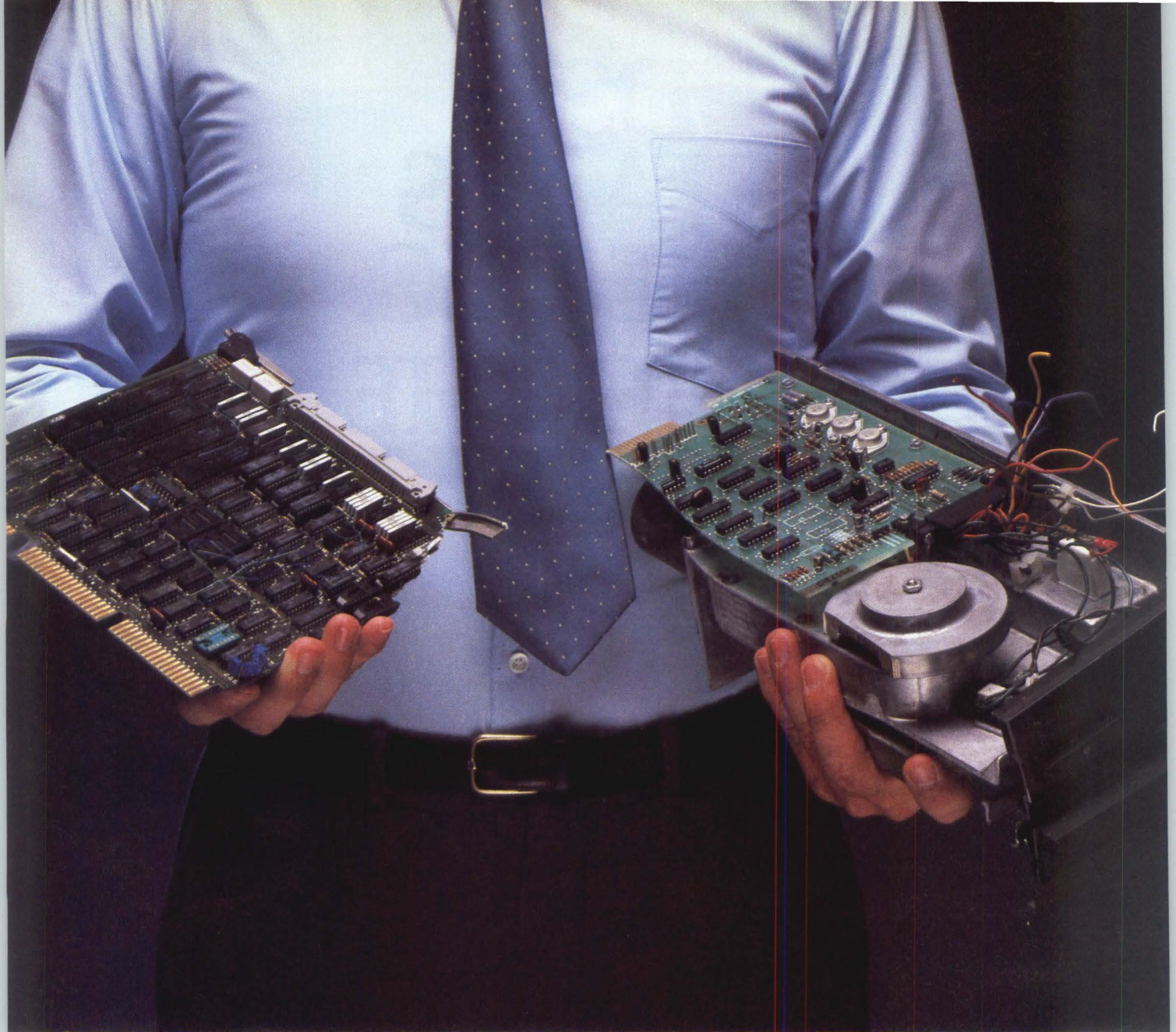
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## DISK DRIVES

# Embedded servo comes to 5¼-in. cartridge disk

WILLIAM POLLOCK, DMA Systems, Inc.

### *Servo data in Winchester cartridge keeps 5M-byte media interchangeable*

The primary requirement for removable-cartridge disk drives is interchangeability. System designers and users must be confident that data recorded on one drive can be accurately read by another compatible cartridge drive. To reduce per-megabyte media costs and the number of media changes, disks should also be able to store a maximum amount of data on available recording surfaces. But as data density grows, interchangeability becomes increasingly difficult.

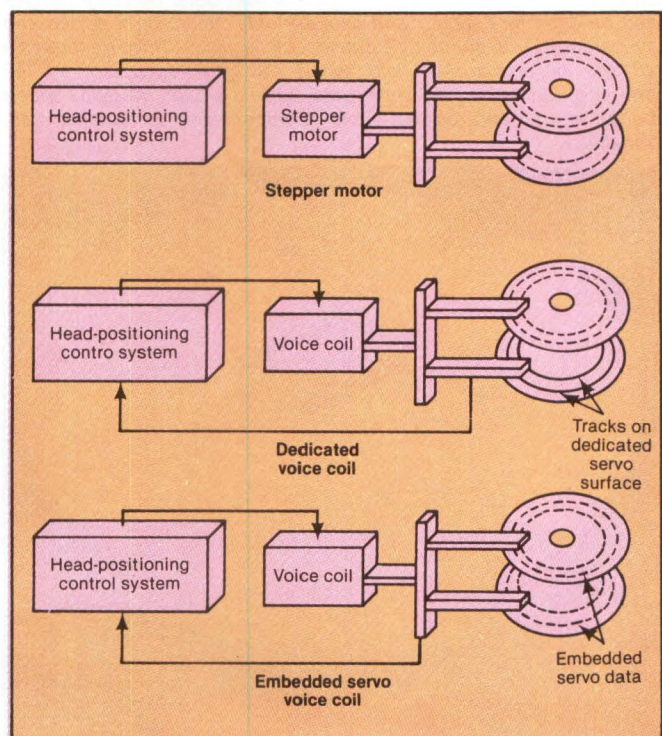
Requirements for both interchangeability and high capacities are now being met by the first application of embedded-servo head positioning to 5¼-in. Winchester cartridge drives. The DMA Systems, Inc., Micro-Magnum drive stores as much as 5M bytes of formatted data on one cartridge disk. Pre-recorded servo data define the tracks, correcting any tolerance differences between cartridge and drive. The Micro-Magnum embedded-servo format has also been proposed as an American National Standard Institute standard to ensure interchangeability not only between drives from one manufacturer, but between any fixed/removable or removable-only devices that meet the embedded-servo standard.

#### **Servo solutions for cartridge problems**

Accurate head positioning is difficult even for fixed-disk drives as data densities increase to 400 to 500 tracks per in. Removable cartridges compound the positioning problem by adding another set of track-positioning variables, as the media itself must be properly positioned.

Distance between track center lines at 500 tpi is 0.002 in. If the maximum allowable head-to-track offset is 10 percent, write and read heads must be held within 200 µin. of a track center line in the face of a variety of

head-positioning hazards. Spindle-bearing wear, for example, can change the center of rotation. Thermal



**Fig. 1. Servo head-positioning schemes include stepper motor, dedicated servo voice coil and embedded servo voice coil. Stepper motor digitally microsteps heads to correct positions, using read signal strength as feedback for corrections. Because there is no direct feedback line, stepper motor technique is usually an "open-loop" system. Voice-coil systems position head as a function of a continuously variable voltage modified by servo data on disk. Servo data can be located on a dedicated disk surface or embedded at the beginning of each sector on each surface. Because voice-coil techniques use direct feedback to position heads, they are "closed-loop" systems.**

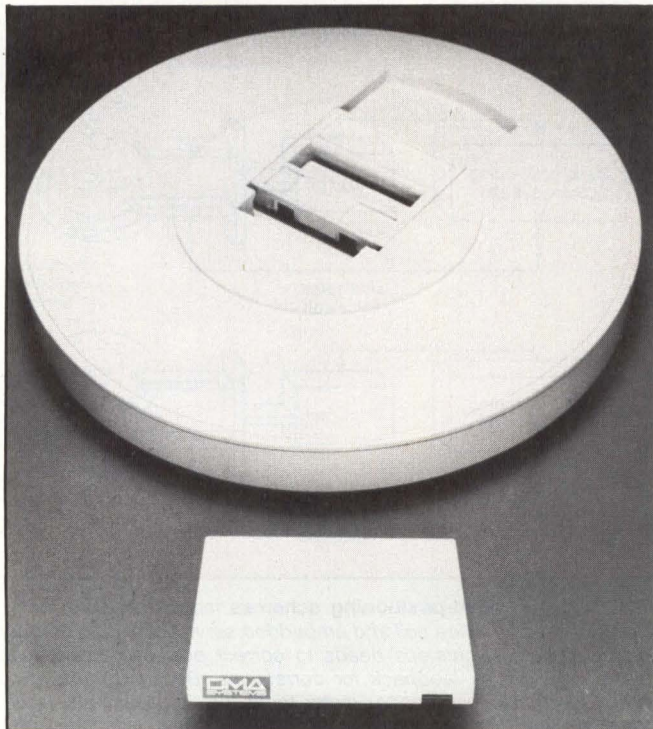


expansion or contraction can alter the track radius. Disk or head vibrations can produce spurious, unpredictable off-center and off-round errors.

Cartridges present additional problems. A spring-loaded recess in a cartridge hub centers the disk on a precision spindle shaft, but wear and contamination can shift the center of rotation to one side. A magnetic chuck engages the hub, holding it firmly in place; again, however, contamination, wear or physical damage can tilt the disk or make it unstable. And factory alignment of fixed-disk heads and surfaces cannot be duplicated in the field with each cartridge insertion. The head-positioning system in a cartridge drive must compen-

Servo field	PLO sync	Sector ID field	PLO sync	Data field	Speed buffer
AAA... 26 bytes	000... 12 bytes	11 bytes	000... 12 bytes	256 user-data bytes, plus 8 CRC, ECC, format bytes	000... 5 bytes

**Fig. 2. DMA Systems sector format provides 330 bytes, including 26 bytes of servo data and 256 bytes of user data. Remaining bytes can be used for cylinder and sector identification, error codes and synchronizing the controller's phase-lock oscillator. Drive generates a 26-byte hexadecimal-A field to fill the gap occupied by the pre-recorded embedded-servo data, while a 5-byte, all-ZERO speed buffer at the end of the sector compensates for rotation rate variations.**



**14- and 5 1/4-in. cartridges use similar technologies, but smaller DMA 5 1/4-in. Winchester cartridge is practical for microcomputer applications. The DMA cartridge runs in DMA Systems' Micro-Magnum 5M-byte fixed/5M-byte removable and removable-only drives, which sell for \$1295 and \$995, respectively, in OEM quantities.**

sate for the worst-case combination of these potential positioning problems.

The most accurate head-positioning systems use servo, or feedback, techniques. Two basic servo schemes are now being applied to 5 1/4-in. drives: stepper motor and voice-coil (Fig. 1).

Stepper-motor systems move the write/read heads in fixed increments, defining the tracks by digitally counting the number of increments from a known "home" position. Read signal strength provides the feedback used for fine adjustment, but this technique cannot always guide head placement when temperature gradients, spindle runout or improperly seated cartridges create off-track errors. Stepper-motor systems are also relatively slow, increasing average access times and, therefore, effective transfer rates when a number of tracks are accessed.

In voice coil systems, by comparison, head positioning is a continuously variable function of current flowing through the coil; the current is modified by servo data on the disk surface. Because the current can vary continuously, the head assembly can be accelerated to match the distance to be traveled and decelerated to a stop with little overshoot. The position of the heads can also be altered as the disk rotates, tracking both off-center and off-round variations.

Servo data for voice-coil positioning can be provided on a dedicated servo surface on a dedicated disk, or as embedded data throughout each disk surface. A dedicated servo surface requires a read-only head for that surface. The mechanical link with the read-only head and the read/write heads can introduce positioning errors that limit track densities. The dedicated surface also costs the drive a large amount of capacity. Embedded-servo systems also have limitations. Servo data, prerecorded at the factory, permanently divide the disk or cartridge into sectors, reducing the flexibility of a system designer or programmer. It may even be necessary to rewrite system software if the fixed-sector size is different from that recognized by the current operating system or disk driver. Servo codes at the start of each sector also displace user data on each track, interrupting the data stream and reducing the average transfer rate for a given data density and disk-rotation rate. Furthermore, complex electronic interlocks must be incorporated into the drive to prevent accidental overwrites of the servo codes interspersed with user data.

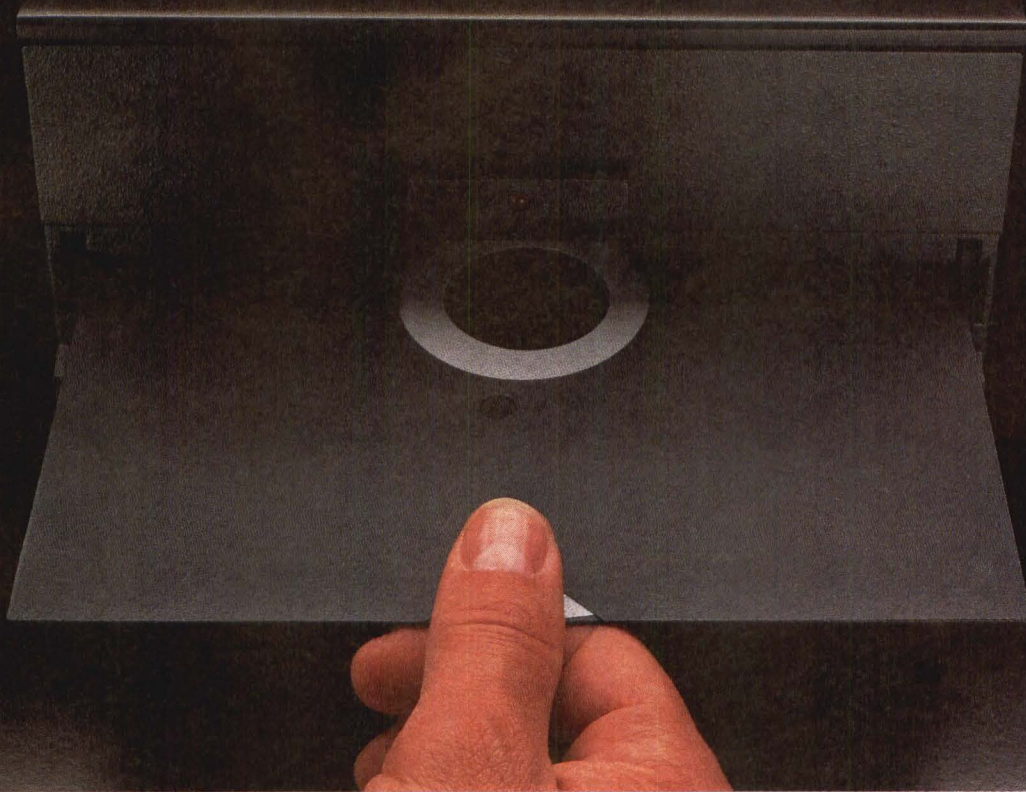
Despite the limitations of embedded servo systems, the technique is best for cartridge drives, given their special accuracy and capacity requirements.

### Sector format includes servo data

Embedded servo format standardization will become increasingly important as cartridges become a widespread medium for fixed-disk backup, and for off-site applications such as software distribution and data exchange among users. DMA Systems' proposed ANSI 5 1/4-in. servo format retains the encoding and read/



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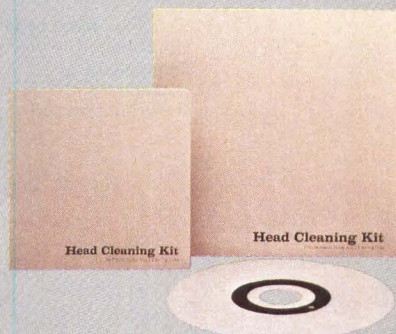
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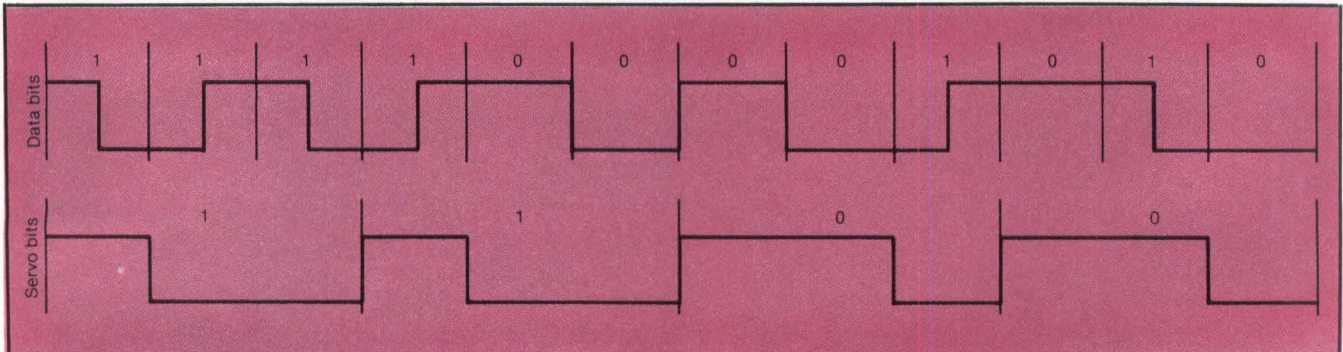


write rates that have become industry standards.

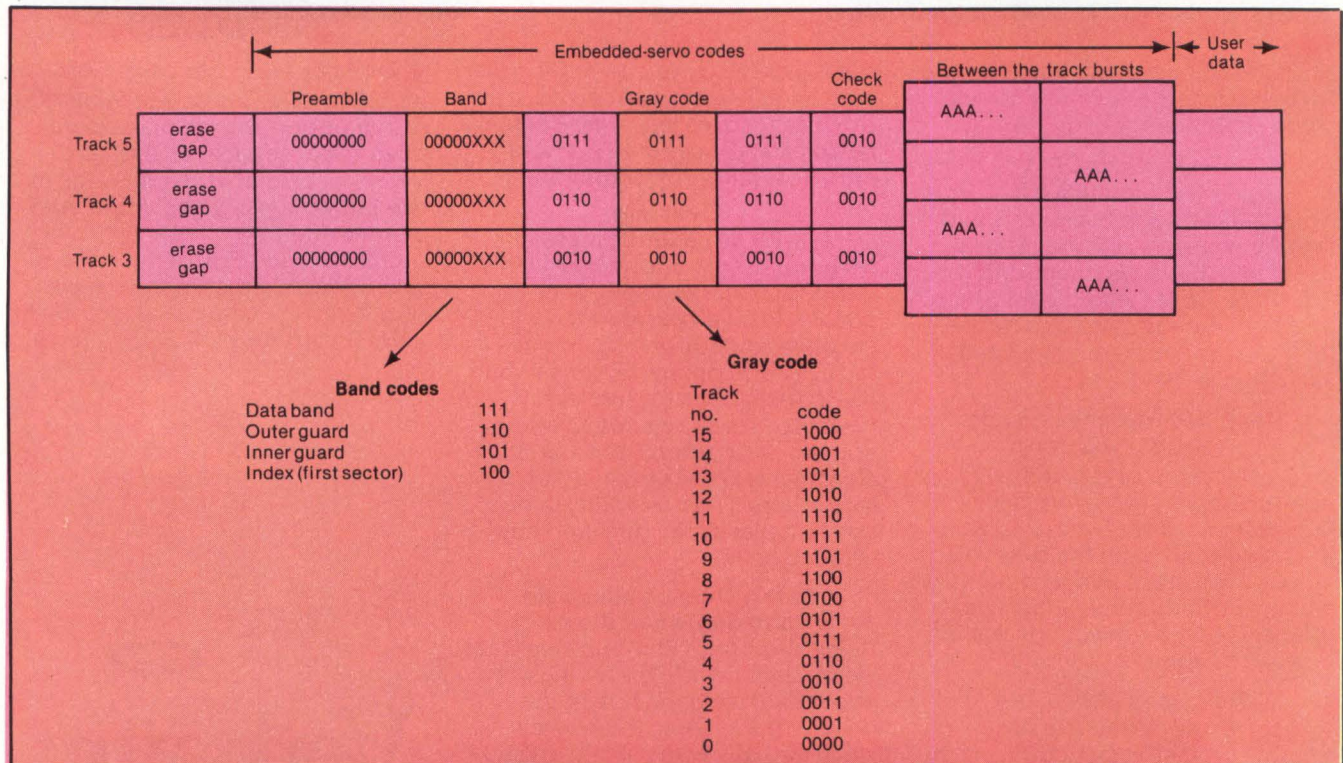
With the disk rotating at 3600 rpm—a de facto industry standard—as many as 83.3K bits can be recorded at the standard 5M-bit rate during each revolution of the disk. These bits represent more than 10.4K bytes per track, which can be conveniently divided, for example, into 32 sectors with 256 bytes per sector. There is also room for gaps between sectors, track and sector addressing, error-detection and correction codes and even to replace a defective sector. There is no space, however, for head-positioning codes

along the track.

To allow for these codes and still maintain a standard size and number of sectors, the 5¼-in. embedded-servo format calls for a reduction in the disk rotation rate to 3443 rpm. This rotation rate slowing increases flux density, to as much as 8617 flux changes per in. on the innermost data track. The higher flux density in turn increases the capacity of each track to nearly 10.9K bytes, permitting each track of each of 33 sectors (32 data sectors and a spare) to record 330 bytes (Fig. 2). Of these 330 bytes, 26 are dedicated to embedded-servo data (the drive generates a hexadecimal-A data output during this interval), 256 bytes are user data, and the remaining 48 bytes can be used for any formatting purpose. The 26 bytes of hexadecimal-A code represent a system overhead, reducing the average transfer rate



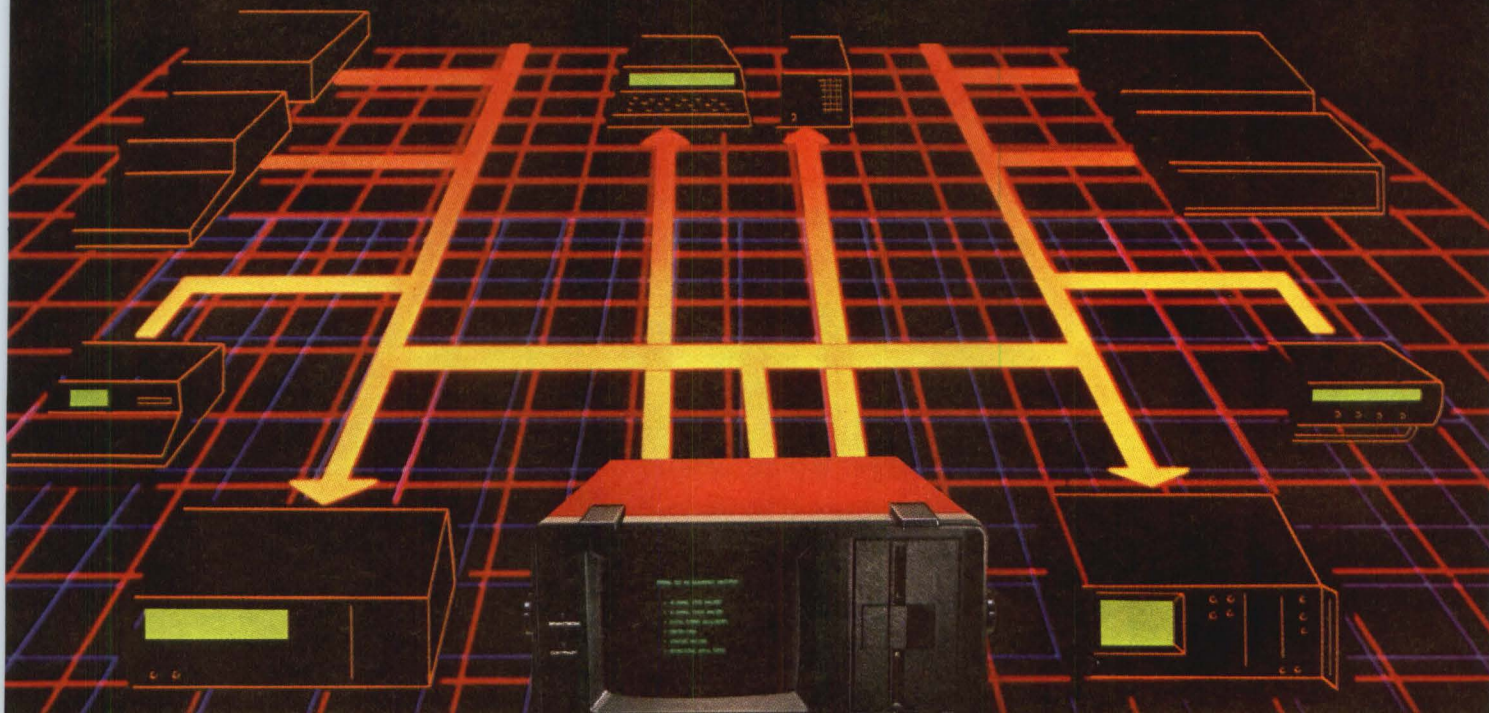
**Fig. 3. Data and servo codes** use different techniques to record information. Data are recorded in MFM code, with a flux change at the center of ONE bit cells and clock-type flux changes at the start of a ZERO bit cell following another ZERO. Embedded-servo information pre-recorded at the factory in a PDM code, uses three bit-cell intervals. PDM ONE pulses equal the bit-cell interval, and a ZERO pulse is equal to two bit-cells.



**Fig. 4. Servo data format** provides pre-recorded head-positioning information at the beginning of every sector. The first 2 servo bytes initialize the servo decoder, and specify whether the heads are in the data band or in the guard bands used for protection during cartridge loading. The Gray Code identifies the track number within a group of 16, and the check code identifies servo read errors. Off-track data bursts are used in fine positioning.



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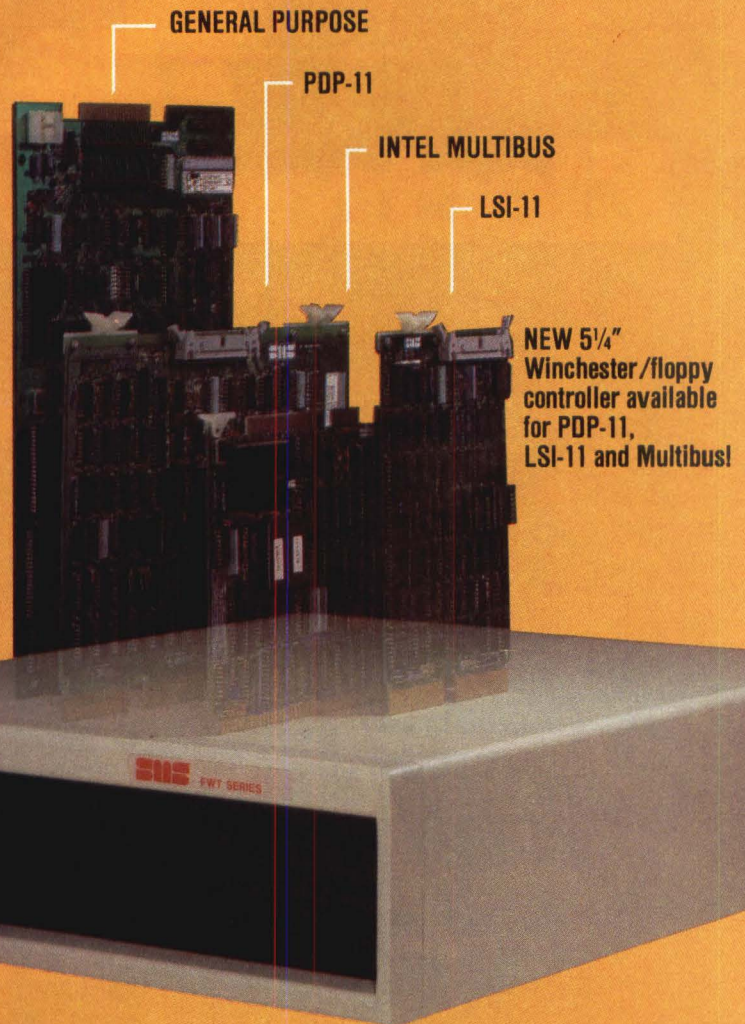
All controllers used in SMS disk peripheral systems are available separately. Each controller supports (2) Shugart/Quantum Winchester and (2) Shugart floppy disk drives, utilizes patented PLL circuitry to provide maximum margins for worst case bit shifted data recovery, incorporates ECC (Error Correction Code) and includes on-board self test! Additional features are:

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## DISK DRIVES

between controller and host by a small percentage. But as track densities and cartridge capacities increase, the price for this overhead will nearly vanish.

### Servo code and positioning

An embedded-servo drive must read, interpret and respond to prerecorded servo codes. The entire operation is internal to the drive, and uses a recording technique that is simple to detect and decode.

Most  $5\frac{1}{4}$ -in. disks use modified frequency modulation encoding for non-servo data (Fig. 3). This scheme calls for a flux change at the center of every bit-cell interval

### *Fine-positioning operations follow variations in the track radius.*

that represents a binary ONE and at the start of every ZERO bit cell that follows another ZERO. Servo information, on the other hand, is written in pulse duration modulation code, in which a ONE "pulse" has a duration of one data-bit cell, while a ZERO occupies the space of two data-bit cells.

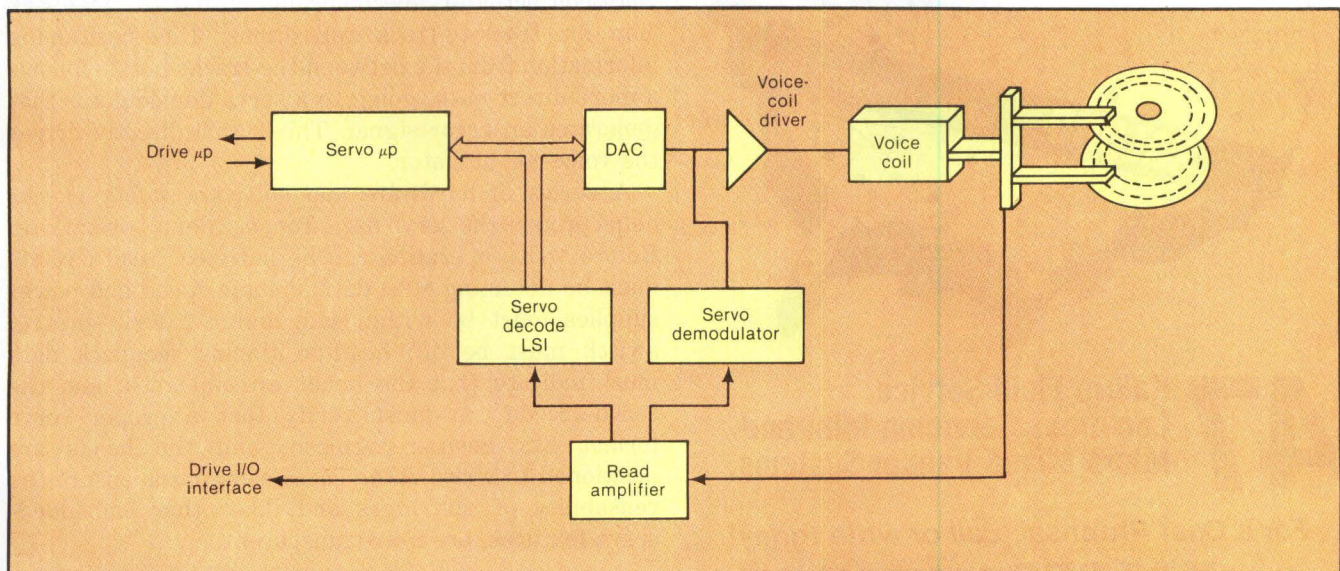
The time interval between servo bits is 600 nsec., equal to three data-bit cells. The embedded-servo format (Fig. 4) starts with a DC-erased gap equal to 1 servo byte, or 3 data bytes. This is followed by an all-ZERO servo-byte preamble to verify the gap and initialize the servo decoder. The first 5 bits of the next servo byte are also ZEROS. The remaining 3 servo bits identify whether the write/read heads are within a

312-track data band (311 data tracks, including five spares, and one customer-engineering track) between two guard-band buffers that protect the data when, for example, a cartridge is inserted in the drive and heads are loaded on the revolving surfaces. The first sector of each track—including those in the guard band—starts with an index signal code.

Head positioning can be divided into two phases—coarse and fine. Coarse positioning locates a specific track, while fine positioning centers the read/write heads on the desired track and follows any variations in the track's radius.

The drive begins a read or write operation after receiving track-seek instructions consisting of a direction signal and the number of tracks to be moved. Coarse positioning is then accomplished by reading the "Gray Code" values that follow the band-identification code. Each 4-bit value identifies a track within a 16-track group. The Gray Code values are repeated three times at the front of each sector, or 99 times around each track. Head-positioning logic, therefore, has the opportunity to identify the tracks the heads cross as they accelerate toward their destination and decelerate to a stop on the selected track.

Gray Codes, rather than conventional binary notation, are used for coarse positioning to avoid read errors caused by combining the codes of adjacent tracks. If conventional binary notations were used for track 3 (0011) and track 4 (0100), for example, the combined codes could be misread as track 7 (0111). With the Gray Code, track 3 is 0010, and track 4 is 0110. Thus, no matter how the patterns are combined, the result will always be the code for track 3 or 4. By repeating the values three times at the start of each sector, the format allows the system to take a two-out-of-three vote on the correct track number.



**Fig. 5. Servo feedback loop** uses servo data on disk to position head. Read head sends servo data to amplifier, which passes coarse-positioning data to a 500-gate LSI array for decoding, and fine-positioning data to a servo demodulator. The LSI array sends decoded information over a byte-wide bus to a servo microprocessor, which returns position commands over the same bus to a digital-to-analog converter. The D/A converter then sends an analog signal to the voice coil. The servo demodulator passes fine-positioning data directly to the voice coil.



## DISK DRIVES

These precautions are futile if the entire pattern has been shifted by, for example, a miscount of the ZEROS in the preamble. A check code detects such errors. If the check-code pattern is not 0010, the system assumes that a shift has occurred and that the Gray Code reading is incorrect.

After the Gray Code readings direct the embedded-servo system to the selected track and verify that the heads are on the correct track, a fine-positioning scheme centers the heads on the track. This scheme enables the heads to follow variations in the track

---

*Firmware calculates the acceleration and deceleration that will move the head a given distance in minimal time.*

---

radius that could lower the signal-to-noise ratio when data are read, increase the error rate or even destroy the integrity of the stored information. Fine-positioning functions are performed by comparing the strengths of two prerecorded data bursts between tracks. The two bursts, each consisting of approximately 15 bits of hexadecimal-A code (1010), occur in succession—one on the inside of the track center line, the other on the outside. If the two burst-signal

amplitudes are not equal, the read/write head assembly is immediately repositioned. A weak outer burst moves the heads away from the center of the disk, while a weak inner burst moves the heads toward the center.

The fine-positioning process is repeated 33 times with each revolution of the disk, or approximately once every 0.5 msec. The result is an almost-continuous sampling and feedback correction of the head-assembly position as it follows the pre-recorded embedded-servo tracks.

### The feedback loop

Both course- and fine-positioning are controlled by the servo loop (Fig. 5) in the drive. The loop starts with the same heads (one per surface) that read data stored on the disk. Servo-bit flux changes are detected and amplified in a conventional manner, and then are separated from the data stream by a read amplifier. A 500-gate LSI array decodes the embedded track-position data and transmits the information across a byte-wide bus to a servo microprocessor dedicated to head-positioning tasks. Firmware calculates, for example, the optimum acceleration and deceleration that will move the head assembly a given track-to-track distance in minimal time. The servo microprocessor also monitors the Gray Code values that indicate the current position of the heads. A second microprocessor performs more general control and interface functions.

Results of these calculations are transmitted across the same byte-wide bus to a high-speed digital-to-

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*Write and read head must be held within 200  $\mu$ in. of a track center line.*

---

analog converter that in turn drives a precision linear voice-coil actuator, mechanically closing the feedback loop for track-to-track repositions. Fine-positioning information from the between-the-tracks bursts follows a more direct path, going to a servo demodulator that generates an error signal. This signal directly drives the voice-coil actuator.

A series of hardware and software safety checks helps protect the servo data from accidental overwrite. Before write operation can be initiated, read circuits must be detecting MFM data; spindle speed and power supplies must be within safe limits; a write-protect switch must be off; head-positioning feedback data must indicate that the heads are on track; and the servo-decode LSI must verify that a proper servo format has been recognized, and the heads are positioned to write data. These safeguards ensure the reusability of cartridges and, like other embedded-servo features, are user-transparent.

---

**William Pollock** is manager of technology development at DMA Systems, Inc., Goleta, Calif.

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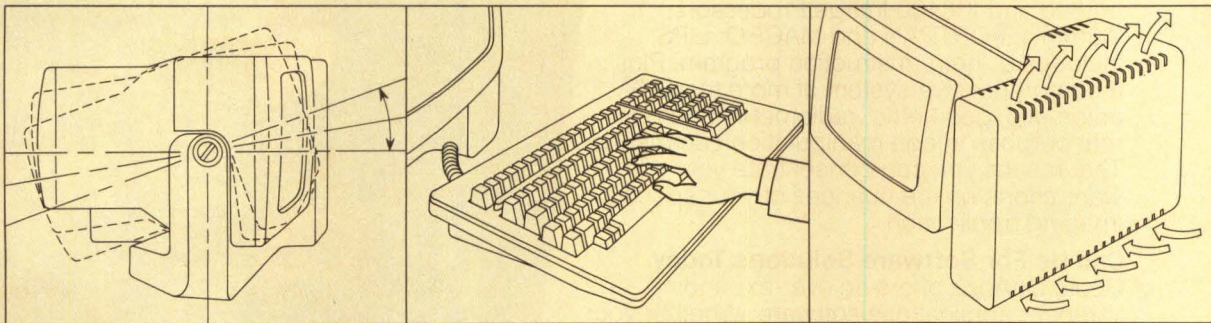
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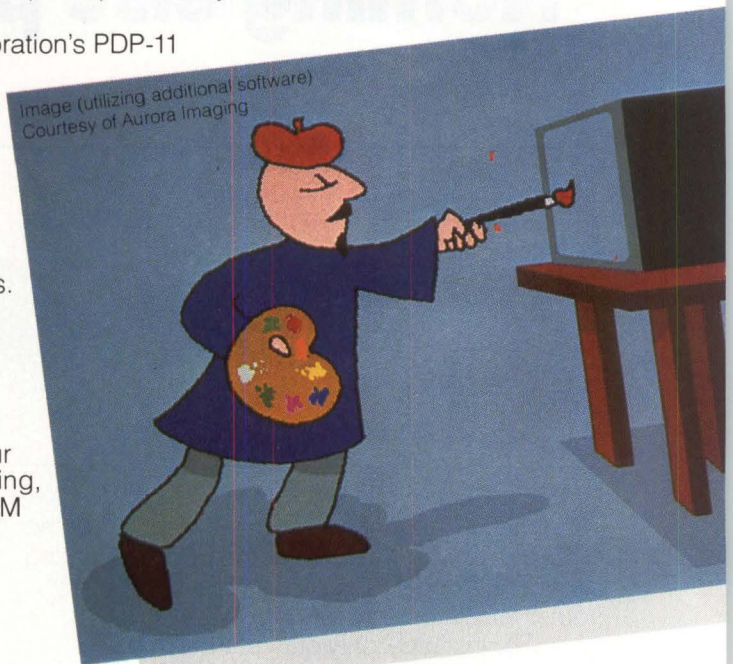
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# Floppy controller speeds access with cache

STEPHEN GOLDMAN, Distributed Processing Technology

## *On-board file-management and paging systems keep floppy data in controller RAM*

Floppy-disk drives have remained a popular means of data storage despite challenges in the OEM market by Winchester drives and bubble memories. Floppy disks are inexpensive, removable and easily handled, and their storage capacity has been increased through double-density, double-sided and, more recently, 96-tpi drives. Little has been done, however, to improve access times for data stored on this media. Cache-memory and I/O paging have been used to decrease access times for rigid disks, but the added cost of the extra hardware required to implement such schemes has priced most of them out of the range of floppy-disk systems.

A floppy-disk controller introduced by Distributed Processing Technology, Maitland, Fla., uses on-board file-management and paging systems to greatly reduce floppy-disk access times.

### **Inside the PM-3001**

The PM-3001 is a single-board floppy-disk controller with an integrated ROM-based file-management system and capacity for as much as 32K bytes of on-board paging (cache) RAM. With bus adapter card, the PM-3001 controls as many as four 8-in. drives and three 5¼-in. drives. Disk access time is significantly decreased by using the on-board paging RAM, allowing floppy drives to handle many applications in place of higher cost rigid-disk drives. Two DMA channels operate simultaneously to transfer data between disk and the paging RAM and between paging RAM and the host computer memory (Fig. 1). All DMA, host-communications, disk-control, paging and file-management functions are controlled by multitasked firmware running on an on-board 8085 CPU.

The heart of the PM-3001 is the ROM-based paging file-management system. PFMS runs entirely on board the PM-3001, transparent to the host computer system. Because file management normally consumes both processor time and memory space, off-loading this function to the PM-3001 processor can increase total system performance.

All PFMS files appear to the user as 2M bytes of byte-addressable virtual memory space. PFMS allocates and deallocates actual disk space during and between disk accesses. Because files are treated as virtual memory, a user program need not consider record sizes and file-space allocation.

The PM-3001 uses a disk paging scheme to speed data access. Paging schemes use RAM as a fast buffer for a relatively slow I/O device. The paging buffer is often a reserved part of the computer's main memory. The paging area is segmented into blocks or pages that usually correspond to the size of the minimum data record on the I/O device. In traditional disk-paging schemes, each page holds one sector of disk data. When a sector is read from the disk, the data are placed in a page, which then acts as a fast buffer between the disk and the CPU. The next time the CPU requests data, it can be quickly read from the paging area, averting a relatively slow disk access.

Most paging methods are based on the least recently used algorithm (Fig. 2). Each page is assigned an age. When the CPU accesses the data in a page, the page's age is set to zero. All ages are incremented at intervals. When new data must be read into the paging area and all pages are being used, the oldest (least recently used) page is emptied and reused for the new data. Another way to implement an LRU scheme is to link all pages



into a list. When a page is accessed, it is removed from the list and relinked as the first page in the list. The last page in the list is then always the least recently used page.

The PM-3001 PFMS links its pages into a tree structure. Each level of each branch of the tree consists of a linked list of pages. By organizing pages into a tree structure, the number of pages to be searched for a data item is reduced, allowing search-and-replacement algorithms to be implemented in firmware. Thus, the PM-3001 can be priced in the same range as conventional controllers.

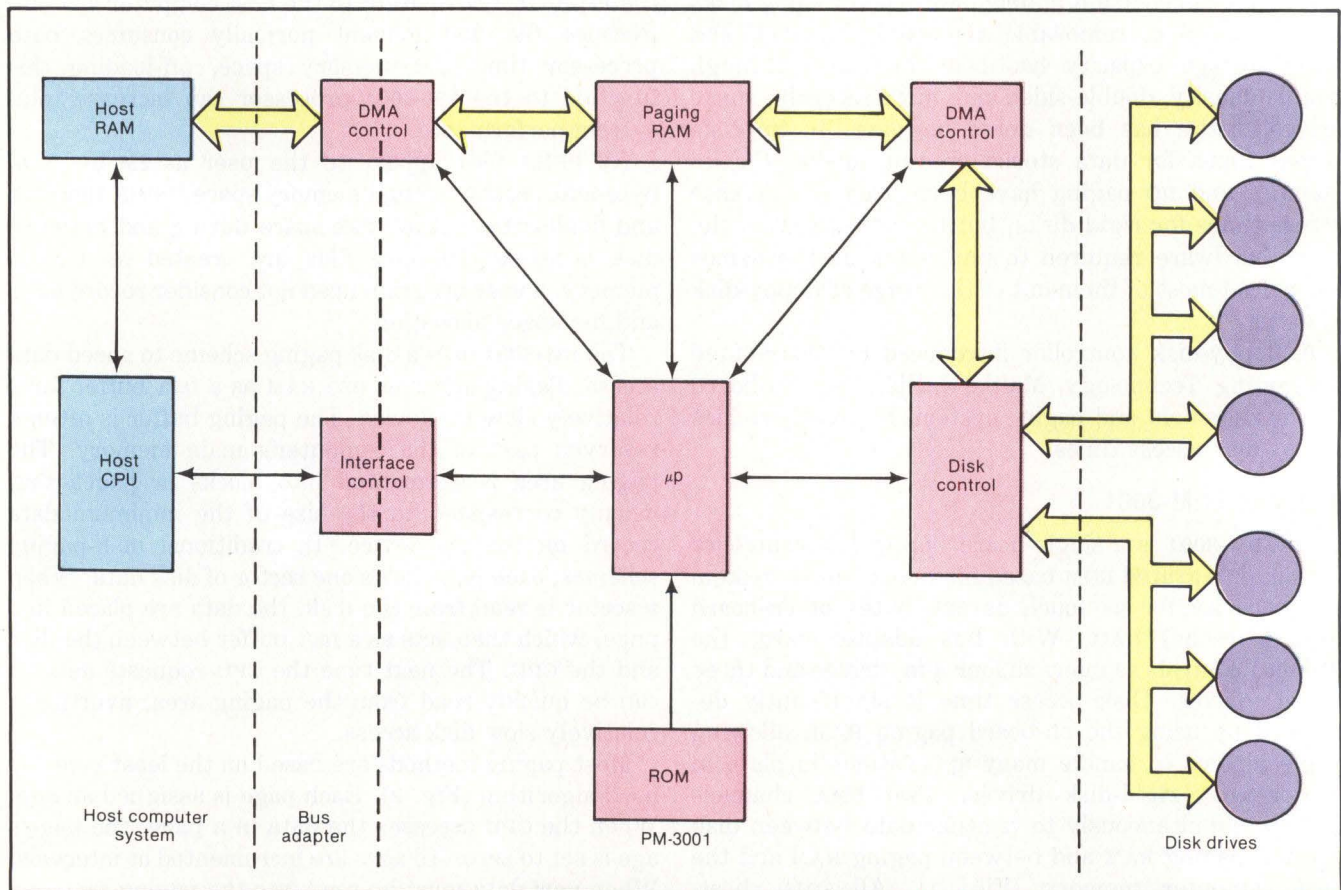
**PFMS file structure**

The PM-3001 hierarchical paging scheme reflects the hierarchical structure of PFMS disk files. PFMS files are byte-addressable. Data are accessed by transferring 1 byte to 64K-byte segments between a PFMS file and the host computer's memory. Data can be read from or written to any location within a file, regardless of the history of that file. File addresses range from byte

location 0 to byte location 2,097,151, providing each file with 2M bytes of memory space. Although every disk file appears to the user to be in 2M bytes of RAM, only the areas of a file that contain non-zero data require allocated disk space. This is accomplished by structuring each file as a three-level tree (Fig. 3).

The root level of the file, consisting of a single disk sector, is the file-header block. Each file header contains statistical information about the file plus 64 sector pointers. Each pointer points to an intermediate level sector or can contain a null value indicating that an intermediate level sectors does not exist for that pointer position. The intermediate level sectors, called bin blocks, each contain 128 sector pointers. Each pointer on this level can point to one of 128 top-level sectors or contain a null value indicating that a top-level sector does not exist for that position in the file. The 8192 top-level sectors contain the actual file data. All other sectors are file overhead and are thus transparent to users.

When a file is created, only the file header block is allocated to the file. All pointers to the next level are set to null. As non-zero data are written into the file, bin blocks and data blocks are allocated so that a three-level tree structure emerges. Branches are added to the tree in positions determined by the file



**Fig. 1. PM-3001 internal architecture** includes an on-board microprocessor that controls all DMA, host-interface, disk-control and paging functions. Two DMA channels operate simultaneously to transfer disk data between floppy drives and paging RAM, and between paging RAM and host memory. The microprocessor runs multitasked, ROM-based firmware, allowing paging algorithms, disk accesses and host-DMA activity to be overlapped.



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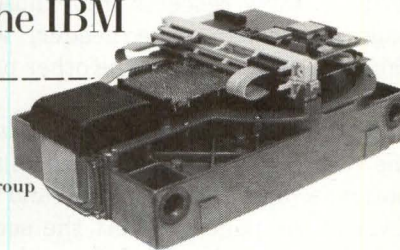


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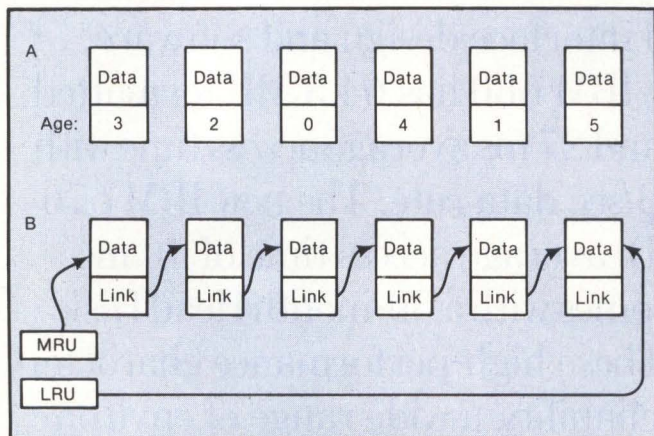


addresses of the data written to the file.

If, in the course of writing to a file, a data sector is found to contain all zeros, that sector is automatically deallocated from the file and returned to the pool of free blocks. The pointer to that sector is set to null. Likewise, if a bin block is found to contain all null pointers, it too is deallocated. Branches grow to accommodate new data and are "pruned" from the tree as the data become zero-filled. Sectors that are deallocated from a file can then be reused by the PFMS operating system to create or expand files.

**PFMS page structure**

The PFMS paging area is also structured as a tree. In this case, pages are the nodes of the tree, each page

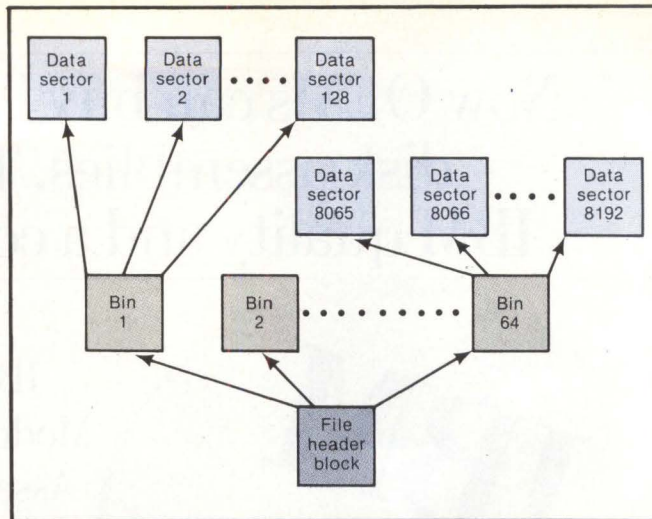


**Fig. 2. Two LRU paging schemes include:** (a) assigning an age to each page and setting the age of the most recently used page to zero and (b) a linked list of pages that tracks recency of use by placing the most recently used page at the head of the chain. The LRU page is then always at the end of the chain.

buffering one disk sector. The branches of this tree differ in some respects from those of disk files. Each page contains a page header, which, among other things, acts as a link to the other pages in the structure (Fig. 4).

At the lowest level of the tree is a single page called the root page. The root page acts as a general-purpose buffer for operating overhead and links into the second level of the page tree. At the second level are pages containing disk-header information. Each node at this level represents control data for a disk drive. All pages at this level are chained to form a linked list of nodes. The ends of the chain are linked back to the root page. Whenever data on a disk drive are accessed, the second level of the page tree is scanned to find the page containing disk-header information for that drive.

If the disk-header page is not in the paging area, it is read into a free page. That page is then linked into the second level as the beginning position in the chain. If



**Fig. 3. PFMS hierarchical file structure includes a file-header sector containing statistical information about the file, and linkage pointers for as many as 64 bin sectors. Each bin sector contains pointers for as many as 128 data sectors. All or none of the data and bin sectors can be allocated for any file.**

*The root page acts as a general-purpose buffer for operating overhead, and links to the second level of the page tree.*

the disk-header page is in the paging area, the page is simply relinked into the beginning position in the chain. The ordering of pages in the chain is thus determined by how recently each was used—the first page being the most recently used and the last page being least recently used. Pages can thus be searched, starting with the most recently used page, and the most frequently accessed pages take the least amount of time to find.

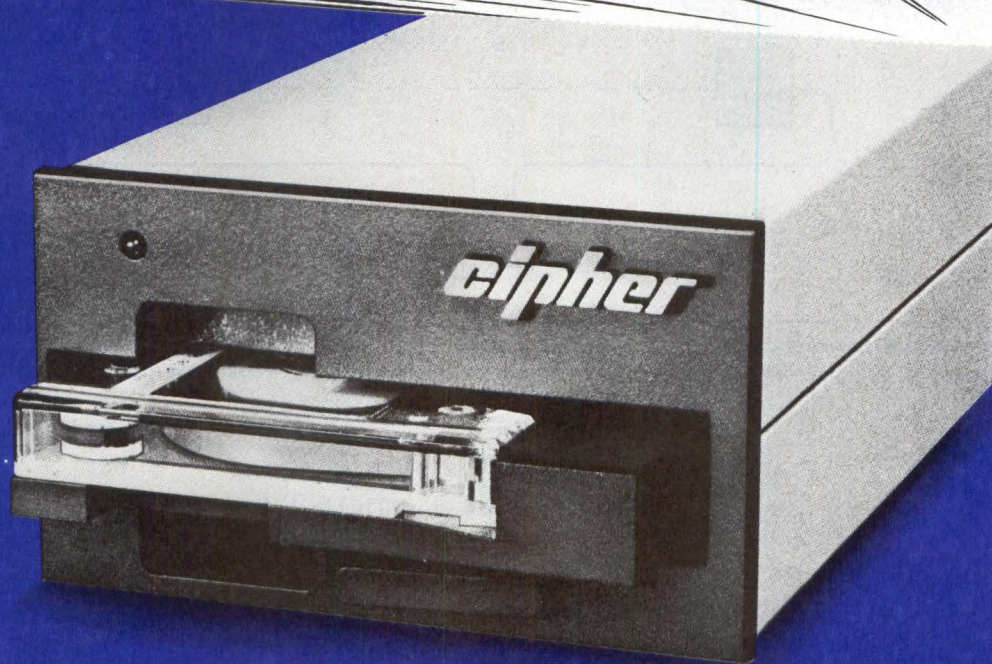
In the next level of the page tree are pages containing file-header blocks for paging-resident disk files. Each disk-header page in the previous level acts as the root node for one chain consisting of file-header pages for that disk. As before, each chain is connected at its ends to the previous level, and the ordering of pages in the chain is determined by recency of use.

The next two levels of the page tree are composed of bin pages and data pages, respectively. These pages are also chained into linked lists that are connected at the end points back to a node page on a previous level, to which the pages logically belong. Bin pages belonging to a file are grouped and linked into that file's header page. Data pages are chained and linked back to bin pages. The resultant structure is a five-level tree, each page acting as the root node for a sub-tree composed of pages on higher levels. When a page is relinked into the most recently used position in its chain, all pages belonging to its sub-tree get moved along with it.

In a more traditional scheme, paging and file



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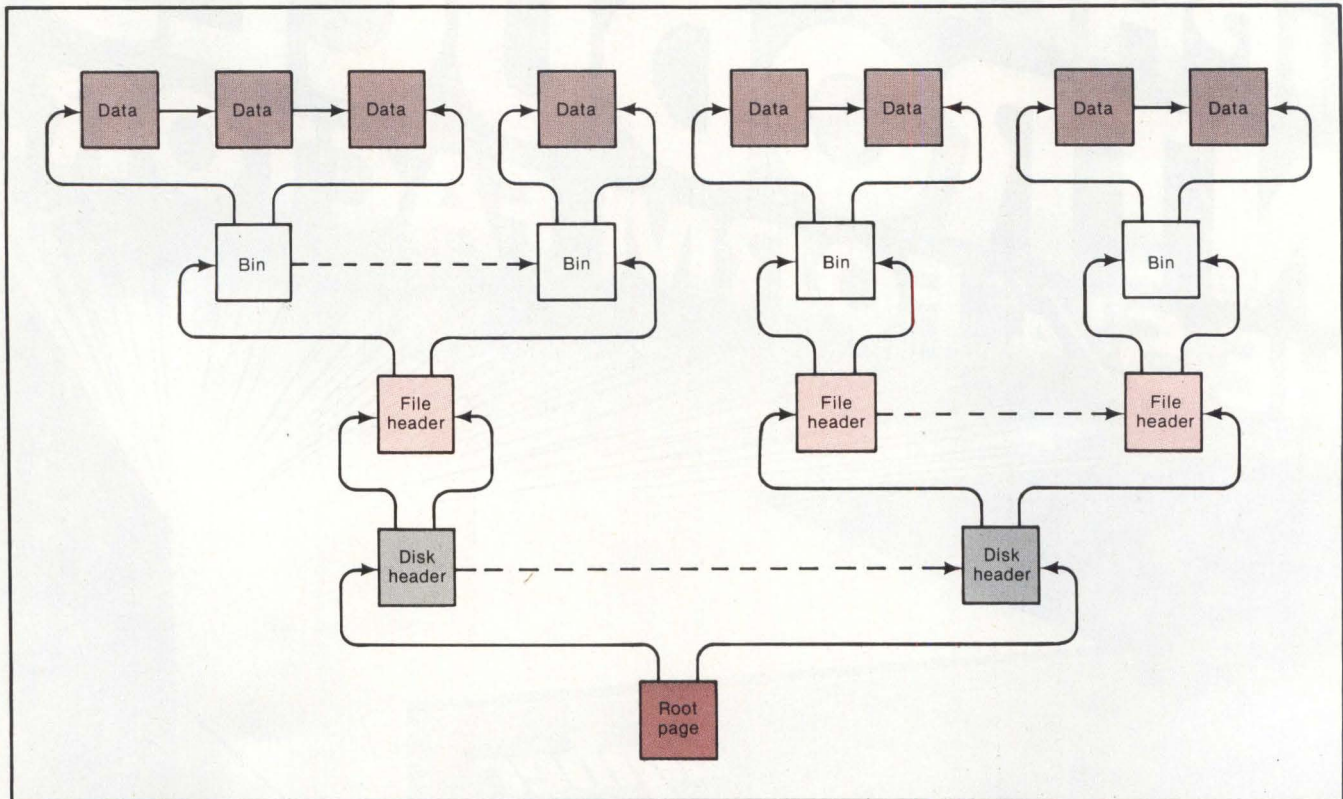
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**Fig. 4. PFMS page structure** is hierarchical. A page's position within any level of a branch is determined by recency of use. The most recently used page is always at the beginning of each chain. Whenever a page gets relinked, all pages belonging to its sub-tree are moved with it.

management functions are separate. All file and disk-management overhead sectors must be buffered in main memory, or sector requests must be issued by the file-management software when an overhead sector must be accessed. If the overhead sector has not been accessed for a while or if a long block of data has been read from the disk, the overhead sector may have been paged out, necessitating an additional disk access.

The PM-3001 always pages out the highest level page of the least recently used branch in the page tree; for a complete five-level tree, this is the LRU data page of the LRU bin of the LRU file of the LRU disk. Consequently, pages used to buffer overhead information for other resident pages always remain in the paging area until after the other pages have been paged out.

Disk controllers normally perform best when sectors are read sequentially from a disk. Because of hardware speed limitations, however, disk sectors are usually interleaved so that two full rotations of the disk are required to read all the data on one disk track. This yields a best-case time of approximately 12.8 msec. per 256-byte sector when reading sequential disk sectors from an 8-in. floppy. The PM-3001 can access page resident data at a typical rate of 2.2 msec. per 256-byte

sector. This includes all file overhead manipulation, and the file data do not have to be in contiguous disk sectors.

Worst-case disk accesses using a conventional controller take one disk revolution plus the time it takes to read one disk sector. For an 8-in. floppy, this yields a worst-case access time of 172 msec. The worst-case time for accessing page-resident data using the PM-3001—when the data are located in the least recently used page—is 19 msec., including all file overhead accesses. Data that are not page resident are accessed in times comparable to those of other controllers.

Using the PM-3001 typically reduces access times by a factor of at least six when the file data is page resident. The improvement is greater for 5¼-in. floppy-disk drives. Host memory requirements for file-management software and file overhead buffering are reduced, and more host processor time can be allocated to other resources. □

**Stephen Goldman** is general manager at Distributed Processing Technology, Maitland, Fla.



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# Testing Winchester disk drives

MICHAEL F. JULIFF, Qubex Associates, Inc.

## *Correlation of manufacturer and customer tests can keep relations cordial*

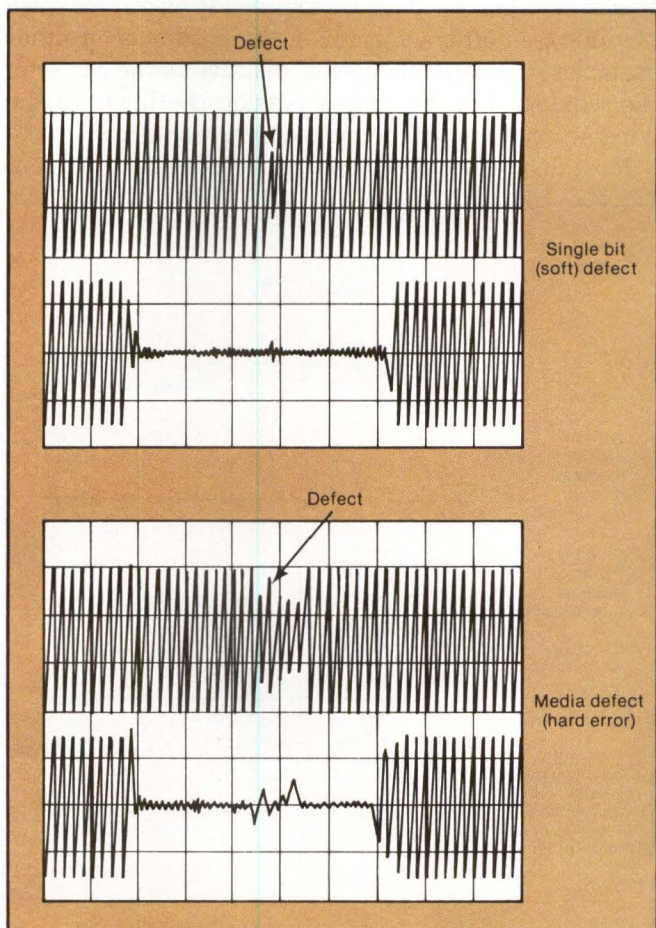
The small Winchester disk drive is perhaps the biggest peripherals success story of this decade. More than 40 companies are manufacturing and shipping Winchesters to some 2000 worldwide customers. Experts predict that, by 1985, shipments of these drives will exceed 800,000 units a year, up from the 20,000 shipped in 1980.

In the rush to satisfy this market demand, many drive manufacturers did not develop the specialized equipment necessary for drive testing at customer sites. All drives are tested before being shipped to customers, but there are no standardized test criteria to ensure that the manufacturers' outgoing tests and the customers' incoming tests are the same. This test-correlation problem has created some major differences between manufacturers and customers. But which tests need to be better correlated? Is one more important than the others? Which ones lacking correlation are causing the most serious problems?

### Testing read performances

Determining a drive's read performances—specifically identifying hard and soft error rates—is the basic problem. Hard errors are usually caused by media defects and are relatively easy to identify. Soft errors are caused by a multitude of possibly unrelated events and are, therefore, difficult to identify (Fig. 1).

Manufacturers test drives in relatively controlled, clean and electrically noise-free environments. Drive testing includes one or more read/write passes over each disk surface to locate each media defect (hard error). Large media defects are easy to locate; the smaller ones—single-bit defects common with Winchester technology—are much harder to find. Any defect



**Fig. 1. Disk errors** are available in two flavors, as these two test screens illustrate. Soft errors (top) are caused by a multitude of often unrelated events (e.g., shock, vibration or electrical or radio frequency interference) and are difficult to detect. Hard errors (bottom) are usually caused by media defects and are easy to identify.

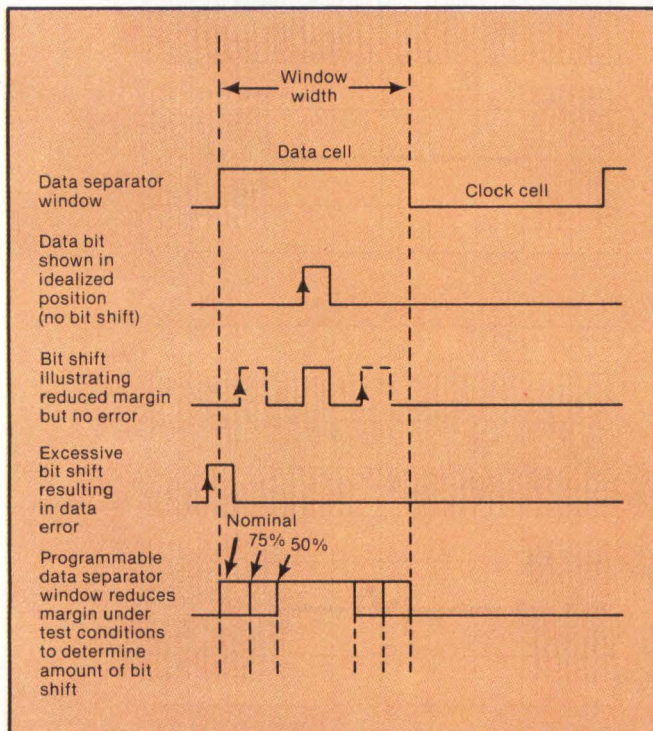


detected is analyzed, logged by location and ignored in subsequent read/write testing. Once all tests are completed, a label identifying the number of defects and their locations is printed. The manufacturer attaches the label to the drive and ships it to a user.

In an ideal situation, a customer receives a drive and enters the manufacturer's test results into his system before he starts testing the drive. Unfortunately, many customers ignore the defect list provided by the manufacturer and opt to test for defects using their own system. They sometimes fail to find all of the defects the manufacturer found and, in subsequent testing, observe an excessively high read-error rate. The drive fails to meet specification and is returned to the manufacturer.

Determining a drive's read-error rate is at best difficult, time-consuming and often frustrating. In simplest terms, a data bit from the drive is detected as such if it occurs within a fixed window—commonly called the "data separator window" (Fig. 2). The window is locked to the incoming data and, under ideal conditions, remains centered about the data bits. However, when the data are exposed to electronic noise (EMI/RFI), an off-track error in the positioner or other variables, the data bit "moves" relative to the center of the window. If a bit moves outside the limits of the window, that bit will be logged as a read error.

Most drives are designed to have a 25- to 30-percent



**Fig. 2.** The "data separator window" is the time during which data bits are detected by a disk drive. When electrical interference or other conditions cause "bit shifts," bits can fall outside the window, and errors can result. By allowing both a user and a manufacturer to vary the width of the window, the Qubex QA 2000 ensures that both parties can test at the same mutually specified tolerance.

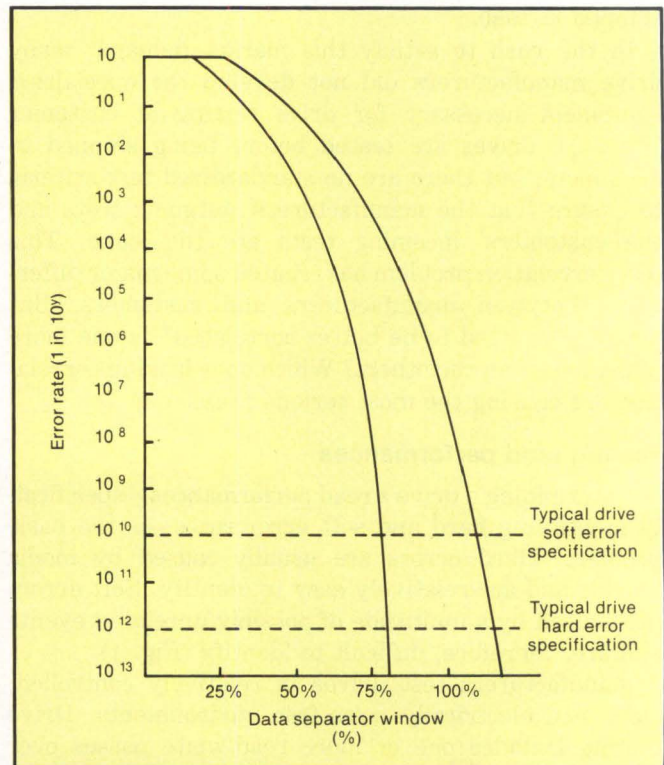
margin between the window limits and the worst-case bit shift because of drive variables (Fig. 3). This margin can be substantially eroded by factors over which disk-drive manufacturers have little control once a drive leaves a plant. The presence of extraneous electrical noise from CRTs, switching power supplies and the like, coupled with a poor data separator, can reduce this margin and adversely affect drive-acceptance tests. When manufacturers and customers are testing under different conditions, using different test equipment, arriving at identical results is virtually impossible.

**Getting correlated**

Improved correlation between tests is needed to keep manufacturers and customers on good terms. The best way to achieve better correlation is to install the same test system in both manufacturer and customer locations.

Qubex Associates, Inc.'s founders formed the company and developed the QA 2000 disk tester because they saw a need for standardized testing. The QA 2000 (models A1 and A2) tests more than 50 functions and parameters (Fig. 4). It is designed to test for industry-standard specifications and to provide identical drive tests for both the manufacturer and the customer.

The QA 2000 has made large strides in overcoming the problems of measuring both hard and soft read-error rates because it tests for phase margin, a factor that can determine all the variables that affect read-error



**Fig. 3.** The width of the data separator window and a disk's error rate are related. This exaggerated representation shows what might be observed as the programmable data separator window of the Qubex QA 2000 was gradually "opened."

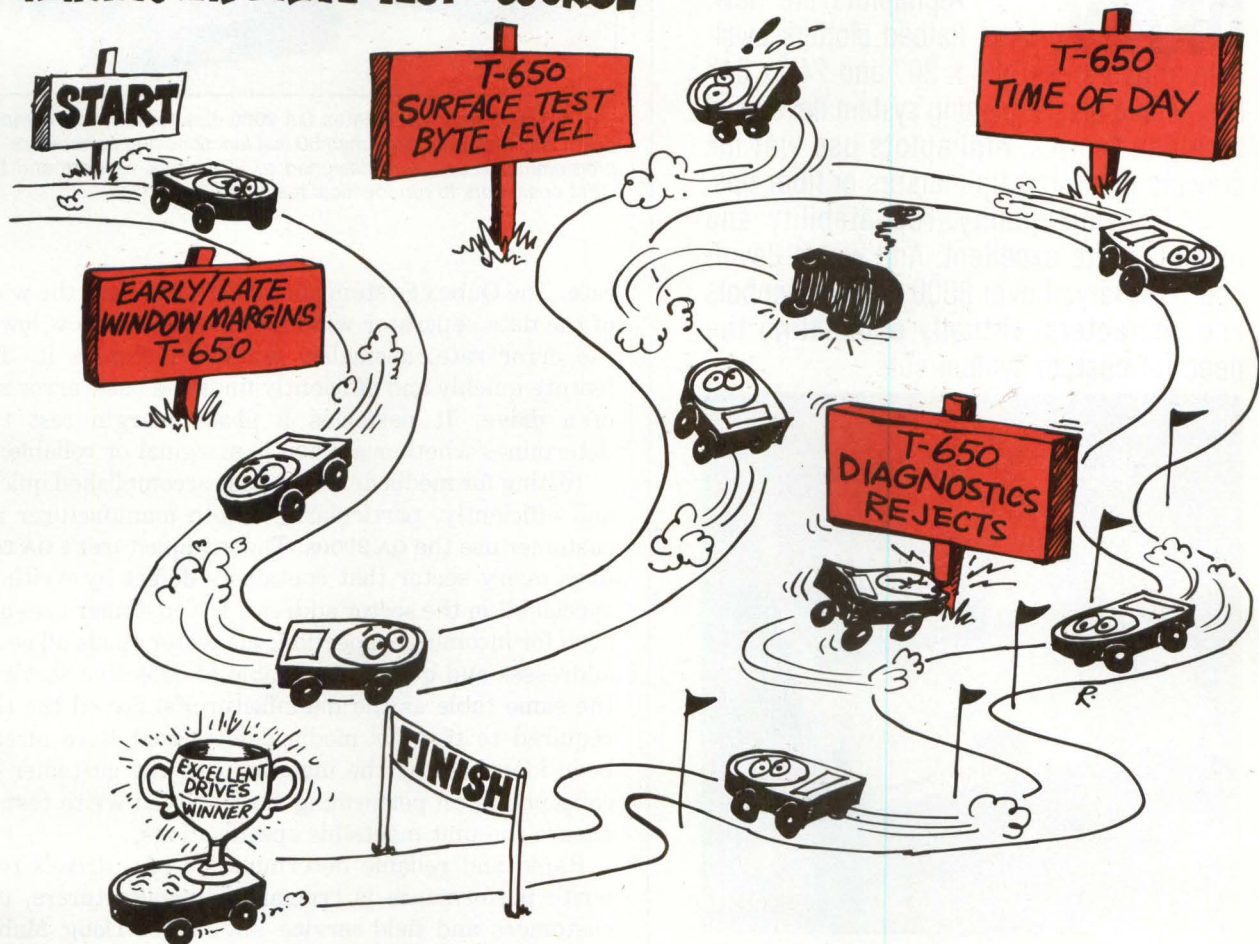


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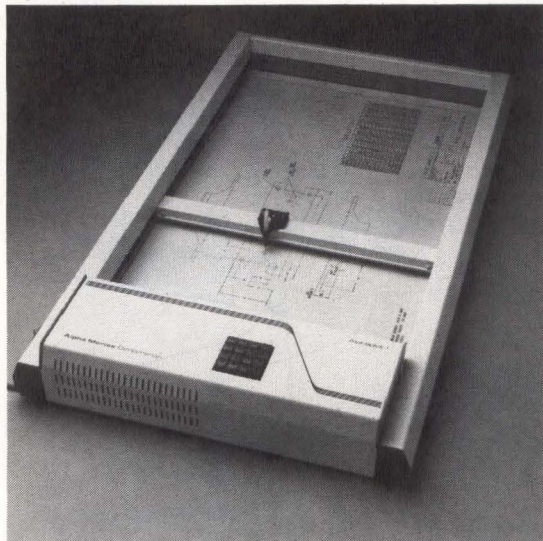


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## MEMORY SYSTEMS



**Fig. 4. The Qubex Associates QA 2000 disk tester offers complete diagnostic testing of more than 50 test functions and parameters. The programmable unit was designed to allow disk vendors and their OEM customers to run identical tests.**

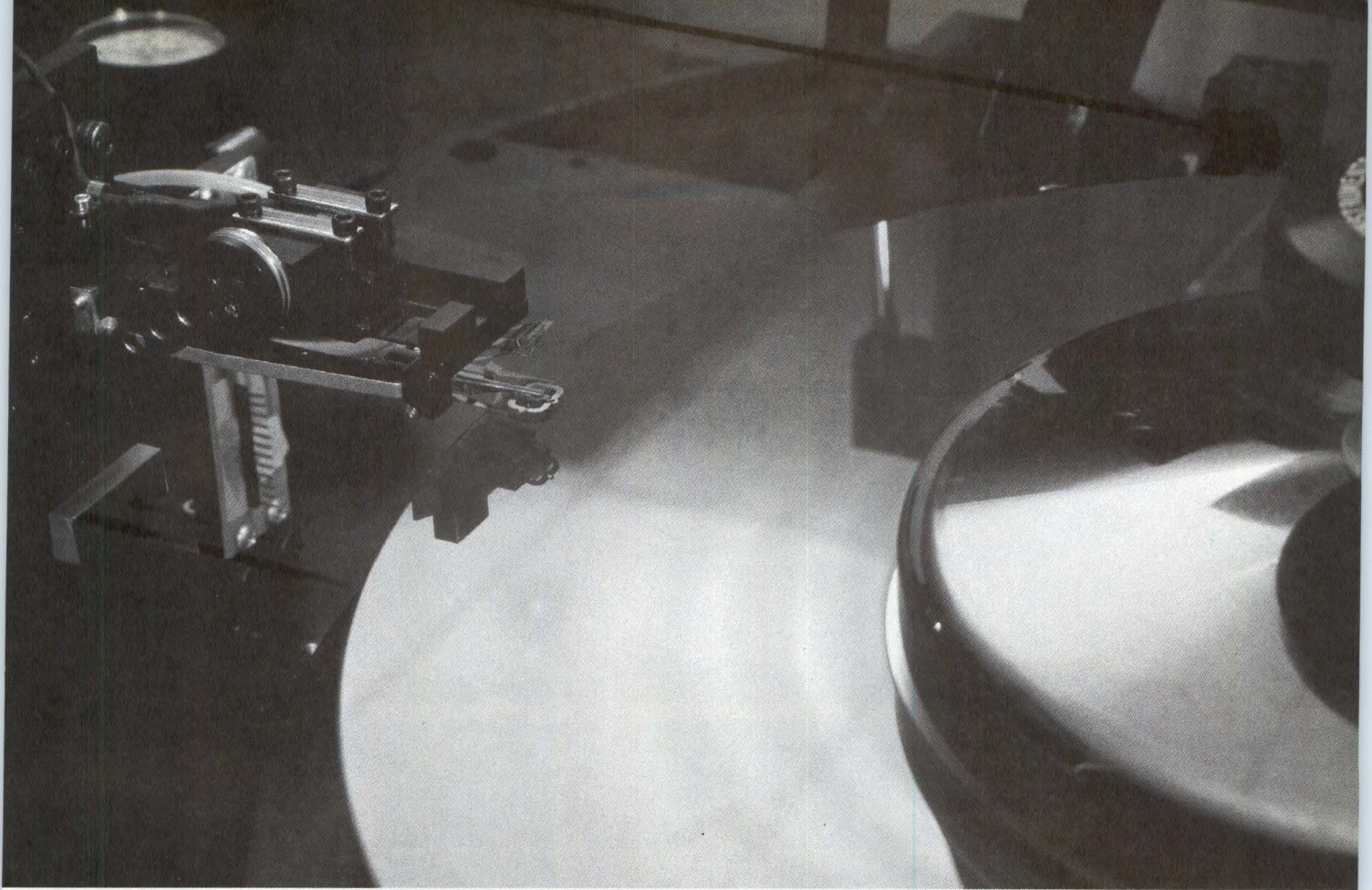
rate. The Qubex System allows a user to vary the width of the data separator window. A wider window lowers the error rate; a smaller window increases it. This feature quickly and efficiently finds the basic error rate of a drive. It performs a phase margin test that determines whether a drive is marginal or reliable.

Testing for media defects is also accomplished quickly and efficiently, particularly if both manufacturer and customer use the QA 2000s. The manufacturer's QA 2000 flags every sector that contains a defect by writing a special bit in the sector address. If a customer uses a QA 2000 for incoming inspection, his tester reads all sector addresses and generates a table of defective sectors—the same table as the manufacturer's. Saved the time required to test for media defects that have already been identified by the manufacturer, the customer can concentrate on performing further read/write tests to ensure the unit meets his specifications.

Rapid and reliable determination of a drive's read/write performance is crucial for manufacturers, OEM customers and field-service engineers. Doug Mahon, manager of engineering at Seagate Technology Corp., points out, "The manufacturers that don't pay attention to the correlation detail are going to pay for it sooner or later." Norman Zimmerman, manager of technical support at Quantum Corp., concurs: "The drive manufacturers see the importance of this kind of testing correlation. So do the people at the customer's incoming inspection. However, these aren't generally the people who want to get into test-equipment hardware." The QA 2000 gives large-volume disk customers powerful, flexible test capabilities, but more importantly, it provides a means of establishing standardized test criteria between manufacturers and customers. □

**Michael F. Juliff** is vice president, engineering, at Qubex Associates, Inc., Santa Clara, Calif.





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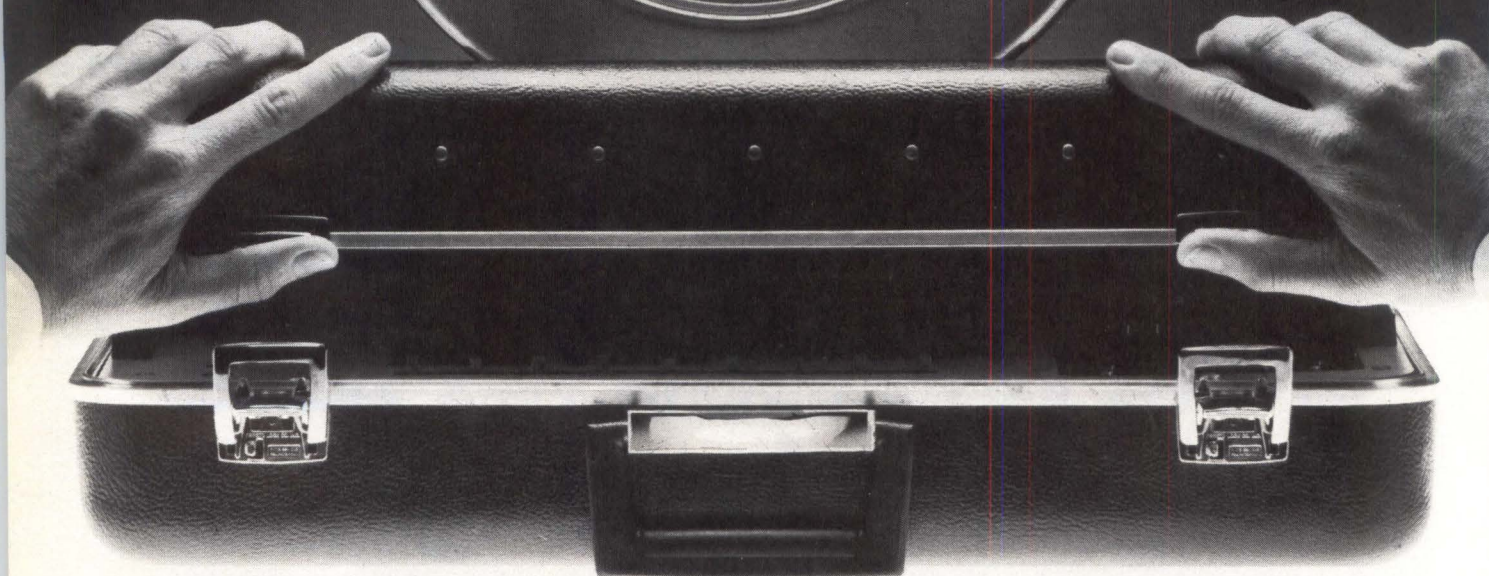
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## GRAPHICS

# Office workstation gets bit-map graphics

DREW HOFFMAN, Convergent Technologies

### *Graphics board adds vector and raster displays to distributed system*

OEMs looking for graphics capabilities in a workstation have often had to choose between dedicated, high-performance bit-map graphics designs and more versatile, multifunction systems with low-resolution graphics. Convergent Technologies has combined these features by adding a bit-map graphics board to its intelligent workstations. The IWS graphics workstations provide both bit-map and character-oriented video, and include vector and raster drawing modes with multilevel software interfaces.

#### **Bit-map and character features**

The IWS workstations provide both full bit-mapped graphics and alphanumeric (character-oriented) video. The hardware and software required to generate these types of displays are different, and to perform both types well, a graphics processor board has been added to the existing alphanumeric video-control board.

Alphanumeric video is generated by a video-control board accessible by a main 8086 CPU via the proprietary CT-BUS (Fig. 1). A character and attribute map is maintained in system memory. The video control board transfers this map into its row buffers on a character line basis using direct-memory access, resulting in an alphanumeric screen format of 34 lines  $\times$  80 or 132 characters, with each character 10  $\times$  15 pixels. Characters of any shape or size can be displayed by programming the font RAM on the video-control board. A font consists of as many as 256 characters. The standard Convergent character set includes the entire printing ASCII character set, common symbols, selected

foreign alphabetic characters and graphics symbols, which can be used to create fairly simple rectilinear graphics such as forms.

Bit-mapped graphics are generated on the IWS graphics board, which resides on the application-hardware Multibus (Fig. 2). This board has its own 8086 processor. The main CPU performs the higher level graphics subsystem tasks such as scaling and clipping and hands a list of lower level commands such as Draw Line Absolute to the graphics processor, which executes them in parallel with the main processor's tasks. The main CPU also handles processes such as communi-



**IWS-110 and IWS-120 graphics workstations** from Convergent Technologies feature bit-map graphics in vector or raster mode. The workstations are hardware- and software-compatible with previous workstations in the series.



cations protocol handling.

Commands are sent from the main CPU to an 8K-byte inter-processor communications queue on the graphics board. The graphics processor draws into a 1024 × 1024 display RAM comprising 128K bytes of 64K-bit dynamic RAM chips. This memory is organized as two 1024 × 512 display planes, with each plane containing a 656 × 510 screen bit-map. All of the display memory is continuously refreshed by video refresh cycles. Either plane can be displayed; the nonvisible plane can be used to store graphics-character fonts, or real-time animation can be implemented by updating both planes and rapidly switching the viewport between them.

**Drawing modes**

While most graphics display systems are limited to drawing in vector or raster modes, the IWS displays can operate in both modes.

In vector mode, an image consists of a group of vectors, or line segments. This mode is commonly used for engineering and scientific applications, primarily because vectors can be efficiently scaled in size: to change the size of an object in vector format, one need only increase the length of all the vectors by a common factor. Raster operation consists of the high-speed logical combination of a rectangular display memory with another memory of the same dimension. This

mode is useful for implementing interactive text and graphics characters, as a font can be stored in nondisplayable memory and quickly raster-copied into displayable memory. The higher speed of this mode is also better-suited to manipulating and modifying images than is a vector mode (with the exception of scaling).

The IWS draws vectors at a rate of approximately 2500 50-pixel vectors per sec., and raster images at

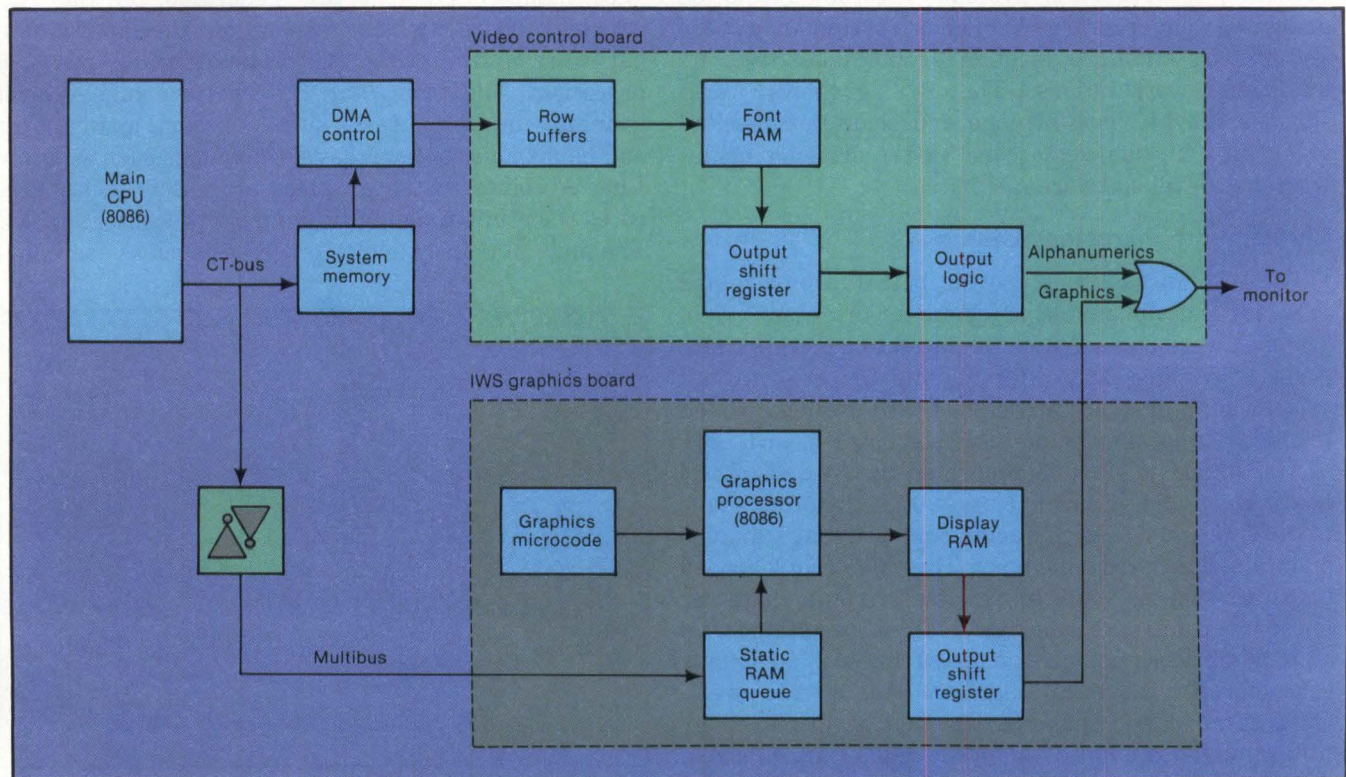
*The IWS workstations provide both full bit-mapped graphics and alphanumeric video.*

about 940,000 pixels per sec.

All local memory and I/O on the graphics board are accessible via a 16-bit Multibus slave interface. The graphics processor executes its algorithms out of 8K bytes of firmware, and the main CPU can down-load microcode enhancements into the static RAM.

**Display memory**

The IWS display memory contains a one-to-one bit map of all of the pixels on the screen. This memory must be accessed by both the graphics processor, to change the contents of the display memory, and the video-control board, to refresh the screen with the information in the display memory, requiring a dual-ported display-memory scheme. To enable the graphics



**Fig. 1. IWS video subsystem** provides concurrent alphanumeric and graphics displays. The workstation's main CPU down-loads graphics commands to the graphics processor, remaining free to perform scaling, translation and communications functions. Alphanumerics and graphics can be enabled independently by application software.





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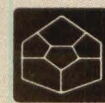
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processor to draw quickly, the memory must be readily accessible. In most graphics designs, the processor can access the memory only during display blanking or retrace, typically comprising 25 percent of the time. Such designs often compensate by using a costly bipolar bit-sliced processor able to update the display memory during blanked intervals.

The IWS graphics board can use a lower cost 16-bit MOS microprocessor by incorporating an interleaved synchronous memory controller. This controller time-division multiplexes or interleaves video refresh and local bus cycles in 616-nsec. cycles. Thus, the graphics

*The IWS display memory contains a one-to-one bit map of all of the pixels on the screen.*

processor or main CPU (via the Multibus wait only 616 nsec. to access a 16-bit word of display memory, not the 32  $\mu$ sec. of an entire scan line.

The memory controller is synchronized to the graphics pixel clock, which has a period of 39 nsec. There are 32 pixel clock states, comprising 16 states for two page-mode read cycle for video refresh and 16 states for a processor or Multibus read or write cycle (Fig. 3). During a memory controller cycle, 32 pixels are accessed. By accessing pixels in two 16-bit page-mode video-refresh cycles rather than one 32-bit cycle, the number of required RAM chips is reduced from 32 to 16, and the width of the display bus is reduced from 32 bits to 16 bits.

**Multilevel graphics software**

The IWS graphics workstations provide software

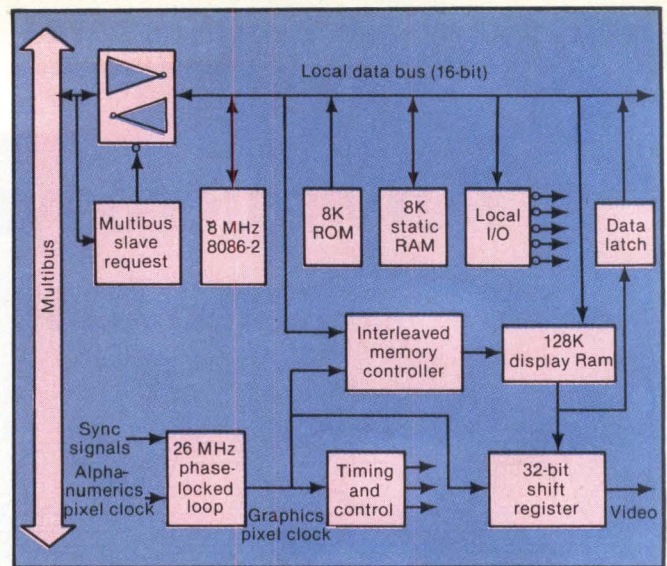


Fig. 2. Graphics board incorporates 8086 CPU and 128K bytes of display RAM, and is Multibus-compatible.

interfaces at both the system level, for OEM flexibility, and the application level, for end-user ease of use.

The system-level interface consists of a set of standard graphics primitives or procedures that provide a programmer with control over the full range of features of the graphics processor. The graphics primitives fall into two classes: device-dependent and device-independent routines.

Device-dependent primitives are those that are specific to the IWS graphics board in terms of resolution and capabilities such as Draw Line Absolute and Set Vector Mode Absolute. This level of software support is aimed at those applications that require a close interface to the hardware for maximum performance.

Device-independent routines are those that allow system designers to create images that can run on Convergent graphics workstations and output devices of any resolution. These routines fall into five categories:

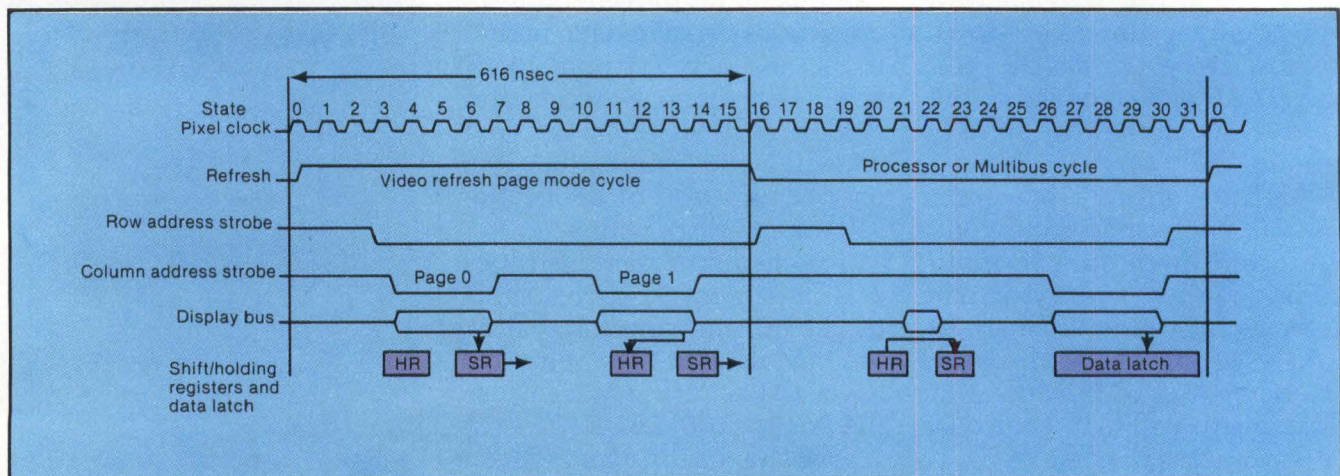
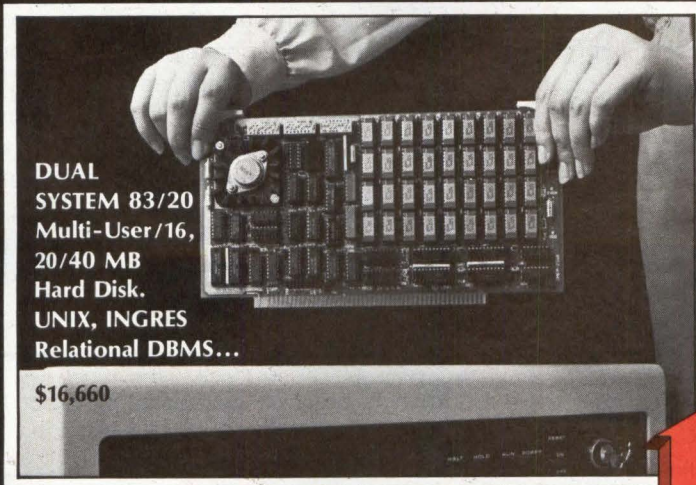


Fig. 3. Interleaved synchronous display memory controller scheme provides close coupling between the local graphics processor and the memory. Refresh cycles use page mode, reducing the number of dynamic RAM chips from 32 to 16.



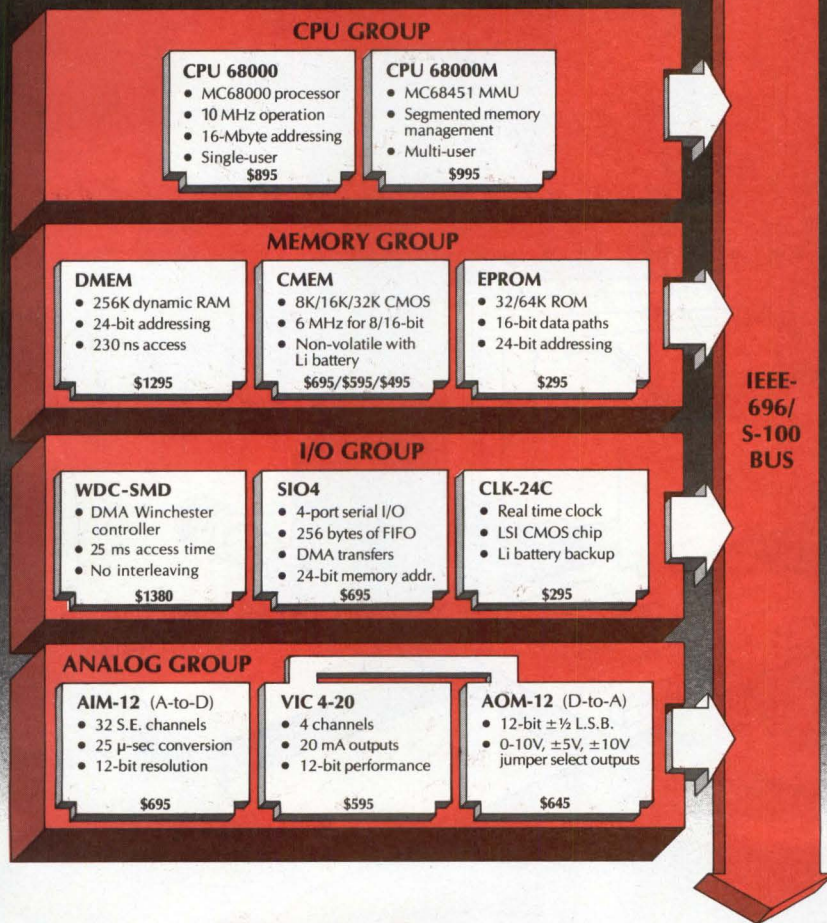
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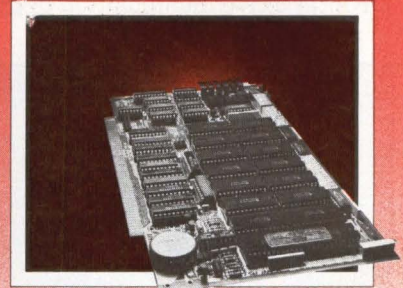
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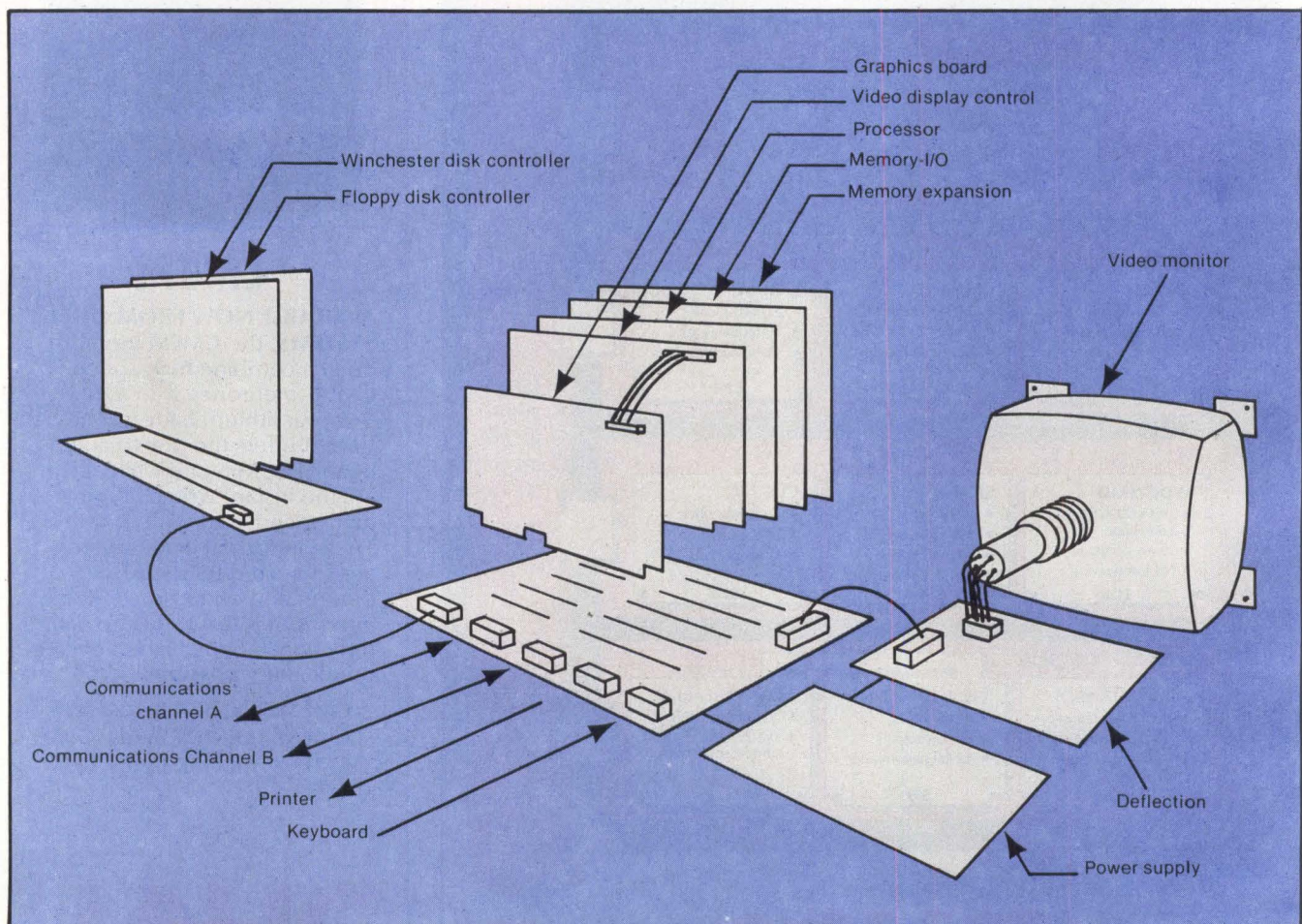
Application-level software support consists of enhancements to the standard Convergent high-level programming languages for simple creation, manipulation and storage of graphics objects. For example, with a single parameterized statement, a pie chart can be drawn from BASIC, FORTRAN, COBOL or Pascal.

The IWS workstations also provide a business graphics plotting package designed to be used as part of an OEM's office-automation product. This package allows for interactive manipulation of graphics images such as

bar, line and pie charts. Multiple graphs or labels can be merged into a single picture and moved and scaled interactively via single-keystroke commands. Shading of charts and font styles of labels can also be changed. A single keystroke saves a picture on disk or outputs it directly to a color pen plotter. The picture can be plotted on standard 8½- × 11-in. paper for reports or on transparencies for viewgraphs.

This graphics cut-and-paste capability is accessible to Multiplan, Convergent's financial-planning and modeling package, through a transparent interface. Tabular data generated in Multiplan can be graphed immediately with a few Multiplan commands, and the resulting graphs can then be manipulated. A user can quickly return to Multiplan to change data and then regraph the new data. The business graphics package interface is designed so that OEMs can easily provide their own data-entry front ends other than Multiplan. □

**Drew Hoffman** is graphics development project leader at Convergent Technologies, Santa Clara, Calif.



**IWS electronics** consists of five PC assemblies mounted vertically in a card cage that supports four Convergent CT-BUS boards, and two or five Multibus-compatible boards. The five assemblies comprise the IWS graphics board, a video-control board, a processor board, a memory-I/O board and an optional memory-expansion board. The last four assemblies are linked through the CT-BUS bus, separate from the Multibus logic, which supports the graphics board. Additional Multibus masters or slaves can be added to the system for customized I/O or additional processors.



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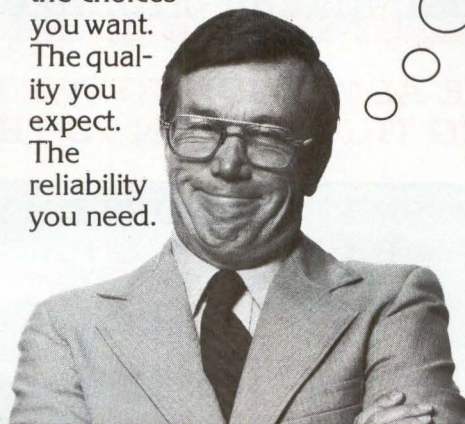
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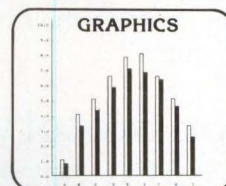
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# MP/M-86 handles real-time and multi-user business applications

FRANK HOLSWORTH, Digital Research, Inc.

*OEMs can tailor this 16-bit multi-user operating system to different applications without losing software compatibility*

As competition heats up in the 16-bit microcomputer market, OEMs are looking for ways to differentiate their products while maintaining compatibility with existing software. Digital Research, Inc.'s MP/M-86 operating system provides one possible solution, offering a modular design that facilitates customizing and is compatible with CP/M-86 software. The multi-user, multitasking operating system provides 8086-based systems with real-time capabilities based on system queues, and file-security features for business applications.

## Modules make customizing easier

MP/M-86 comprises several modules, each responsible for a set of physical or logical functions (Fig. 1). This modularity allows OEMs to adapt MP/M-86 to several hardware environments and applications with minimal effort. The modules are the extended input/output system (XIOS), the real-time monitor (RTM), the basic disk operating system (BDOS), the supervisor (SUP), the memory manager (MEM) and the character input/output manager (CIO).

The XIOS is of a set of simple routines that serves as the hardware interface. The XIOS handles physical disk and console I/O, the real-time clock, interrupt routines and memory selection for systems with memory-management hardware. OEMs adapt the XIOS to fit different hardware environments.

The other MP/M-86 modules are hardware-independent. The BDOS handles file management,

calling on the XIOS for physical file operations. The RTM controls process scheduling and communication. The TMP is a shared-code program that runs as an application program, serving the MP/M-86 user interface; it can be modified or replaced by OEMs to suit specific applications. Intermodule communication is handled by the SUP. The MEM supports shared-code programs and, as it becomes available, hardware memory management. As many as 254 character devices, such as consoles and printers, can be configured through the CIO.

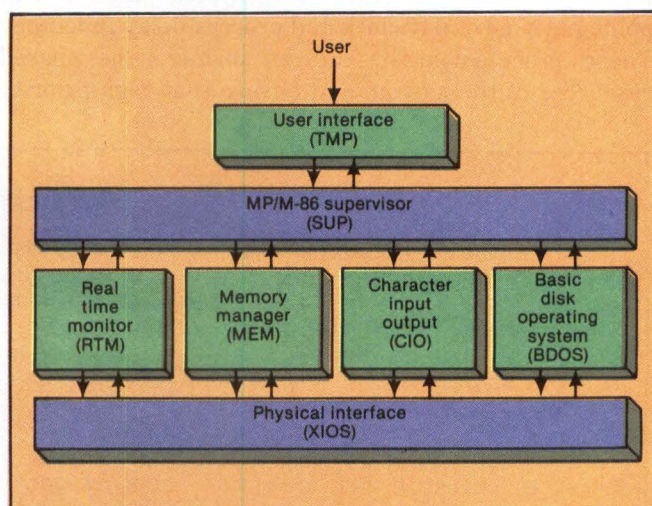


Fig. 1. MP/M-86 modular design separates all physical I/O in the XIOS. Other modules access I/O via system calls to the XIOS.



Minimum hardware requirements for MP/M-86 are an 8086, 8088 or a compatible microprocessor, a real-time clock and 64K bytes of RAM. The MP/M-86 kernel takes up less than 40K bytes, but 128K bytes is a suggested minimum for OEMs that intend to reconfigure the system. Special file-system and memory-management modules will be available for more sophisticated systems and memory-management hardware.

Because it contains a BDOS module compatible with other 16-bit Digital Research operating systems, OEMs can offer MP/M-86-based systems to customers using single-user CP/M-86 or single-user, multitasking Concurrent CP/M-86. All CP/M-86-compatible software runs unchanged under Concurrent CP/M-86 or MP/M-86.

*Physical processes are mapped within the operating-system kernel, communicating in real time.*

Because all Digital Research operating systems have compatible file structures, files created under 8-bit CP/M can be transported to MP/M-86-based systems without modification. Companies that developed languages for 8-bit CP/M are already developing versions for CP/M-86, facilitating the conversion of application programs from 8- to 16-bit environments.

### Real-time monitor

The real-time monitor (RTM) is the module responsible for MP/M-86's real-time and multitasking capabilities, controlling process creation, deletion, dispatching and communication (Fig. 2). The RTM also manages the logical interrupt structure using system flags, device polling, a time of day clock and process-delay functions. These process-control features manage the shared resources of the system and ensure that high-priority

tasks are accomplished.

Under MP/M-86, processes are represented by process descriptors. Combined with its extension, the user data area, a process descriptor contains all the information needed to manage a process, including state information, register locations and interrupt vector save areas for a process that is out of context.

*The BDOS handles file management, calling on the XIOS for physical file operations.*

All process descriptors are maintained on system lists. For example, all processes that are ready to run are maintained on a ready list, which consists of linked process descriptors maintained in priority order. When a process descriptor is inserted into a system list, it is placed in front of the first process descriptor that has a lower priority. The currently running process is always

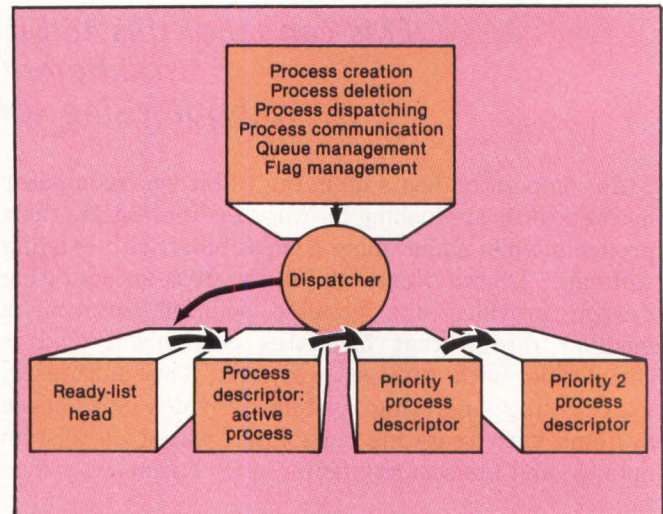


Fig. 2. Real-time monitor in MP/M-86 performs process-control and communication tasks. Processes are run on a priority-driven schedule, with processes of equal priority run on a round-robin basis. Priorities are established through a ready list, with the active process at the head of the list followed by processes in descending priorities.

### MP/M-86 UTILITIES

ABORT Terminate an active process  
 ASM-86 8086 assembler produces HEXfiles  
 ATTACH Attaches a program in the background to the console  
 CONSOLE Shows the current console number  
 DDT-86 Assembly-level debugger  
 DIR Shows files in current directory  
 DSKRESET Resets a disk drive for removal  
 ED Text line editor

ERA Erases disk files  
 ERAQ Erases disk files with query  
 GENCMD Produces command files from HEX files  
 GENSYS System generation  
 PIP Copies files between devices  
 PRINTER Shows and changes the default printer  
 REN Renames a file  
 SDIR Extended DIRSET Sets file and system attributes  
 SHOW Shows drive and system

attributes  
 SPOOL Spools disk files for printing  
 STAT Shows disk drive and file status  
 STOPSPLR Stops a file from printing  
 SUBMIT Executes a series of commands that have been placed into a disk file, allows SUBMIT commands anywhere within other SUBMIT scripts  
 TYPE Shows the contents of a disk file  
 USER Shows and changes the default user number



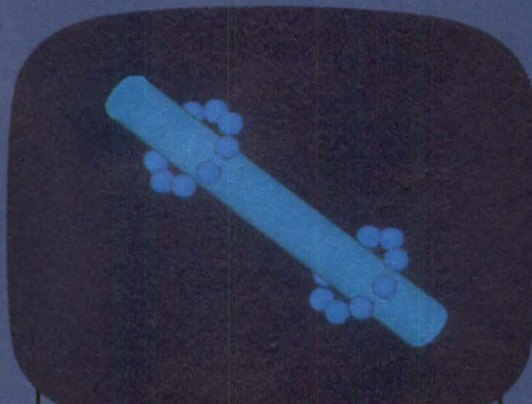
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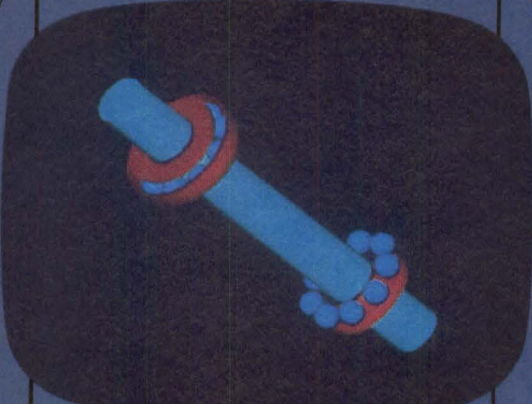
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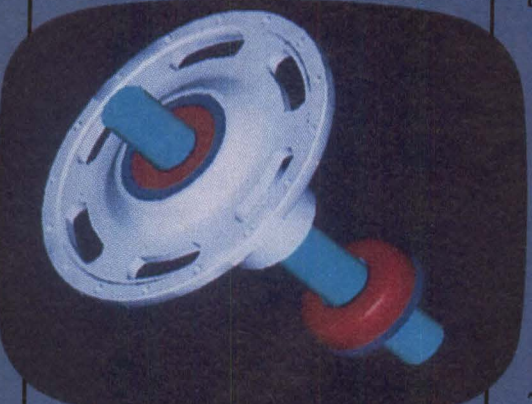
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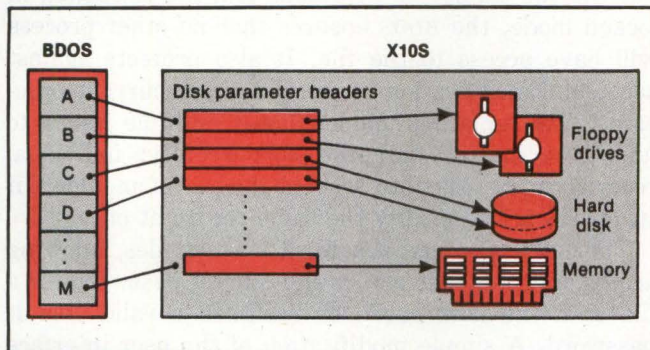


at the head of the ready list.

The portion of the RTM that changes currently executing tasks is called the dispatcher. The dispatcher is called by a process every time a resource is needed or released within the operating system. It is also called at every system tick, which occurs 60 times per sec. in a typical MP/M-86 system. During a dispatch, the process descriptor at the head of the ready list is placed in a

*Each device that has a process waiting for it is polled at every dispatch.*

different system list, or in a different position on the ready list, depending on why the dispatcher was called. If the process is still ready to run, it is re-inserted into the ready list. If it has the highest priority, it stays on the top. If its priority is the same as a number of other processes, it is inserted below those processes, allowing round-robin scheduling for equivalent priority processes.



**Logical-to-physical drive mapping** is handled by a table of disk parameter headers in the XIOS. Files can be assigned to disks or to memory.

The RTM maintains a logical interrupt structure using system flags. A process that must wait for an interrupt calls the flag-wait function, which places that process in a waiting state. Through the dispatcher, the process is removed from context. Other processes can then run until the appropriate interrupt occurs, at which point the interrupt routine calls the flag-set function, which initiates the process. This scheme allows real-time response to the interrupt.

The number of system flags in MP/M-86 is determined in system generation, and their uses are defined through the XIOS. An arbitrary interrupt structure can thus be mapped into a logical interrupt structure.

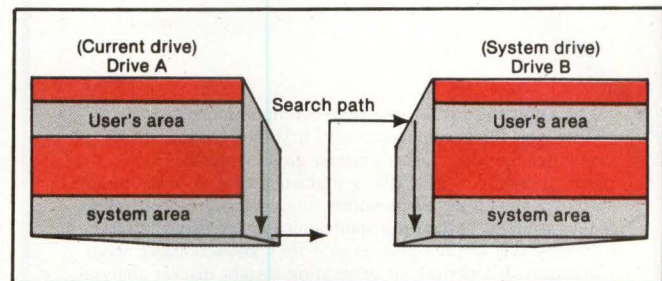
When a process must wait for I/O, and the physical I/O

device is not interrupt driven, the RTM uses the poll-device function. The poll-device function places the current process on the poll list, removing it from context and allowing other processes to run. Each device that has a process waiting for it is then polled at every subsequent dispatch. If the device is ready, the process is placed into the ready list.

### Process communication via system queues

The RTM uses system queues to provide process communication, synchronization and mutual exclusion. Queues are resource-management mechanisms that serve a function similar to that of the "pipes" for UNIX. Unlike pipes, however, queues allow variable-sized messages to be written and read from any number of processes at once.

Processes communicate through a queue typically created by one of the processes. Each queue has an eight-character name. Once a queue is created, any process can open it, read it and write messages in it. While the length of message is defined when the queue



**A command file search** is initiated when a user types a command. The BDOS first searches for the command in the user's assigned area on the current logical drive (each user is assigned an area on each logical drive, with one area reserved for the system). If the command is not found, the BDOS looks at the system area on the current drive, then the user's area on the system drive and finally the system area on the system drive.

is created, the content of the messages can be arbitrary and are defined by the cooperative processes that use the queue.

There are many cases in which one process must wait for a certain point in the execution of another process to begin. This is called process synchronization, and is accomplished by having the process read such a message from an empty queue.

Mutual synchronization can be achieved through system queues, as well. If two processes must be synchronized, but it is not known which will arrive first, the processes can be synchronized using two queues, each containing one message. The first process reads from the first queue and immediately writes into the second queue. The second process reads from the second queue and writes to the first queue.

Because processes can communicate with each other through queues, MP/M-86 can manage sets of mutually dependent tasks typical in industrial process control. Physical processes are mapped within the operating-



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system kernel, communicating in real time. The application program can simultaneously monitor the processes and respond quickly with the appropriate control data.

**File security**

A multi-user, multitasking operating system is often used with a shared centralized database. Consequently, security features, such as file and record lockout and password protection, that enable users to protect their data are essential. These security features are provided in MP/M-86 through the BDOS module.

*A simple modification forces a user to specify a password to gain access to the system.*

MP/M-86 files can be opened in one of three modes: read-only, locked or unlocked. If a file is opened in the read-only mode, it can be opened by other processes in read-only mode. Multiple processes can access the file, but the file cannot be modified. If a file is opened in locked mode, the BDOS ensures that no other process will have access to the file. It also protects against accidental modification by unrelated, concurrent processes. The unlocked mode allows multiple users to update a master database concurrently; individual records can be locked to prevent the loss of an update if two users try to modify the same record at once.

The BDOS also can password protect files, allowing access only if a user enters the correct password for a file or if the user has been assigned a valid default password. A simple modification of the user interface sets a password into a LOGIN file, which forces the user to specify the password to gain access to the system. The BDOS also can stamp each file with the date and time of the last modification and a date of creation or last access. Such features reduce the chances of errors or tampering in a shared-database environment.

**Frank Holsworth** is product engineering manager of the Operating System Division of Digital Research, Inc., Pacific Grove, Calif.

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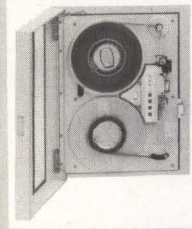


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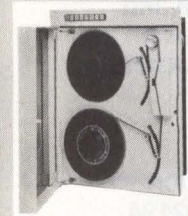
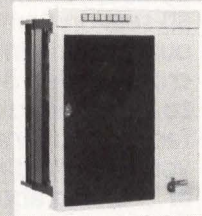
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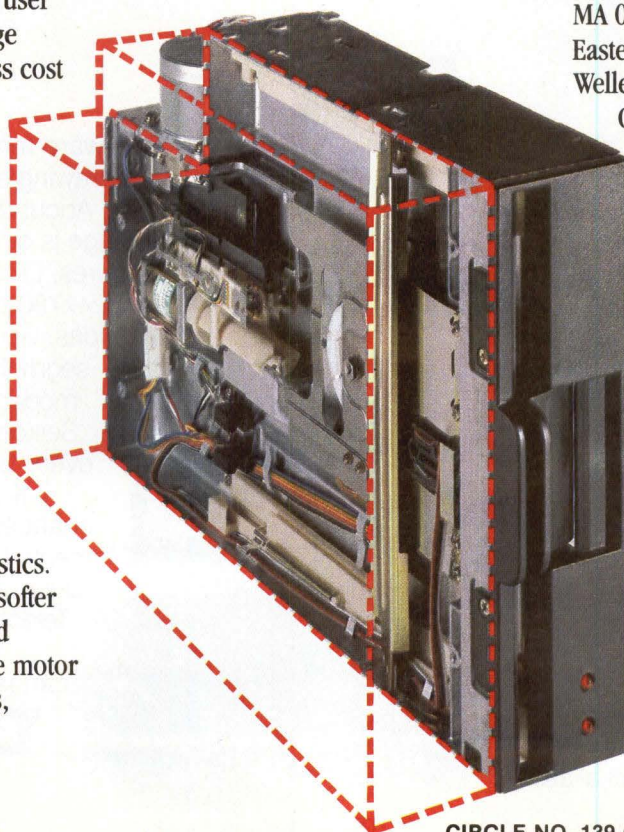
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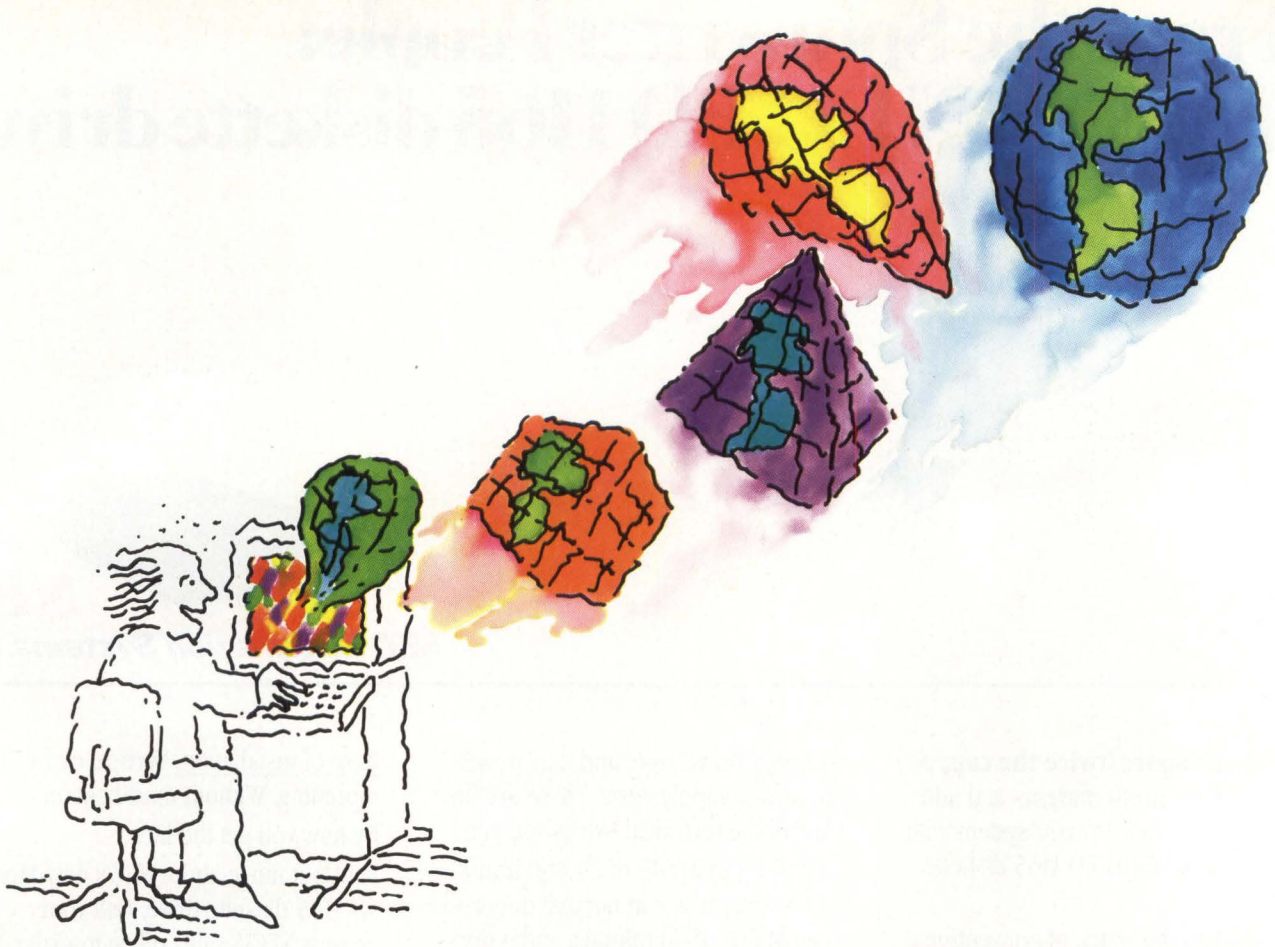
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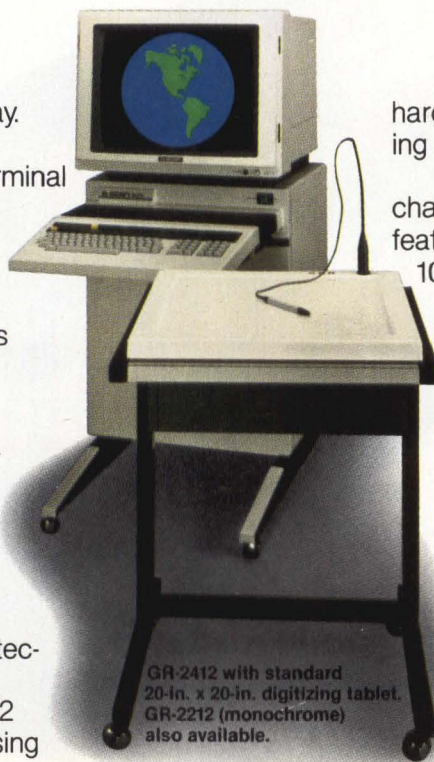
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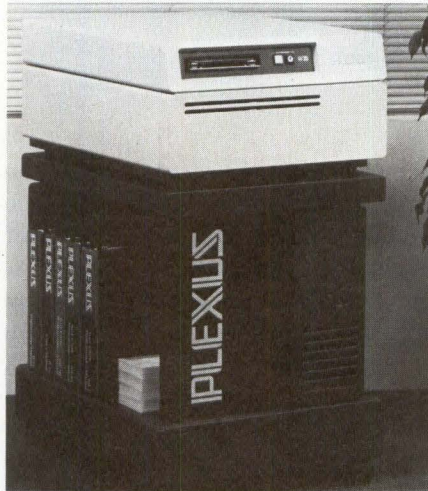
Plexus Computers has introduced two 16/32-bit MC68000-based systems that offer VAX 11/780 performance at prices beginning at \$13,500 in OEM quantities. The new systems are targeted for use by OEMs, large end users and systems houses.

The two new supermicrocomputers, called the P/35 and P/60, are designed to use the UNIX System III operating system and incorporate a multiprocessor architecture consisting of a central job processor that handles only the primary computational tasks and intelligent I/O processors that handle the I/O workload.

The central processor of the P/35 and P/60 is a proprietary Plexus module based on the MC68000 microprocessor operating at 12.5 MHz. It is augmented by five on-board performance assists including a cache memory implemented as 4K bytes of 45-nsec. static RAM, a RAM bank implemented as 16K bytes of static RAM, a hardware memory map, a 32-bit dedicated memory path and DMA.

Each I/O processor includes its own 16-bit Z8000 microprocessor and local memory. Down-loaded with instructions from the job processor, an intelligent communications processor is dedicated to data communications and terminal handling. An ICP supports eight serial ports and one parallel port. An intelligent mass-storage processor, down-loaded with UNIX code, supports disk and tape I/O.

The P/35 is a tabletop system that supports as many as 16 users. A basic, single-user P/35 system, with 512K bytes of main memory, 22M bytes of on-line, 8-in., Winchester disk storage, an MC68000 job



**The Plexus P/35 supermicrocomputer system** can be used in applications that call for heavy computational and data analysis loads in addition to terminal I/O. These applications include decision support, inventory analysis and economic and financial modeling.

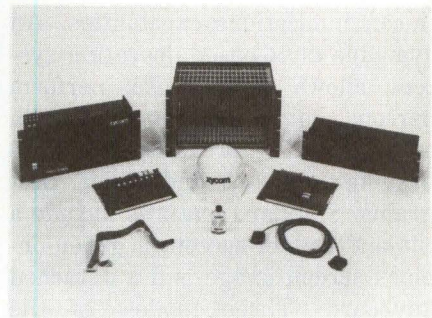
processor and a built-in cartridge tape drive, is priced at \$13,500 in OEM quantities. An eight-user version sells for \$15,000 in OEM quantities.

The larger P/60 supports as many as 40 users. An eight-user P/60 system, with 512K bytes of main memory, 72M bytes of on-line, 14-in., Winchester disk storage and streaming nine-track tape drive, is priced at \$32,250. **Plexus Computers, Inc.**, 2230 Martin Ave., Santa Clara, Calif. 95050. **Circle No 350**

### Portable computer uses 6502 microprocessor

The Olympia portable computer features a 1-MHz 6502 microprocessor, a memory capacity of 116K bytes—64K bytes of ROM and 52K bytes of RAM—a 26-character LCD and a 65-character keyboard with

three user-definable keys. An internal battery pack enables the unit to remain operational for as long as 40 hours. Application software is contained on ROM capsules that plug into the primary unit. The OPC's standard capabilities include a 10-digit calculator, a clock/controller and a file system. Options include an RS232 port, an acoustic modem, a TV adapter, a thermal printer, an AC adapter and an I/O adapter. Price is \$380 in single-unit quantities. **Olympia USA**, Box 22, Somerville, N.J. 08876 **Circle No 351**



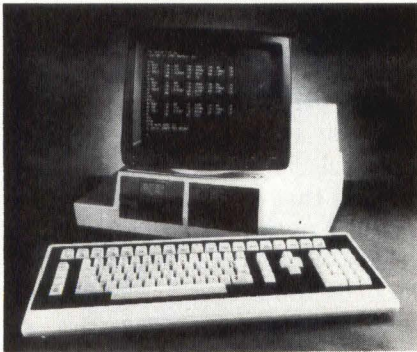
### Microcomputer starter kit features industrial BASIC

The 180+ industrial microcomputer starter kit includes a microcomputer module and a memory module with 32K bytes of EPROM containing the industrial BASIC system plus 14K bytes of battery-backed RAM for user BASIC programs and sockets for an additional 14K bytes of EPROM for user programs. The set also includes a 20-slot chassis, a rack-mounted power supply, RS232 communications adapters for connection to a terminal and to a serial printer, cassette unit or other device, a communications adapter rack with power supply for as many as three more communications adapters, cables and a 250-page industrial BASIC user's manual. Price is \$4790 in single-unit quantities. **Xycom**, P.O. Box 984, Ann Arbor, Mich. 48106. **Circle No 352**



# Systems

NEW PRODUCTS

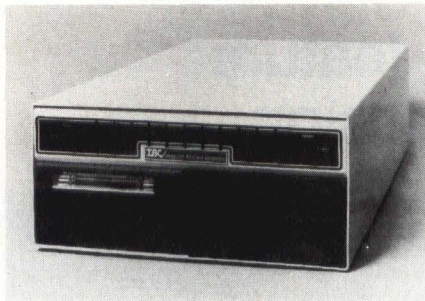


## Information processors fill personal-computing needs

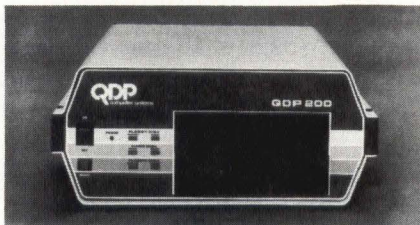
The RDS-200 series of information processors combines word-processing features with data-processing, records-processing and data-communications capabilities. An available CP/M-based operating system allows a user to perform personal computing functions such as electronic spread-sheet, database-management and BASIC programs. Standard features include a tilt and swivel screen, a green-on-black screen image and a detached keyboard. Three models of the RDS-200 series are offered. The entry-level, non-menu-based RDS-200 with word-processing software and a 20-cps printer is priced at \$6495. The models RDS-201E and RDS-202E, priced at \$7995 and \$9745, respectively, are single- and dual-floppy disk drive versions of the basic model and feature many menu-based productivity aids. **Raytheon Data Systems**, 1415 Boston-Providence Turnpike, Norwood, Mass. 02062. **Circle No 353**

## Multi-user microcomputer features five processors

The Middi-Cadet and the Ensign are high-performance, multi-user microcomputer systems. The five-processor Ensign computer system supports as much as 8M bytes of main memory, more than 1G byte of SMD-type disk capacity, a cartridge-tape drive, a nine-track reel-to-reel tape drive and networking and



communications capabilities. The main CPU is the Motorola 68000 running at 8 MHz with no wait states. Two Motorola 6801 processors handle all serial I/O for as many as 32 users. A 6-MHz Z80B microprocessor supervises all disk and tape I/O, and another Z80B processor is used for memory management. The Ensign supports the OASIS-16 and UNIX operating systems. An eight-port Ensign system is priced at \$15,595. The Middi-Cadet, priced at \$7500, features a 6-MHz Z80B microprocessor, 256K bytes of RAM, 10 serial I/O ports, one Centronics port, a 20M-byte, 5¼-in. Winchester disk drive and a 1M-byte floppy disk drive. Options include a cartridge-tape controller, cache memory and bisynchronous communications hardware. The Middi-Cadet supports single- and multi-user OASIS, CP/M 2.2, MP/M II and MVT-FAMOS. **IBC/Integrated Business Computers**, 21592 Marilla St., Chatsworth, Calif. 91311. **Circle No 354**

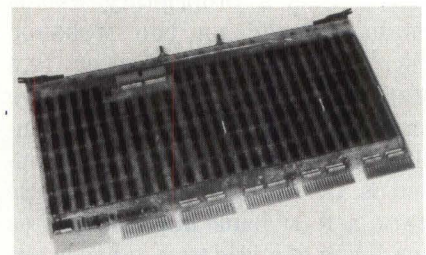


## User-friendly micro features slim-line floppies

The three-slot, S-100 bus model QDP-200 microcomputer features 64K bytes of RAM, an enhanced version of the CP/M operating

system and an on-line help facility for CP/M, MP/M and system utilities. Two slim-line, 8-in., double-sided, double-density floppy disk drives that store 1.2M bytes each are standard, and the model is also available with one drive. One 10M- or 15M-byte, 5¼-in. hard disk is optional. The model also features a programmable floppy disk drive shut-off that extends drive and media life. Using a 4-MHz Z80A microprocessor, the QDP-200 has two serial and two parallel ports and a real-time clock. The single-user system is available with the vendor's cache-memory disk buffering. The single- and dual-drive versions are priced at \$2995 and \$3495, respectively. **QDP Computer Systems**, 10330 Brecksville Rd., Cleveland, Ohio 44141.

**Circle No 355**



## Processor module is PDP-8 compatible

The CPU 8 PDP-8 processor replacement is hardware compatible with DEC HEX-wide Omnibus backplanes and software compatible with all PDP-8 software. It features a cycle time of 1.2  $\mu$ sec. and requires 5V DC at 2.2A. Its instruction set includes six memory-reference instructions, 20 microprogrammable operate microinstructions and eight I/O transfer instructions for each of as many as 64 I/O devices. The board measures 8½ × 15¾ in. Single-unit price is \$995. **Computer Extension Systems, Inc.**, 17511 El Camino Real, Houston, Texas 77058.

**Circle No 356**



# FOR SERIES/1: GET REMOVABLE AND FIXED STORAGE IN ONE DRIVE.



Easy to operate, with reliable front-loading disk cartridges.

13.3 Mbytes *removable* storage per cartridge, 64.5 Mbytes *fixed* storage per drive.

Fast, simple back-up: data can be easily copied from fixed to removable storage.

Save space: Dual CMDs mount in a single cabinet for 155.6 Mbytes of storage.

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# Systems

NEW PRODUCTS



## STD bus microcomputer includes Z80 or 8085 CPU

The ISB 80/85 stand-alone microcomputer with STD-bus-expansion capability includes a Z80 or an 8085 CPU card, a 64K-byte RAM card, a 12-in. CRT, a detachable keyboard and either two 5¼-in., dual-sided, dual-density floppy disk drives or one 5¼-in. floppy disk drive and one 10M-byte, 5¼-in. Winchester disk drive. Users can add as many as six STD bus cards to the built-in slim-line card cage. A fully integrated ISB-ICP/M operating system based on CP/M 2.2 is supplied along with a standard software package. Prices range from \$5990 to \$8990 in single-unit quantities. **Intersil Systems, Inc.**, 1275 Hammerwood Ave., Sunnyvale, Calif. 94086.

Circle No 357

## Computer system is expandable

Based on the MC68000 microprocessor, the Pertec 3000 16/32-bit microcomputer system supports as many as 19 terminals or printers in any combination as well as more than 1M byte of RAM and 100M bytes of mass storage. The basic system is equipped with 256K bytes of memory, one 8-in. Winchester disk drive with a storage capacity of 26M bytes, one 8-in. floppy disk drive with a 1.6M-byte storage capacity, one ¼-in. streaming cartridge-tape drive and three RS232 ports. Expansion capabilities include as much as 1.18M bytes of RAM, as many as three add-on Winchester disk drives and as many as 16 additional RS232 ports. The Pertec 3000's operating system supports Assembler, C compiler and Business BASIC languages and runs a variety of applications including order processing, billing inventory management, sales analysis, general accounting, financial planning, job costing, manufacturing and word processing. Price is less than \$19,000. **Pertec Data Systems**



**Division**, 17112 Armstrong Ave., Irvine, Calif. 92714.

Circle No 358

## Compact microcomputer is DEC compatible

The MDX-11 LSI-11-based 16-bit microcomputer contains a DEC-compatible Q-bus backplane that can be configured with the LSI-11/2 or LSI-11/23 CPU. The quad-sized backplane can accommodate as many as eight dual-height Q-bus cards. The system can be configured with as much as 10M bytes of 22-bit memory. The MDX-11 includes a 10.6M- or 15.9M-byte 5¼-in. Winchester disk and a double-sided, double-density, slim-line floppy disk drive that is RX02 compatible. Its SMS FWD0106 disk controller allows automatic recognition of DEC floppy

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With ATC's new Model 195 plug-in conversion the proven reliable Texas Instruments 810 RO printer performs encoding and printing of twenty barcode types including Code 39 with OCR A annotation. Simple user command statements energize ATC programs which simplify generation and printing of forms and labels.



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## MADE EASY

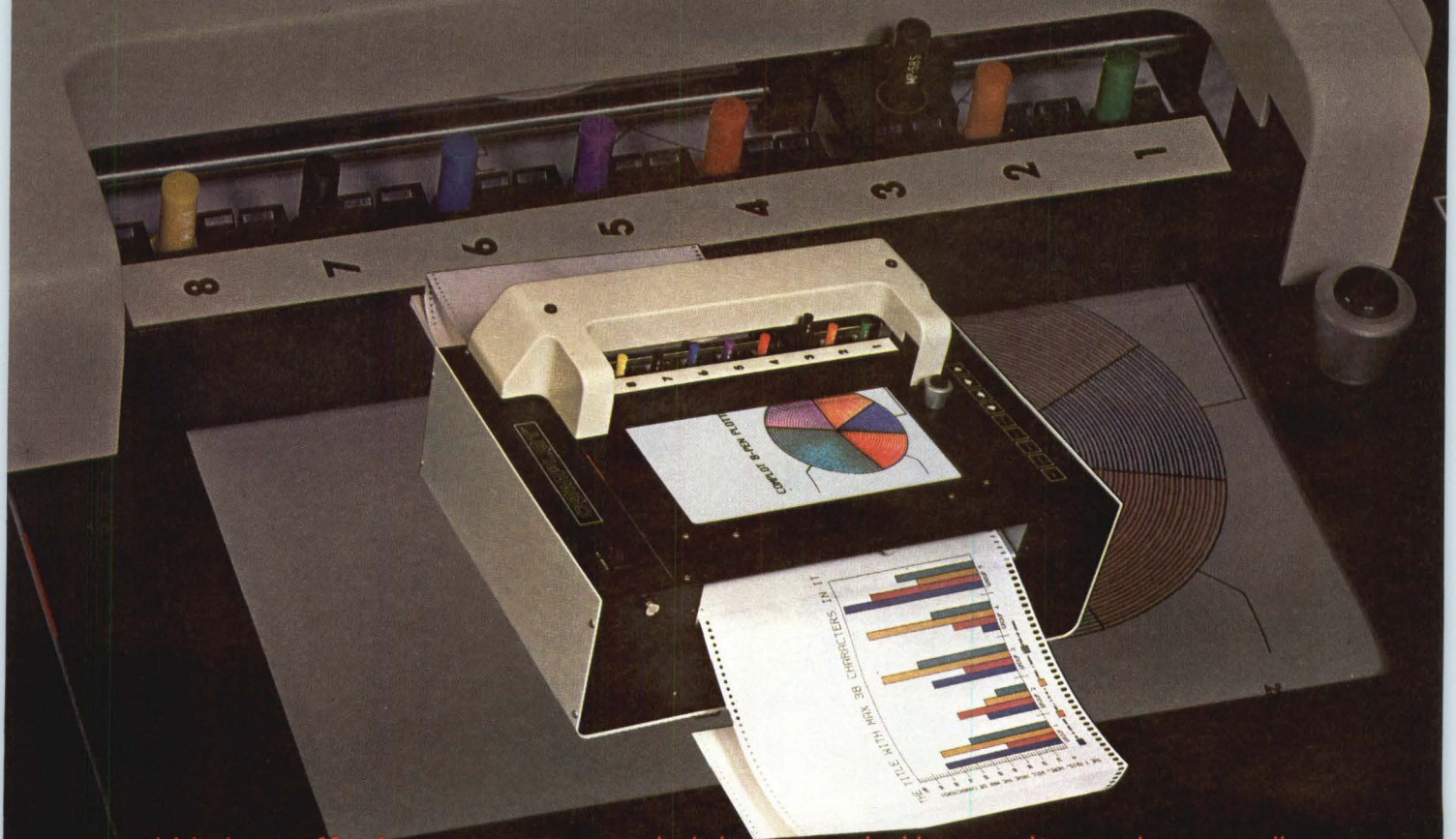
- Vary character size to 10 inches
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The CPS-20 is a solid performer from the broad lineup of Houston Instrument plotters. For example, a choice of built-in sophisticated firmware attributes enables novice and experienced operators alike to take advantage of a host of automated features. DM/PL™ spares you and your computer from low-level housekeeping chores, enabling you to get the most from your investment. DM/PL is compatible with previous firmware, and offers extensive options in plot formatting.

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Step size on the CPS-20 is only 0.005". When combined with a guaranteed accuracy within 1 increment on either axis, you are assured of precise virtually step-free traces.

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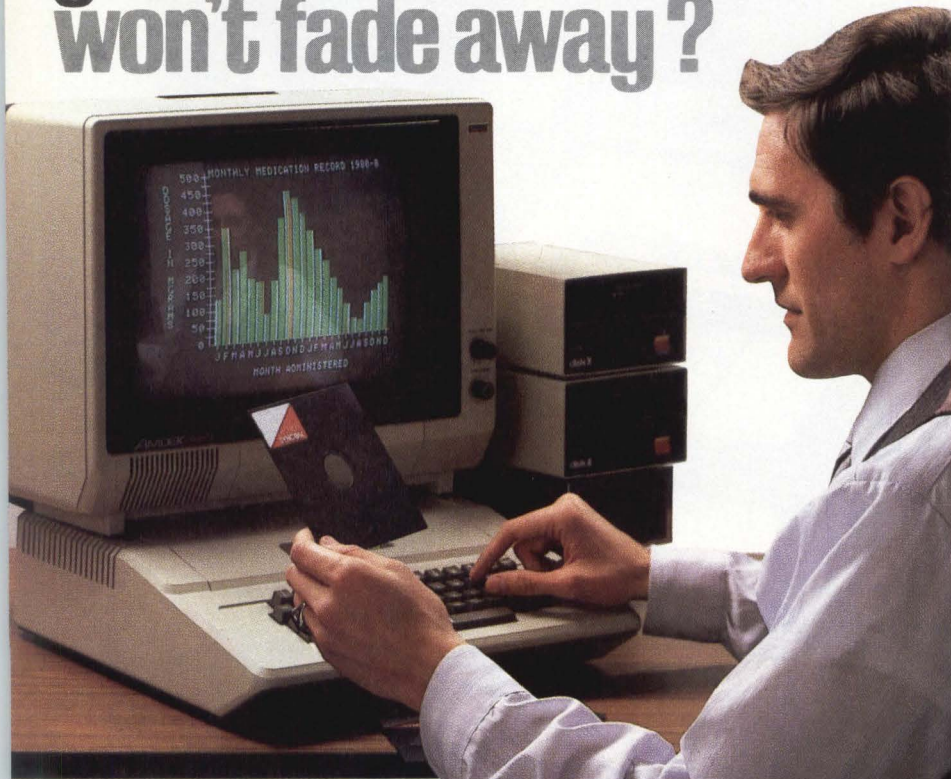
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Rely on SYNCOM diskettes with Ectype® coating. Balanced coercivity means long-lasting signal life.

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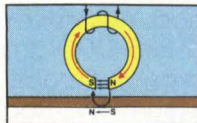
First, with calibrated coercivity — a precisely balanced blend of milled ferrous oxides that allows Ectype® coating to respond fully to "write" signals, for strong, permanent data retention.

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Balanced coercivity of Ectype® coating allows write current to saturate fully.

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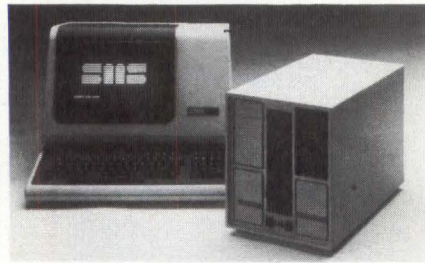
## SYNCOM

Manufacturer of a full line of flexible media

CIRCLE NO. 144 ON INQUIRY CARD

## Systems

NEW PRODUCTS



formats (RX01, RX02 and RX03) and IBM floppy formats (3740 and 2/2D). This 35-lb. tabletop microcomputer measures 11.2 × 9.5 × 17 in. Price for the 10.6M-byte version of the MDX-11 system without DEC CPU and memory is \$5700 in 15-unit quantities. Price for the 10.6M-byte version with LSI-11/23, 256K bytes of memory and DLV11-J is less than \$9000. **Scientific Micro Systems, Inc.**, 777 E. Middlefield Rd., Mountain View, Calif. 94043.

Circle No 359

### Computer runs CP/M-based application programs

The Micro 16S personal business computer system features two microprocessors (an 8-bit Zilog Z80 and a 16-bit Intel 8088), two 320K-byte, 5¼-in. floppy disk drives and 128K bytes of parity-checking RAM, expandable to 1M byte. The Micro 16S also has parallel and serial output ports and 640- × 200-dot resolution color graphics capability. The system has a detachable keyboard with separate numeric keypad and 10 programmable function keys. The CP/M-86 operating system, word-processing software and the SuperCalc electronic spread-sheet application program are standard. A 10M-byte, 5¼-in. Winchester disk and Omninet communications capability are optional. Price of the system, including software, 52K bytes of graphics RAM and a black-and-white monitor, is less than \$4000. **Fujitsu Professional Microsystems Division**, 2985 Kifer Rd., Santa Clara, Calif. 95051.

Circle No 360



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- with total compatibility with today's operating software.
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Our CacheStreamer Series uses a solid-state Cache memory to isolate its interface from its simple streaming mechanics. By emulating a true start/stop at the interface, CacheStreamer becomes a streamer that "thinks" it's a start/stop drive.

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Our answer is an internal data communications system you can do whatever you want with. Net/One™. A truly general purpose system that gives you everything you need, but doesn't lock you into one medium, one standard, one protocol. A system that makes as much sense for systems integrators as it does for sophisticated end users.

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What you need is a system that keeps all your doors open. You don't have to be closed into one way or another. And right now, there is only one local communications system that gives you the option of either broadband or baseband or both, with architecture that will allow you to add other media such as fiber optics in the future. Net/One, from Ungermann-Bass.

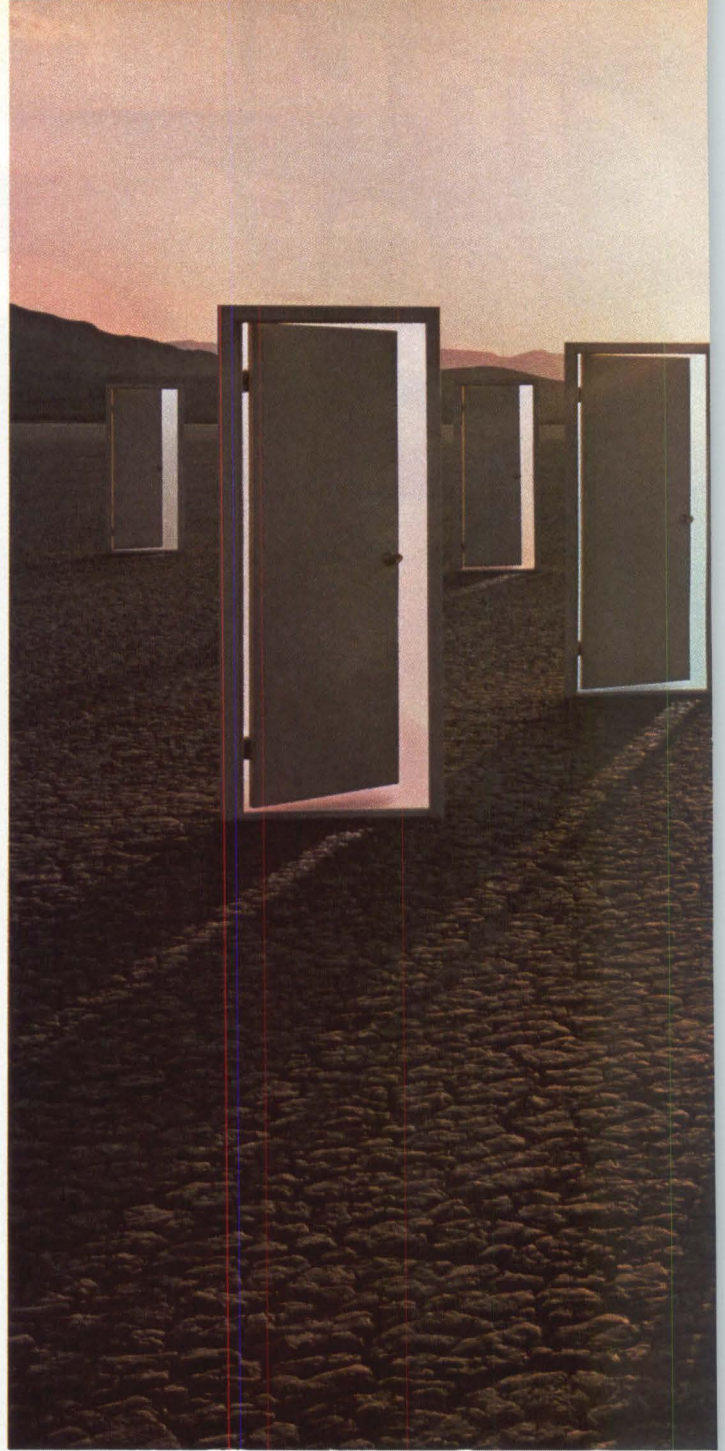
#### WHAT ABOUT COMPATIBILITY WITH SPECIAL EQUIPMENT?

Net/One supports the widest range of physical interfaces and software protocols on the market: RS-232 serial, IEEE-488, 8-16- and 32-bit parallel, RS-449, V.35, Async, Bisync, HDLC and DEC DR-11B/W™. And the list is expanding every month. But if your equipment interface isn't in that list, Net/One is the only local area network that is fully programmable at every level, so you can add whatever special interface protocols you need.

That programmability means your future equipment options are always open. You're free to choose information processing equipment based solely on capability, because with Net/One, you have the programming tools you need to assure compatibility.

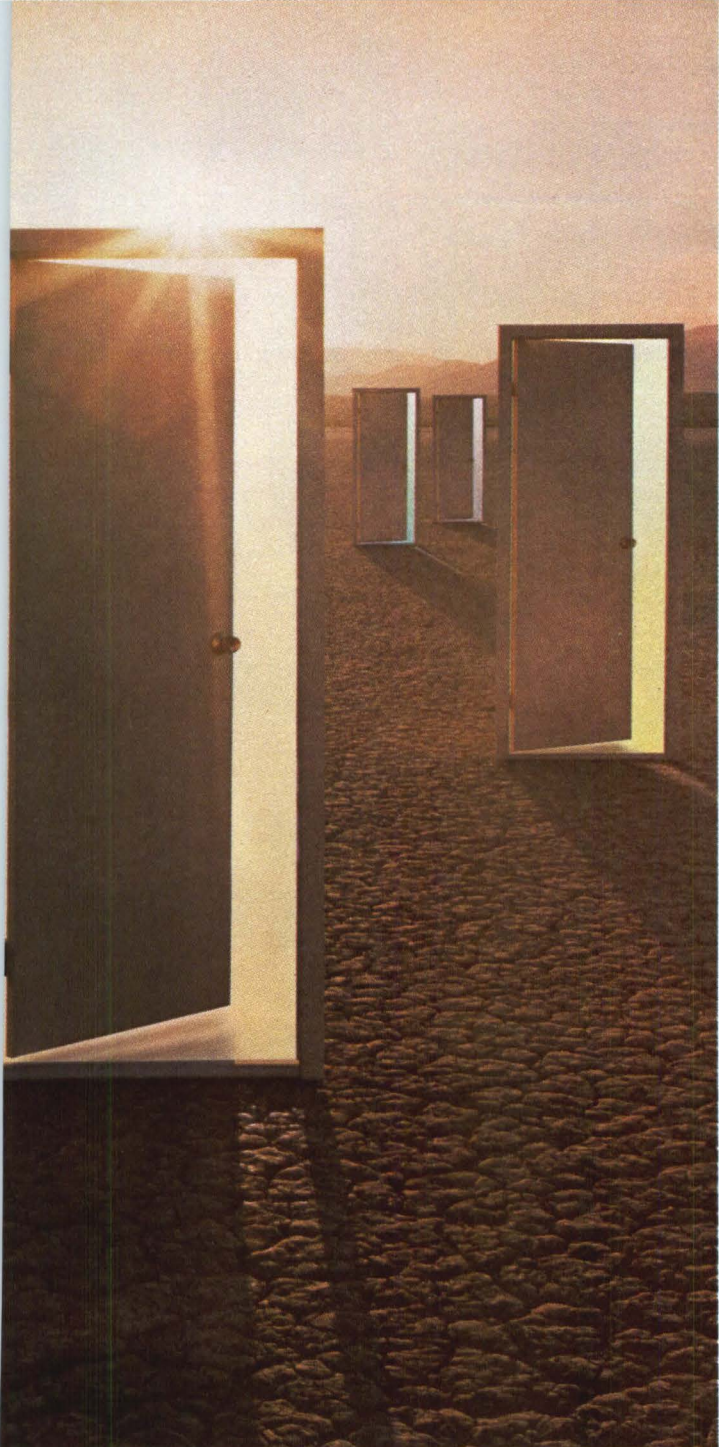
#### WHICH STANDARDS WILL END UP BEING PREDOMINANT?

We're not sure, either. Nobody is. That's why we



# Opt for a local area network that leaves you





leave that option open, too. Net/One can be adapted to any standard, at any time. Simply. We're not in business to sell one communications technology or another. What we do is provide efficient solutions to make your internal data network work, with the equipment you have now, with the equipment you may want to add, with public networks, with whatever you want.

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Based on advanced microprocessor design, the G-1000 meets your CAD/CAM requirements for high speed

interactivity. Add such features as a wide range of text and line styles, alphanumeric overlay, digitizer support and a variety of hardcopy options, and you'll understand why the Genisco G-1000 helped set the graphics standard. In addition, the G-1000 is software compatible with a growing number of application programs that include ANVIL™, DISSPLA™, DI-3000™, EIDS™, GARDS™, NISA™, PATRAN-G™ and TEMPLATE™. Or, a Software Development System is available to program special applications.

## Backed by Our Commitment to You

For nearly a decade, Genisco has maintained a commitment to design and production excellence. Now we

can promise you the most responsive support we know how to give through our nationwide service centers. Join the growing list of satisfied G-1000 users today. Call or write for more information to Genisco Computers Corporation, 3545 Cadillac Avenue, Costa Mesa, California 92626. (714) 556-4916.

\*Single unit price. Quantity discount available.

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## THE COMPETITION IS STILL GREEN WITH ENVY

# Genisco

Computer Graphics Display Products

CIRCLE NO. 150 ON INQUIRY CARD





# Peripherals

NEW PRODUCTS

## Half-height floppy drives give OEMs a choice

The 500 and 900 series of half-height, 5¼-in. floppy disk drives from Micro Peripherals, Inc., Chatsworth, Calif., cover the spectrum from entry-level consumer products to high-performance industrial products. With a number of packaging and performance options, the drives are intended to meet the needs of minicomputer and microcomputer system integrators.

The single-sided model 501C and the double-sided model 502C are targeted for low-cost, personal-computer applications. They feature 20-msec. track-to-track access times and store 250K and 500K bytes, respectively, using double-density recording techniques.

Small-business and word-processing systems are the key applications for the single-sided model 501 and the double-sided model 502. They feature 6-msec. track-to-track access times and have the same storage capacities as the models 501C and 502C.

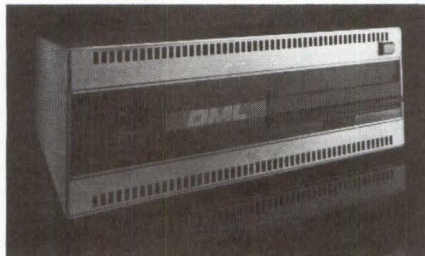
The single-sided model 901 and double-sided model 902, both 96 tpi, store 500K bytes and 1M byte, respectively, and are suited for industrial applications. They have 3-msec. track-to-track access times.

All six drives include split-band positioners, manganese-zinc heads, SASI compatibility, disk ejectors and a 250K-bit-per-sec. transfer rate. Options include a full-sized bezel on all six models and a half-height bezel with an IBM-type mechanical latch on the 501/502 and 901/902 versions. For applications in hostile environments, a head-loading solenoid can be provided.

Volume prices for the new family range from \$125 to \$265 each. **Micro Peripherals, Inc.**, 9754 Deering

Ave., Chatsworth, Calif. 91311.

Circle No 361



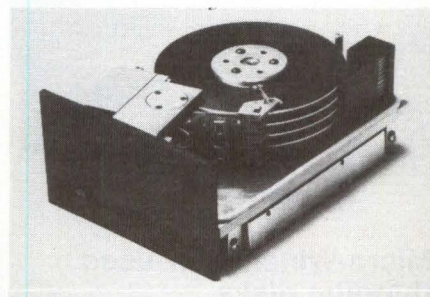
### Winchester for Intel systems stores 26.2M bytes

The model 1040 8-in. Winchester disk mass-storage subsystem gives Intel microcomputer development system users 26.2M bytes of formatted storage. The drive is ISIS-II compatible, has built-in error checking and correction and includes a selective backup and restore utility. It features a 4.36M-bit-per-sec. transfer rate and a 65-msec. average access time. The subsystem requires only one Multi-bus card slot. The model 1040, priced at \$9200, includes an 8-in. floppy disk drive that is software selectable to single- or double-density modes. The model 1041 without floppy disk drive is priced at \$8200. **Data Management Labs**, 2148 Bering Dr., San Jose, Calif. 95131.

Circle No 362

### Winchesters aimed at multi-user computer systems

The models V130, V150 and V170 5¼-in. Winchester disk drives offer 30M-, 50M- and 70M-byte capacities (unformatted), respectively, and a 30-msec. average access time. The drives use the ST412 interface and feature a 5M-bit-per-sec. data-transfer rate. The product line is targeted to high-performance computing systems and applications



including multi-user, multitasking systems and graphics/image-processing applications. The drives use a dual-frequency, closed-loop servo system to reduce temperature-induced read/write and off-track errors. This servo technology allows the drives to operate at 960 tpi. The V100 series is designed to operate with thin-film or oxide media. Prices range from \$1100 to \$1500 in moderate OEM quantities. **Vertex Peripherals**, 2150 Bering Dr., San Jose, Calif. 95131.

Circle No 363

### Half-height minifloppy has high capacity

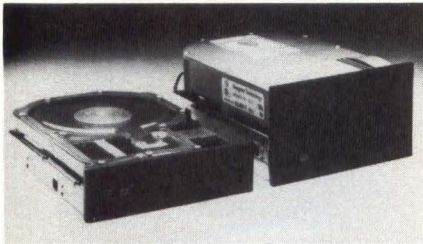
The half-height Drivetec 320 SuperMinifloppy offers an unformatted capacity of 3.33M bytes, a 160-msec. average access time and a 500K-bit-per-sec. transfer rate. The double-sided drive has a recording density of 192 tpi and uses a two-stepper head positioning system for accurate positioning over the desired track. Other features include an absolute-vertical clamping mechanism for diskette registration, an on-board microprocessor and brushless DC drive motor, an activity light and door lock, buffered track seek and downward compatibility with existing 48-tpi minidiskettes. Price is less than \$325 in OEM quantities of 1000. Manufacturing start-up of the drive is planned for the second quarter of 1983. **Drivetec**, 2140 Bering Dr., San Jose, Calif. 95131.

Circle No 364



# Peripherals

NEW PRODUCTS



## Micro-Winchester uses thin-film disks

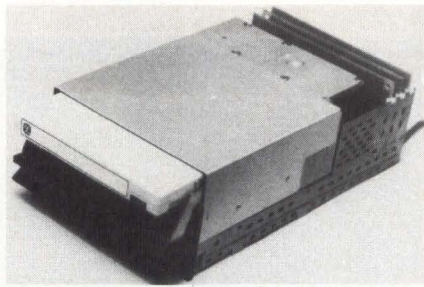
The model ST206 half-height 5¼-in. Winchester disk drive stores 6.38M bytes of unformatted data on two surfaces of a thin-film-plated rigid disk. The drive is compatible with the industry-standard Seagate ST506 interface and operates at a transfer rate of 5M bits per sec. Average access time is 85 msec. using a split-band positioner and stepper-motor-driven actuator. The Winchester is designed as a companion drive to a half-height floppy disk drive in single-slot intelligent terminals and portable computers. Price is \$745 in quantities of 500. Production units will be shipped during the second quarter of 1983. **Seagate Technology**, 360 E. Pueblo Rd., Scotts Valley, Calif. 95066. **Circle No 365**

## GCR tape system is Multibus compatible

Designed for use with Multibus computers, the MTC model 4000 GCR tri-density magnetic-tape system provides read/write capability at 6250 bpi (GCR), 1600 bpi (PE) and 800 bpi (NRZI) at tape speeds from 50 to 125 ips. The system can store 145M bytes of data on a nine-track reel of tape and features an average data-transfer rate as high as 630K bytes per sec. at 125 ips. Rewind speed is 500 ips. Software is provided for operation in the iRMX 86 environment or as a stand-alone procedure. The basic tape system including an MTC single-board Multibus-compatible controller, Telex tri-density model 6250 for-

matted tape transport, equipment rack, manuals and cabling sells for less than \$34,000. **Mesa Technology Corp.**, 16021 Industrial Dr., Gaithersburg, Md. 20877.

**Circle No 366**

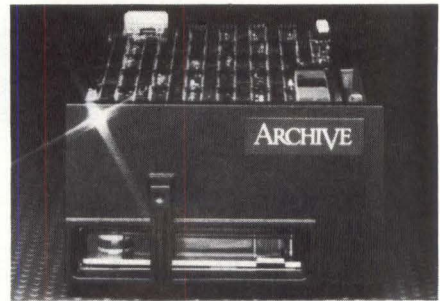


## Fixed/removable drive uses embedded-servo system

The model D520 5¼-in. Winchester disk drive stores 13M bytes on a fixed disk and 13M bytes on a removable disk cartridge. The new drive includes a 40-msec. average access time, a 5M-bit-per-sec. transfer rate, an embedded-servo tracking system and an ST706/DMA interface. The D520's removable cartridge is front loading and compatible with the proposed ANSI standard. The fixed disk and the removable cartridge each use a single oxide platter recorded on both sides at 860 tpi. MTBF of the drive is specified at 8000 power-on hours. The drive has the same mounting requirements and physical dimensions as a standard minifloppy or 5¼-in. Winchester drive. Evaluation units of the D520 will be available in April, with production units slated for mid-year. Price is \$1350 in 1000-unit quantities. **Cynthia Peripheral Corp.**, 3606 W. Bayshore Rd., Palo Alto, Calif. 94303. **Circle No 367**

## Tape drives fit into minifloppy cutout

The Scorpion series of ¼-in. streaming cartridge-tape drives stores 20M bytes on four tracks or 45M bytes on nine tracks. The



drives use a minifloppy form factor and can back up 5¼-in. Winchester drives from 5M to more than 50M bytes with data-transfer rates of 20M bytes in 4 min. and 45M bytes in 9 min. Intelligent versions of the Scorpion family stream at 30 or 90 ips and are designed for streaming environments at recording densities of 8000 bpi. The Scorpion series uses a front-loading cartridge that is media-compatible with existing Archive products. The Scorpion is also interface-compatible with all Archive products, using the industry-standard QIC-II interface. Prices start at \$800 in OEM quantities. **Archive Corp.**, 3540 Cadillac Ave., Costa Mesa, Calif. 92626.

**Circle No 368**

## Winchester drive stores 160M bytes

The Disctron model D-1600 8-in. Winchester disk drive stores 160M bytes (unformatted) using thin-film plating technology. Data are carried on four thin-film-fixed disks. Seven surfaces, each served by a dedicated read/write head, carry data. The eighth surface is reserved for track-following servo information. Average access time is 30 msec. The D-1600 has the same form factor as a standard 8-in. floppy disk drive. It uses standard +5V, +12V and +24V voltages. ANSI-standard and SMD interfaces are available. Price is \$1980 in OEM quantities. **Disctron**, 1701 McCarthy Blvd., Milpitas, Calif. 95035.

**Circle No 369**



# Easy on the eyes. Easy on the wallet.



There's only one thing more attractive than a monitor that's easy on the eyes — a monitor that's easy on the wallet.

Well, now you can have both. Because the new Comrex CR-5400 and CR-5600 are not only easy to read, but very, very competitively priced.

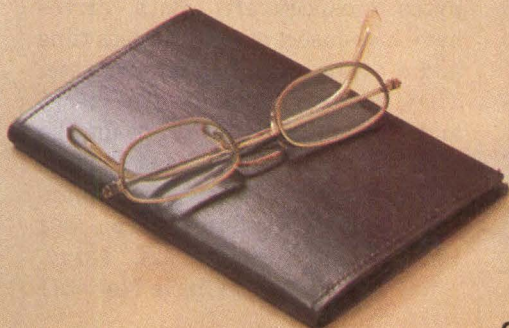
First, the differences. The CR-5400 features a 9" screen; the CR-5600 a 12" screen.

Now, the similarities. Both models have amazingly high resolution. And both give you a choice of three "easy-on-the-eyes" phosphors. Including green, yellow-green, and new amber.

That means, no matter what kind of lighting you have at your workstation, the data on your screen will come through bright and clear.

Sure, you could pay more for a monitor. But the Comrex CR-5400 and CR-5600 are two shining examples proving that a monitor that's easy to read can also be easy to buy.

Find out just how easy. The full line of Comrex monitors is at your nearby computer store.



**COMREX**

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CIRCLE NO. 147 ON INQUIRY CARD



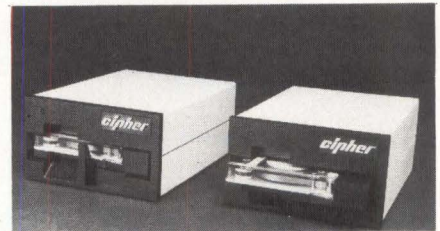
# Peripherals

NEW PRODUCTS

## Tape drive features new front-load design

The models 540-CT and 440-CT  $\frac{1}{4}$ -in. streaming cartridge-tape drives store 45M bytes and are compatible with the industry-standard QIC-02 interface. The

540-CT allows front loading of a standard-sized tape cartridge by turning the cartridge sideways for insertion. The unit can be installed in any system using the same mounting holes and having the same physical dimensions as any  $\frac{5}{4}$ -in.



## Home Sweet Home for Your Multibus\*

Finally there's a system chassis that is designed and manufactured with the thoroughness and care you expect in your Multibus system. It's Electronic Solutions' new Multichassis™.

- 9 slots, 0.6" spacing—or 7 slots, 0.75" spacing
- Hefty 4-output 300W power supply— 40A at +5V
- Cool operation even with high-density boards

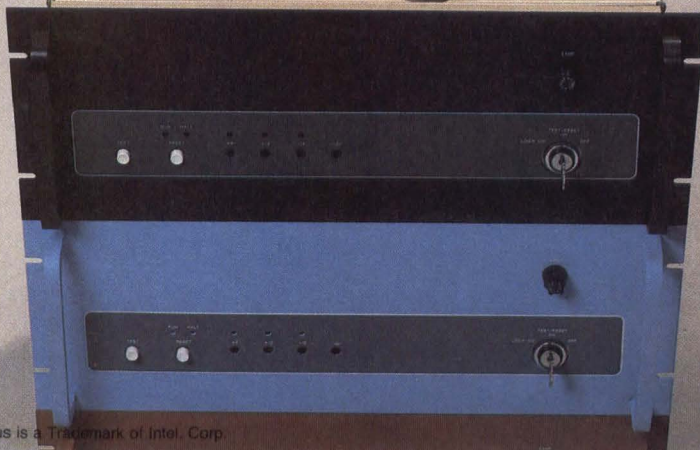
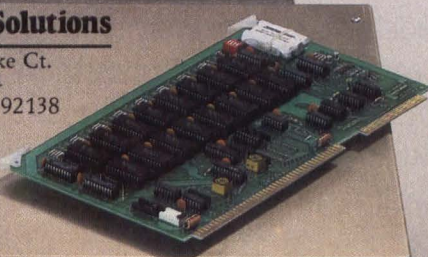
There's a field-proven card

cage and backplane, plus full RFI filtering, locking front panel function switch, power fail detection, and quiet dual cooling fans with quick-change filters.

And best of all, the removable front panel lets you easily customize the Multichassis to match your company color and logo.

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Call Toll Free  
(800)854-7086  
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(619)292-0242



\*Multibus is a Trademark of Intel, Corp.

CIRCLE NO. 149 ON INQUIRY CARD

floppy or rigid disk drive. The model 440-CT fits an 8-in. footprint. Both models have an 87K-byte-per-sec. average read/write transfer rate and operate at 90 ips. They feature 8000 bpi recording on nine tracks and will be available for volume delivery in July. They will sell for approximately \$850 in OEM quantities. **Cipher Data Products, Inc.**, 10225 Willow Creek Rd., P.O. Box 85170, San Diego, Calif. 92138.

Circle No 370



## DEC replacement drives are improved

The  $\frac{5}{4}$ -in. Micro-Magnum 5/5 fixed/removable cartridge and the Micro-Magnum 5 removable-only cartridge Winchester disk drives emulate Digital Equipment Corp.'s RL-01 and RL-02 disk drives. The drives now feature higher formatted capacities of 10.48M and 5.24M bytes, respectively. Both drives have a 40-msec. average access time and a 5M-bit-per-sec. transfer rate. They feature an embedded servo and an SASI. price is \$1275 for the Micro-Magnum 5/5 and \$995 for the Micro-Magnum 5 in 1000-unit quantities. **DMA Systems Corp.**, 601 Pine Ave., Goleta, Calif. 93117.

Circle No 371

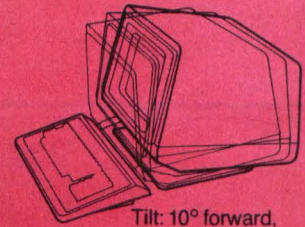


The VISUAL 100 video display terminal is 100% compatible with the DEC VT 100 terminal from identical software right down to the layout of the keys and the sculpturing of the keyboard.

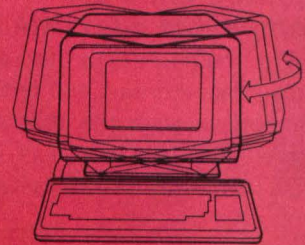
But when it comes to ergonomics, the VISUAL 100 is something else! For example, the VISUAL 100 is designed in lightweight plastic that can easily be swiveled and tilted for maximum operator comfort. A detached, low profile keyboard, and 12" or 14" non-glare screen are just a few of the other human engineering advantages of the VISUAL 100.

The Advanced Video package and current loop interface that are optional with the DEC terminal are standard with the VISUAL 100. Plus we've added an optional Buffered Printer Interface with independent baud rate, independent parity and printer busy via "XON-XOFF" protocol. And although the VISUAL 100 is a step up from the DEC VT 100, it is priced a step below. Only \$1,345. Call or write for full details.

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Tilt: 10° forward,  
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# VISUAL 100.

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CIRCLE NO. 148 ON INQUIRY CARD



# Peripherals

NEW PRODUCTS

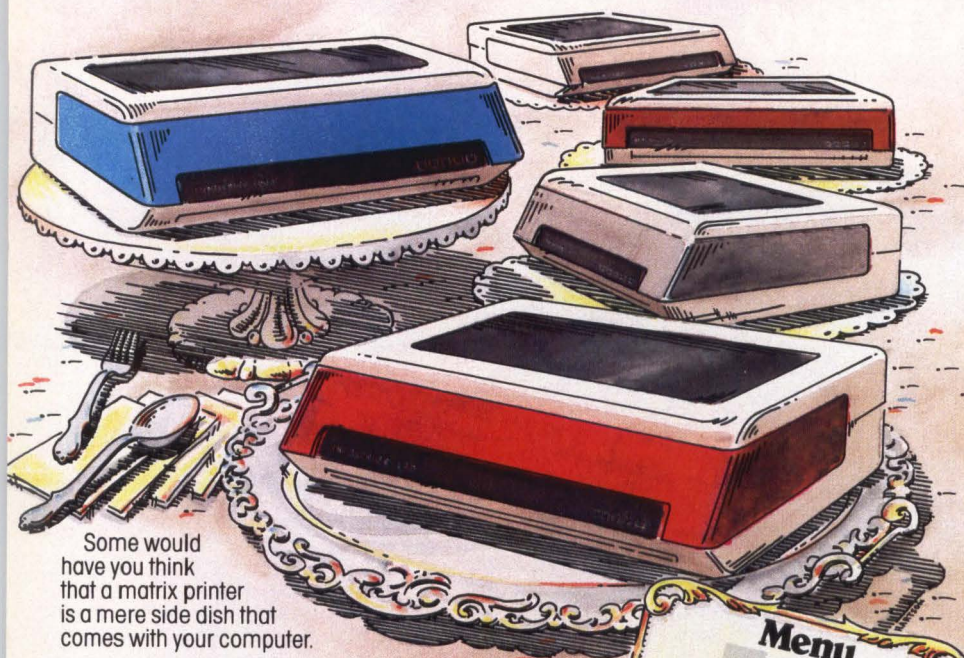
## Storage units are compatible with IBM 3375

The model CDC 33750 14-in. disk subsystem stores 1.63G bytes and is compatible with the IBM 3375 disk drive. The CDC 33750 is designed with thin-film read/write heads,

magnetic recording disks and actuators contained in fixed, sealed head/disk assemblies. Each CDC 33750 device includes four separate and independent head/disk assemblies. The devices feature a 3G-byte-per-sec. transfer rate and a 16-

msec. average access time. A dual access feature that allows any of 16 actuators in a string to be addressed through two internal data paths is optional. Prices range from approximately \$61,000 to \$84,000, depending on configuration. **Control Data Corp.**, P.O. Box 0, Minneapolis, Minn. 55440. **Circle No 372**

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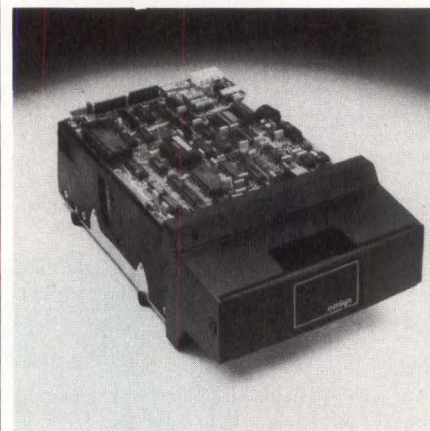
You can switch from high-speed data processing to business letters, at will; handle up to 16-inch-wide paper; make up to five crisp carbons; generate gorgeous graphics in up to eight colors; and enjoy truly elegant and incredibly quiet operation, day-in and day-out.

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Your favorite computer dealer or systems specialist will be delighted to arrange a demonstration for you. Or contact the *matrix d'*: Infoscrite, 2720 South Croddy Way, Santa Ana, California 92704, USA, Phone (714) 641-8595, Telex 692422.

Menu					
MODEL	DRAFT (CPS)	CORRESPONDENCE (CPS)	LETTERS (CPS)	GRAPHICS (72 x 72)	GRAPHICS (144 x 144)
500	150	75			
1000	200	100		X	X
1100	200	100	40	X	X
1200	200	100	40	X	X
1500	400	200		X	X



## Floppy disk drive stores 5M bytes

The model 5460 minifloppy disk drive uses Amlyn's proprietary MiniPac diskette cartridge that contains five flexible diskettes. The interface of the model 5460 is functionally compatible with that of Shugart Associates' SA460 minifloppy or its equivalent. The 5460 appears to the computer system as if it were five SA460 drives, with each of the five diskettes in the cartridge addressable as if it were a single drive. Typical unformatted capacities are 5M bytes per cartridge using 1M byte per diskette surface in double-density recording. The data-transfer rate for this capacity is 250K bytes per sec. The average access time is 95 msec. The drive is physically compatible with other minifloppy drives and can be mounted in a 3 1/4- x 5 3/4- x 8-in. space. Price is \$610 in 500-unit quantities. **Amlyn Corp.**, 2450 Autumnvale, San Jose, Calif. 95131.

**Circle No 373**

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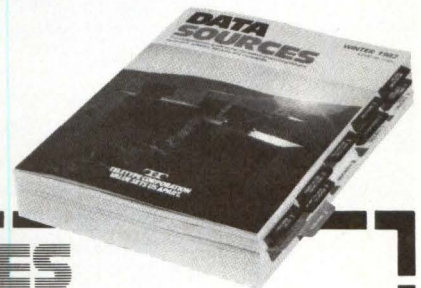
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City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Telephone \_\_\_\_\_

Type of business:  End user  OEM  Distributor/Vendor

Other \_\_\_\_\_

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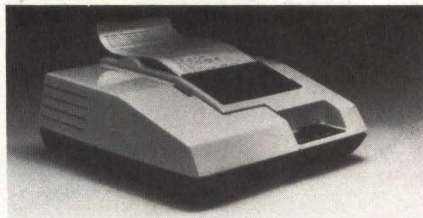


# Peripherals

NEW PRODUCTS

## High-speed printer is aimed at OEMs

The model EX401 non-impact electrosensitive printer prints 3 lines per sec. (as fast as 192 cps). It prints the 96-character ASCII set and uses 5-in.-wide electrosensitive

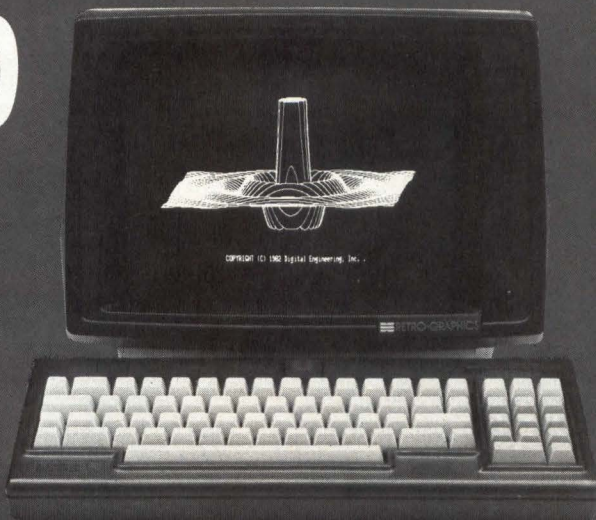


paper. It is available in a 40/20- or a 64/32/22-column configuration that includes 128 extra symbols and characters in the character set. A standard parallel, RS232C/20-mA or IEEE-488 interface is available. Standard software controls permit easy integration into an OEM system and allow transmission of user-generated 8-bit dot patterns for graphics printing. Single-unit quantity price is \$549. **Axiom Corp.**, 1014 Griswold Ave., San Fernando, Calif. 91340. **Circle No 374**

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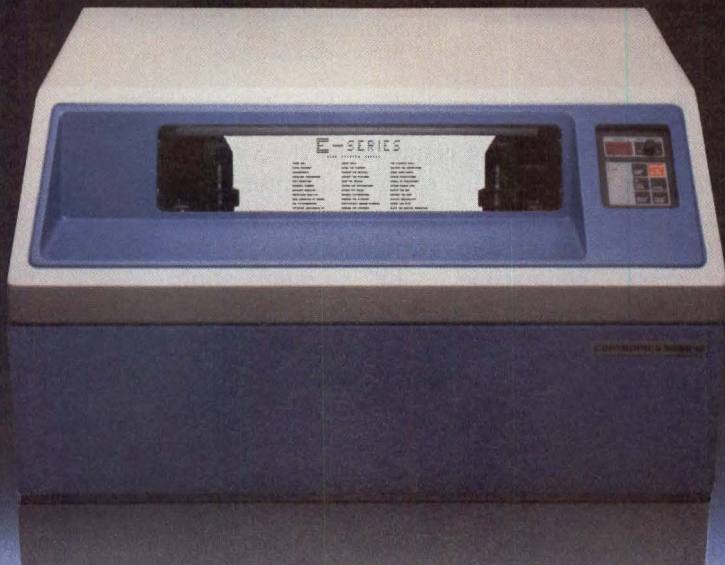


## Line printers feature nonstop printing

The TIP-150 and TIP-300 single- and dual-print-head-assembly impact dot-matrix line printers offer character printing at 150 and 300 lpm, respectively, and enhanced word-processor-quality printing at 45 and 90 lpm, respectively. Standard default print density is 10 cpi with condensed formats of 13.3 and 16.6 cpi. The printers can accommodate one- to six-part forms using 3- to 16-in.-wide fanfold paper. They feature a standard Centronics parallel interface and an optional Dataproducts parallel or RS232C interface. The model 150 can be field-upgraded to the model 300 by adding a second print-head-assembly and related electronics.



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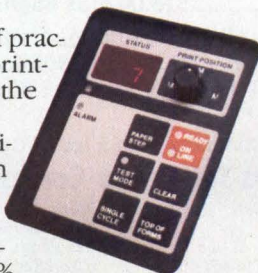
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With the experience of 25,000 line printers backing the E-Series, it's no wonder we win so many head-to-head

comparisons. But, when the time comes for service, you'll be happy to know that one of Centronics' worldwide network of service locations is nearby and available for third party service support.

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## CENTRONICS® PRINTERS

CIRCLE NO. 154 ON INQUIRY CARD



# Peripherals

NEW PRODUCTS

The dual-print-head-assembly design has a nonstop printing feature that allows uninterrupted printing by a single print-head assembly should one unit fail. Prices are \$3900 and \$4900 for the TIP-150 and TIP-300, respectively, in single-unit quantities. **Trilog, Inc.**, 17391 Murphy Ave., Irvine, Calif. 92714.

Circle No 375

## 120-cps mini-printer has five alphabets

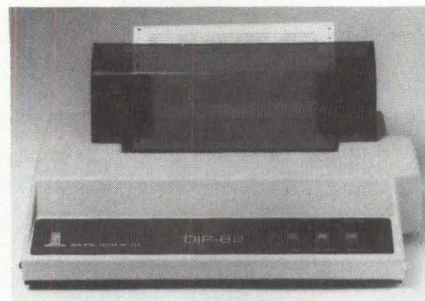
The Scanset model 725 dot-matrix mini-printer offers five alphabets and eight character sizes and prints bidirectionally at 120 cps. It prints 40, 80 or 136 characters per line with automatic vertical and horizontal tabbing. The printer's built-in graphics mode has a 144 x 160-dot-per-sq.-in. resolution. The

model 725 connects to the vendor's Scanset line of personal information terminals and other RS232C-compatible terminals or to TTL-compatible, 7-bit parallel equipment. Price is \$795 in single-unit quantities. **Tymshare**, 20705 Valley Green Dr., Cupertino, Calif. 95014.

Circle No 376

## Dot-matrix printer features six character sizes

The D-82 F/T dot-matrix printer features a 7 x 7 or 14 x 7 expanded matrix, 100-cps bidirectional printing, short-line-seeking logic, an 800-character buffer and dot-addressable graphics. Under program control, a user can specify six character sizes and one- or two-pass printing. The printer prints the 96-character ASCII set at 40, 48, 66,



80, 96 or 132 characters per line on 8½-in.-wide paper. Operator controls include power switch, select/deselect, line feed, top of form, self test and variable-form-length setting. A Centronics-compatible parallel interface is standard, and an RS232C interface is optional. Price is \$595 for single-unit orders. **Data Impact Products, Inc.**, 745 Atlantic Ave., Boston, Mass. 02111.

Circle No 377

## Winchester/Floppy Drive Exercisers That Fit the Palm of Your Hand.



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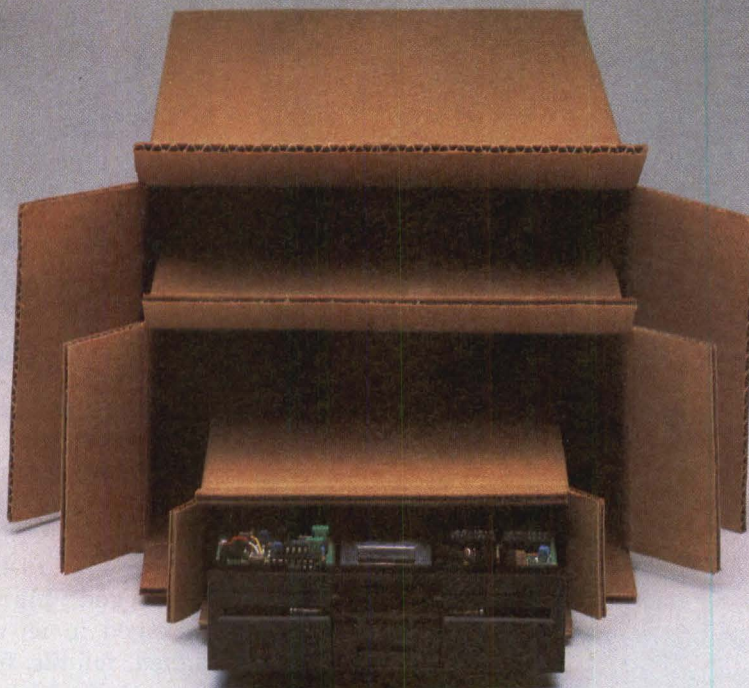
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(203) 438-9684 TWX-710-467-0668

**West**  
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Las Vegas, Nevada 89101  
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CIRCLE NO. 156 ON INQUIRY CARD



# INTRODUCING 1.6 Mb REPACKAGED



8" disk drive

8" half-height

5 1/4" half-height

## More Storage. Less Space.

It's new and it's from Mitsubishi: the M4854 half-height 5 1/4" flexible drive. The M4854 delivers up to 1.6 Mb of storage—the same as most 8" drives—yet it takes up only half as much space as a conventional 5 1/4" drive. Not bad, considering the M4854 is about the same price as most conventional 5 1/4" disk drives. And just in case you prefer a half-height unit with 1.0 Mb of storage, Mitsubishi also makes the M4853.

## More Features. Less Money.

As with all other Mitsubishi flexible disk drives, the M4854, 1.6 Mb, 5 1/4" half-height offers more than a lot of memory. It gives you many features:

Like a head load mechanism with all ferrite heads. A patented circular Gimbal support that ensures stable read/write operation and long media life. An advanced Direct Drive brushless DC Motor that eliminates all concern for changing drive belts. It also provides the torque necessary to reduce the disk rotation starting time to only 250 milliseconds. And for speed, the M4854 has a steel band head positioning mechanism which results in a track-to-track time of only three milliseconds and average access time of 91 milliseconds.

You'll also find Mitsubishi OEM prices are extremely competitive.

## More Products. Less Hassle.

Of course, features like these aren't just limited to Mitsubishi 5 1/4" half-height drives. You'll find them throughout the entire Mitsubishi line, which includes standard-height 5 1/4" fixed and flexible drives, 8" fixed drives and 8" full and half-height flexible drives.

## More Reliability. Less Maintenance.

Now that you know what goes into our drives, you'll know why they have a MTBF rate of 10,000 POH or more. Unit life is even more impressive—5 years or 20,000 power-on hours, whichever occurs first. No matter which type of drive you need, Mitsubishi has a package that's just right for you. For details on the entire line, contact your Mitsubishi representative today.





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MMS-283

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CIRCLE NO. 158 ON INQUIRY CARD

## Peripherals

NEW PRODUCTS



### Terminal displays eight colors

The MVI-100 model 813 eight-color terminal emulates the DEC VT100 and VT52 terminals. It features a 13-in., in-line pre-converged, high-resolution CRT packaged in an ergonomically designed, full-tilt, full-swivel cabinet. The terminal has an 80-column × 24-line display with an additional 25th line for status messages. Other features include vertical and horizontal scrolling, four split screens and the ability to insert and delete characters and lines, erase lines and pages and address the cursor independently. The detachable 87-key keyboard features 128 ASCII standard characters and 24 programmable function keys. The MVI-100 communicates with the host computer through an RS232C connector in half- or full-duplex mode at baud rates of 110 to 19.2K baud. Price is \$3000 in single-unit quantities. **Colorgraphic Communications Corp.**, 2379 John Glenn Dr., Atlanta, Ga. 30341. **Circle No 378**

### Data terminal converses at eight speeds

The model 4503 conversational data terminal, which is code-compatible with the Lear-Siegler ADM-3A, features a detached typewriter-style keyboard with auto-repeating keys and a 4-ft. coiled



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The ERGO 2000 is fully code-compatible with the DEC VT52, Hazeltine 1500, ADM 3A and the Micro-Term ACT-5A, and includes features such as smooth scroll, full video attributes, host definable function keys, block mode transmission, sophisticated printer port and more.....

The new ERGO 3001 is totally VT100 compatible and offers as standard equipment 132 columns by 24 lines, a full range of video attributes, bidirectional printer port, plain english set-ups, user programmable function keys, diagnostic mode, screen saver, enlarged buffer and two pages of memory....

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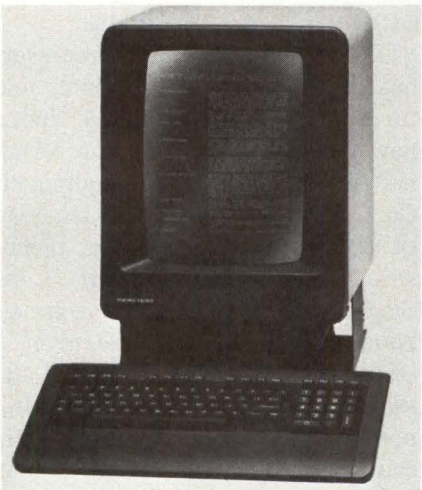


# Peripherals

NEW PRODUCTS



cord. The 12-in., non-glare, green screen displays 24 lines of 80 sharp 7 × 9 dot-matrix characters. The terminal is conversational at eight data rates from 110 to 19.2K baud. A transparent monitor mode displays received control codes. Other features include a serial asynchronous RS232C interface, absolute and relative cursor addressing and clear to end-of-line and end-of-screen functions. Price is \$495 in single-unit quantities. **NABU Commercial Terminals, 333 Metro Park, Rochester, N.Y. 14623. Circle No 379**



## Terminal features full-page word processing

The Ergo 4000 full-page word-processing terminal displays 66 lines of 80 characters on a 15-in., green, non-glare-screen. The terminal is compatible with Digital Equipment Corp.'s VT100 codes. It features four video attributes, a pass-through printer port, 15 user-

MINI-MICRO SYSTEMS/February 1983

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**New! Emulate your floppy disk drive with Hicomp's high reliability one megabyte bubble memory peripheral.**

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**Non-volatile bubble memory - the technology that doesn't forget.** When the power goes down, the MBM-1 retains all data, without expensive battery back-up systems.

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CIRCLE NO. 161 ON INQUIRY CARD





## SWITCHING TERMINALS A PROBLEM?

WTI has a lineup of low cost solutions... RS232 Switching Devices!



### AB MiniSwitch \$89

End the hassle of plugging and unplugging data cables. MiniSwitch lets you manually switch between two RS232 devices and a common device such as a Modem and a Printer sharing a Minicomputer.

### TM-41 4 Port Push Button Switch \$295

Switch ports electronically from the Terminal by pressing a button instead of flipping switches on a common AB Switch box. Selectable operating modes include—equal priority lockout, multiple and single port select.

### CAS-41 4 Port ASCII Code Activated Switch \$395

Your Computer may select one or any combination of up to 4 RS232 ports by a user selectable code sequence.

### CAS-161 16 to 64 Port Code Activated Switch \$795

Your Computer may select between any one of 16 ports by a two character ASCII code sequence. The unit is field expandable to 32, 48, or 64 ports.

### SMRT-1 8 Port "Smart Switch" \$795

This flexible microprocessor controlled 8 port switch allows a user on any port to communicate with an RS232 device on any other port. Up to 4 pairs of users can communicate simultaneously. "User Friendly" commands aid in port selection, port status and sign off. The unit's so smart, it even signals you when the port you wanted is no longer busy! Each port can be configured for DTE or DCE by pressing a button.

### PSU-41 Printer Port Sharing Unit \$395

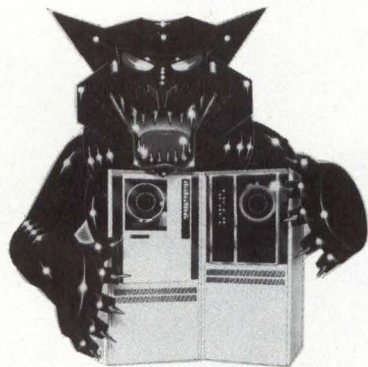
Allows up to 4 CRTs to share one Printer automatically without software changes! The PSU-41 scans each CRT and locks on until the screen has been sent to the Printer, then resumes scanning.



**western telematic inc.**

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Call our toll free number: 1-(800)-231-7972



CIRCLE NO. 163 ON INQUIRY CARD

# Peripherals

NEW PRODUCTS

programmable function keys, diagonal cursor movement, a savable setup mode, an alternate character generator, a transparency mode and settable tabs. Ergonomic features include a screen that tilts 25 degrees, an on/off switch on the front of the cabinet and a detached keyboard with an integrated palm rest. Price is \$1695 in single-unit quantities. **Micro-Term, Inc.**, 1314 Hanley Industrial Court, Saint Louis, Mo. 63144. **Circle No 380**



## Terminal offers emulation capabilities

The Visual 330, a microprocessor-based video display terminal, features emulation capabilities and a new ergonomic design. The terminal emulates Digital Equipment Corp.'s VT52 and Data General's D200 terminals and includes menu-selectable emulation of Lear Siegler's ADM-3A and Hazeltine's 1500 terminals. It features a streamlined plastic housing, tilt and swivel capabilities, a 12- or 14-in., non-glare screen, 7 x 9 dot-matrix characters and a detached low-profile keyboard with matte finish keycaps. Other features include block and character transmission modes; 12 user-programmable function keys; blink, underline, reverse, bold and blank video attributes; a line-drawing character set; and split-screen viewing. Single-quantity price is \$1150. **Visual Technology**, 540 Main St., Tewksbury, Mass. 01876. **Circle No 381**



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Stan Gorman

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### SILENT/SCRIBE MODELS

Standard Features	Chr. per Inch	DP-9000A	DP-9500A	DP-9001A	DP-9501A	DP-9000A
	10	150	150	120	120	200
Printing Speed (Char. per Sec.)	12	180	180	—	—	120
	12.5	—	—	150	150	—
	13.3	200	200	—	—	—
	15	—	—	180	180	150
	16.4	—	—	200	200	164
Enhanced	10	—	—	—	—	100
Expanded Print (Double Width)		Yes	Yes	Yes	Yes	Yes
Dot Addressable Graphics (Dot/In. H/V)	60/72	60/72	75/72	75/72	72/72	72/72
Max. Line Width (In.)	8.0	13.2	8.0	13.2	13.2	13.2
Audible Alarm	Opt.	Opt.	Opt.	Opt.	Yes	Yes
Out-of-Paper Sense	Yes	Yes	Yes	Yes	Yes	Yes
Ribbon, Continuous Loop Cartridge (Yds)	30	30	30	30	30	30
Interfacing:						
Parallel Cent. Comp.	Yes	Yes	Yes	Yes	Yes	Yes
RS-232-C Serial	Yes	Yes	Yes	Yes	Yes	Yes



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DP-9000A



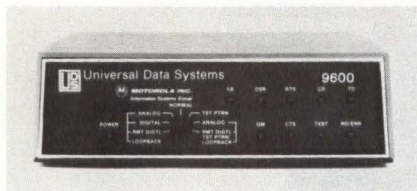
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# Datacomm

NEW PRODUCTS



## Modem operates at 9600 bps

The UDS 9600 data modem for four-wire operation in point-to-point configurations processes 9600 bps of synchronous, digital data. The built-in test functions of the CCITT V.29-compatible product allow a rapid four-step check of data terminals, modems and telephone lines. An automatic digital adaptive equalizer overcomes the effects of large variations in delay and amplitude distortion. At 9600 bps, the modem operates at a 2400-baud signaling rate, encoding 4 bits per

signal element. If operating conditions deteriorate, fallback rates of 7200 or 4800 bps can be used. Test features include digital loopback, analog loopback, 511 test-pattern generation/checking, analog loopback with 511 test pattern and remotely activated digital loopback with 511 test pattern. The test features are selected and monitored via a front-panel rotary switch and 10 LED indicators. Single-quantity price is \$2650. **Universal Data Systems**, 5000 Bradford Dr., Huntsville, Ala. 35805.

Circle No 382

## Modem for Apple II is user-friendly

Designed for use with an Apple II, Apple II Plus or Bell and Howell

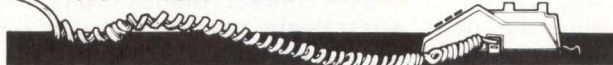
computers, the Modem II features menu-driven software with user prompts at all levels of command entry and keyboard dialing for ease of operation. It plugs directly into one of the I/O slots inside the computer for full- or half-duplex communications at 110 or 300 bps. It is equipped with firmware for direct communications from a bare-bones computer and comes with a software disk containing various utility programs including the terminal program. The unit is also equipped with a built-in speaker to allow audible monitoring of call progress as well as auto-dial and auto-answer. Price is \$369 in single-unit quantities. **Multi-Tech Systems, Inc.**, 82 Second Ave. S.E. New Brighton, Minn. 55112.

Circle No 383

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CIRCLE NO. 165 ON INQUIRY CARD

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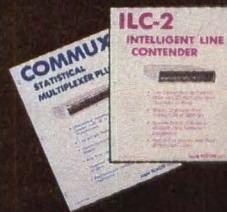
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RIXON Inc. 1982

3039

CIRCLE NO. 167 ON INQUIRY CARD



# Software

NEW PRODUCTS

## Business software is tailored for inexperienced users

Designed for first-time users of IBM personal computers, this business/accounting modular software library includes general ledger, accounts receivable, accounts payable, budget and financial report-



State of the Art, Inc.'s business/accounting application software products are offered with a patent-pending binder that forms a workstation easel when the binder's flap is open. The document is color-coded and features a flip-chart format. Space is provided in the binder for diskette storage.

ing, inventory control and sales invoicing application programs. All modules can be used separately in a stand-alone mode or in combination to form an integrated accounting system.

The vendor claims that users with no computer experience and an elementary knowledge of double-entry bookkeeping can install and begin using the software in about 2½ hours. The manual includes flow cards, sample reports, troubleshooting instructions and a glossary to assist the novice in implementing his system. All programs provide the user with screen prompts and instructions. The programs automatically check all keyboard entries to ensure data integrity and reject

invalid entries. The software library also features program customization. Each program offers a variety of options. The programs are initially released to operate on 5¼-in. floppy disk microcomputers, but they can be transported to hard disk mass-storage systems.

The modules are priced at \$495 to \$595 each. Written in UCSD Pascal, the programs are also available for the Apple II and III computers, and the vendor plans to make the packages available for other computers that support the p-Code interpreter. **State of the Art, Inc.**, 3183-A Airway Ave., Costa Mesa, Calif. 92626. **Circle No 384**

### New version of CP/M simplifies user interface

CP/M Plus, a new version of the industry-standard CP/M operating system, includes many features that simplify the user interface to the operating system. A HELP facility explains operating-system commands and how to use them. CP/M Plus gives users the option to add date and time stamps to files. It allows application programs to trap system errors and uses English messages to instruct users how to correct the errors. An automatic disk log-in feature eliminates the need to reset the disk every time media is changed. A new USER facility lets operators store commonly used programs under USER 0 while allowing access to those programs from any user number. CP/M Plus supports as many as 16 disk drives totaling 512M bytes of storage each, with files sizes as large as 32M bytes. hashed directory access, record-buffering and multi-sector I/O are also featured.

Evaluation copies for OEMs are priced at \$350. **Digital Research**, P.O. Box 579, 160 Central Ave., Pacific Grove, Calif. 93950. **Circle No 385**

### Utility links minicomputers with CP/M microcomputers

The BLAST data-communications utility now links many CP/M microcomputers with Data General computers to provide networking and file-transfer capability. It allows any two computers for which it has been implemented to exchange data files, text files, programs and console commands simultaneously through serial asynchronous modems. CP/M BLAST operates on 8080, 8085 and Z80 systems running under CP/M 2.2, MP/M or MP/M II. With a 4-MHZ Z80, CP/M BLAST can operate at 9600 baud full-duplex. A single-CPU license for CP/M BLAST sells for \$150. BLAST for Data General computers sells from \$250 to \$1000 per copy, depending on CPU size. **Communications Research Group**, 8939 Jefferson Highway, Baton Rouge, La. 70809. **Circle No 386**

### Software-development package for CP/M-80 micros

The ZAS Z-8000 software-development package Version 2 runs on all CP/M-80-based microcomputers and is aimed at Z8000 software developers, hobbyists and OEMs developing Z8000 software. Version 2 includes a relocatable macro assembler that supports both segmented and nonsegmented code using the standard Zilog Z8000 instruction set. The ZLK task builder, included in the package, can combine and rename programs that have been structured into named program or data sections. The ZLD family of object-code-manipulation utilities facilitates down-loading, translation to Intel HEX format and host-system memo-



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microengine level of the machine. The computer must be equipped with DEC's User Writable Control Store option. AMGS, written in Pascal, is licensed for a one-time charge of \$15,000. **JRS Research Laboratories, Inc.**, 202 W. Lincoln Ave., Orange, Calif. 92665.

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### Word processor runs under CP/M

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for monospacing and proportional spacing print fonts. Freeze and thaw operations isolate the text segment being edited and protect the rest from being changed, and a user can "undelete" text. The original version of the line where the cursor is located can be swapped with the current edited version. Price is \$360. **Amanuensis, Inc.**, R.D. #1, Box 236, Grindstone, Pa. 15442. **Circle No 389**

### FORTH language runs on 68000

Hemenway/FORTH, claimed to be a superset of the FORTH-79 language standard of the FORTH Interest Group, runs on MC68000-based microcomputers with at least 30K bytes of memory under the vendor's MSP/68000 operating sys-

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## NEW PRODUCTS

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### Tool kit aids program development on HP 9845

The ROM-based Programmer's Tool Kit for HP 9845B/C desk-top computers aids in program development, debugging and creation of documentation. Editor commands

change identifier names, find specific information, copy and move text and renumber lines of code. Utilities generate memory maps, remove unwanted symbols and comments from programs and provide cross-reference listings. Program statements and functions can be invoked to show the amount of remaining memory; perform decimal-to-binary and decimal-to-hexadecimal conversion; and store, print and display lines of BASIC programs. Price is \$1500. **Structured Software Systems, Inc.**, Box 1072, Irick Rd., Mount Holly, N.J. 08060.

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### 68000 cross-assembler runs on VAX, PDP-11

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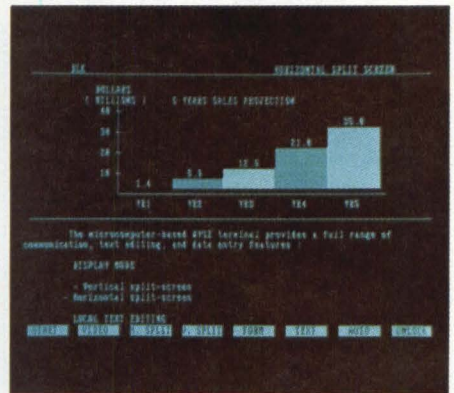
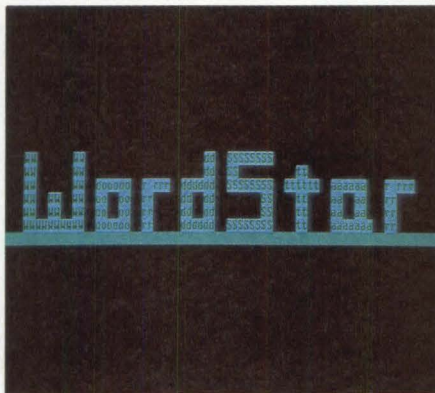
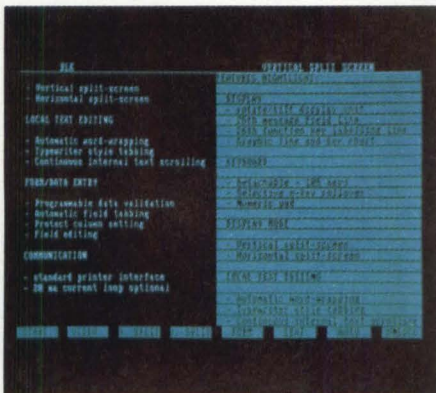
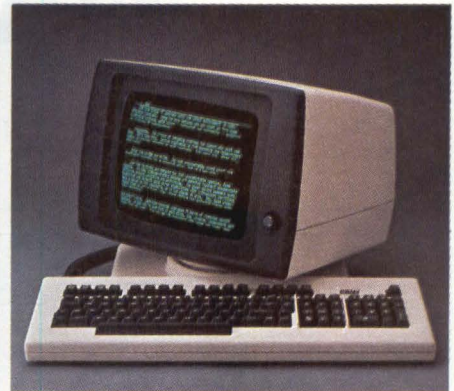
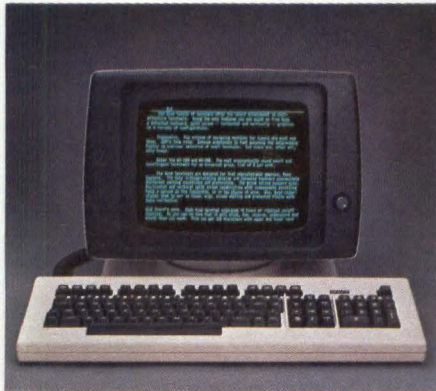
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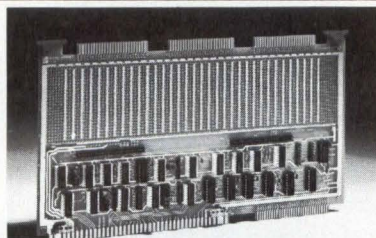


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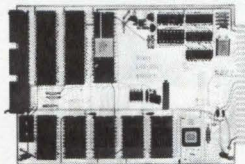
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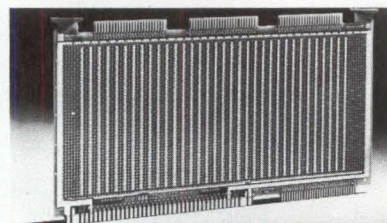
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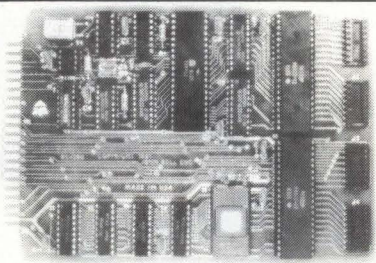
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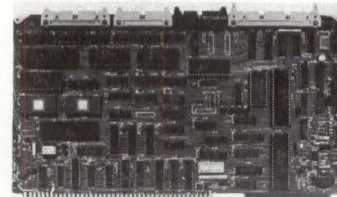
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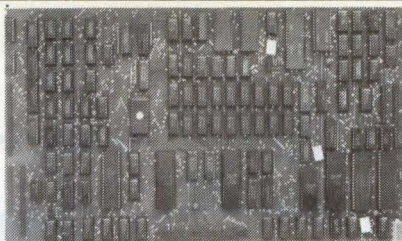
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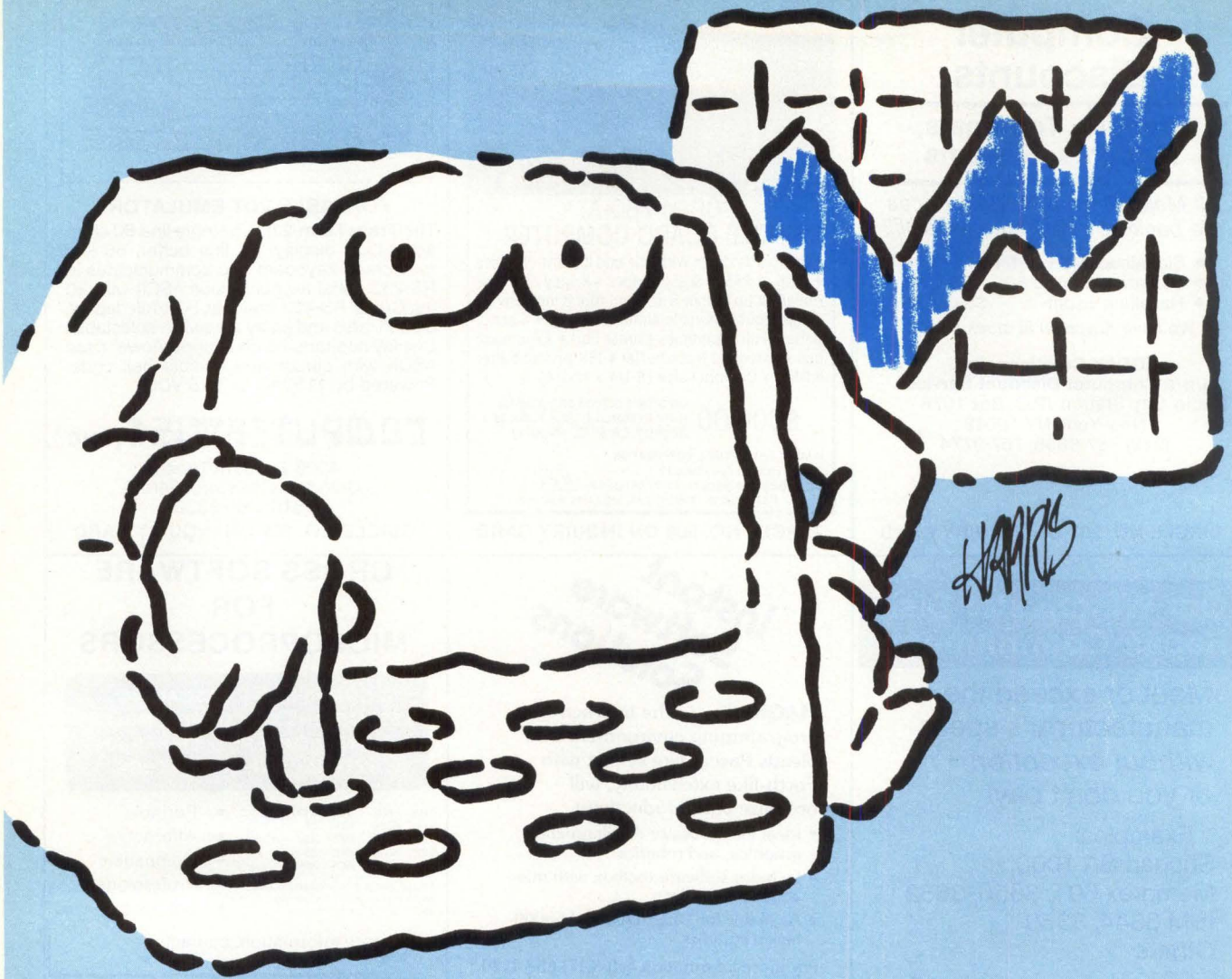
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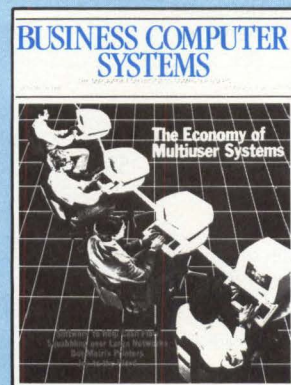
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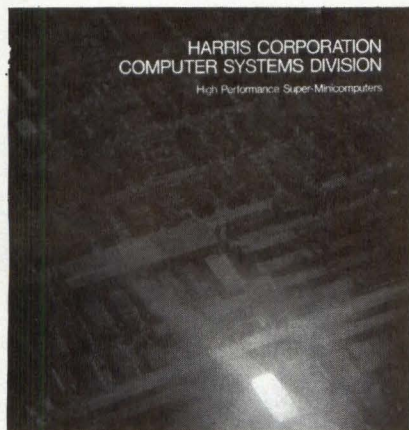


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# Literature

## NEW PRODUCTS



### Brochure describes line of CPUs

A line of superminicomputers is described in an illustrated, four-color brochure. The eight-page brochure has three sections. The architecture section explains the system's bus structure, pipeline processing and floating-point processors. The section on memory describes cache, virtual and shared memory. The third section is on I/O and explains the vendor's communications network processor. **Harris Corp., Computer Systems Division**, 2101 W. Cypress Creek Rd., Fort Lauderdale, Fla. 33309.

Circle No 393

### Data sheet details power supplies

A two-page, two-color data sheet describes the KRL series of single-output, 20W and 40W switching power supplies. The data sheet includes I/O specifications, dimensional drawings, product photos and one- to nine-unit quantity pricing. **KEC Electronics, Inc.**, 20817 Western Ave., Torrance, Calif. 90501.

Circle No 394

### Data sheet explains modem's features

A data sheet on the v.29 Plus Multiport modem describes the product, its applications and its specifications. The data sheet notes

that the v.29 Plus contains a time division multiplexer that accepts input from as many as four synchronous or asynchronous channels, with aggregate speeds as high as 9600 bps. Features such as front-panel programming and down-line loading of all parameters are also described. **Timeplex, Inc.**, One Communications Plaza, Rochelle Park, N.J. 07662.

Circle No 395

### Brochure describes telecommunications terminals

The Micronet 20 and 25 telecommunications terminals are described

in a color brochure. Based on the 6809 CPU, the Micronet 20 has two ports that can be configured from the keyboard for TWX, Telex, DDD (110 to 1200 baud) or IRC Telex. The Micronet 25 is identical, but has built-in single or dual 5¼-in. floppy diskettes that add 160K or 320K bytes of mass storage. The brochure also details the terminals' other features including archival RAM, EEPROM, keyboard programmability and integrated electronic diagnostics. **Sidereal Corp.**, 9600 S.W. Barnes Rd., Portland, Ore. 97225.

Circle No 396

## LITERATURE THAT COSTS

### Security guide lists product information

The 130-page *Who, What and Where in Communications Security* users' guide on voice- and data-communications security and its 58-page 1982 update contain information on the issues involved in designing a communications security system with information about products and their vendors. A product matrix section lists 39 national and international vendors offering 185 products and contains information on product capabilities, encryption algorithm, key management schemes, sales outlets, manufacturing facilities and telephone numbers. The publication also lists more than 500 terms with definitions and 200 acronyms used in security. Price of the directory and its update is \$75. **Marketing Consultants International, Inc.**, 100 W. Washington St., Hagerstown, Md. 21740.

Circle No 397

### CP/M Software Index lists 1688 programs

The third edition of the *CP/M Software Index* lists 1688 professionally supported programs offered by 507 vendors. A brief description, the vendor's name, address and phone number, the price and operating system versions are shown for each package. All indexed programs are available for the CP/M-80 opera-

ting system, and many are also available under CP/M-86, MP/M-80, MP/M-86 and Concurrent CP/M-86. The index is organized into system programs, general applications, accounting applications, utility applications and industry-specific software areas. These areas are broken into 89 categories. Single copies of the index are priced at \$10. **Small Systems Group**, Box 5429, Santa Monica, Calif. 90405.

Circle No 398

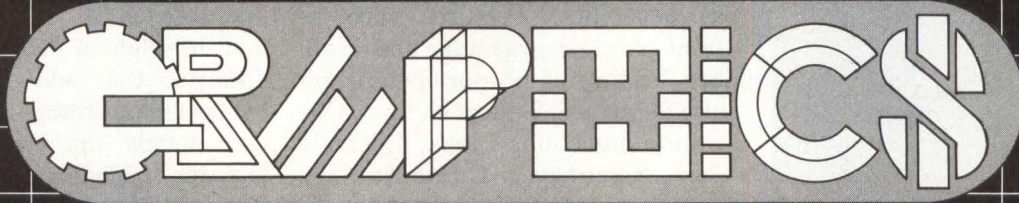
### Standard defines terms for microcomputers

JEDEC Standard No. 100, an updated version of JEDEC Publication No. 100, defines "cache memory," "virtual memory," "address," "branch," "buffer," "bus," "compiler," "diagnostic program," "firmware," "machine cycle," "multiprocessing," "polling," "utility program" and other terms. A section addresses the needs of the microcomputer industry in the area of timing intervals. It shows how the dynamic parameters for microcomputers and memories can be represented in symbolic forms with little ambiguity. Examples of the meaning and use of these terms and symbols are provided. Copies of JEDEC Standard No. 100, a 42-page document, are priced at \$12 each. **Standards Sales Office, Electronic Industries Association**, 2001 Eye St., N.W., Washington, D.C. 20006.

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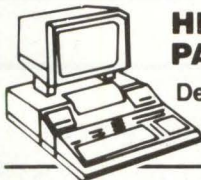
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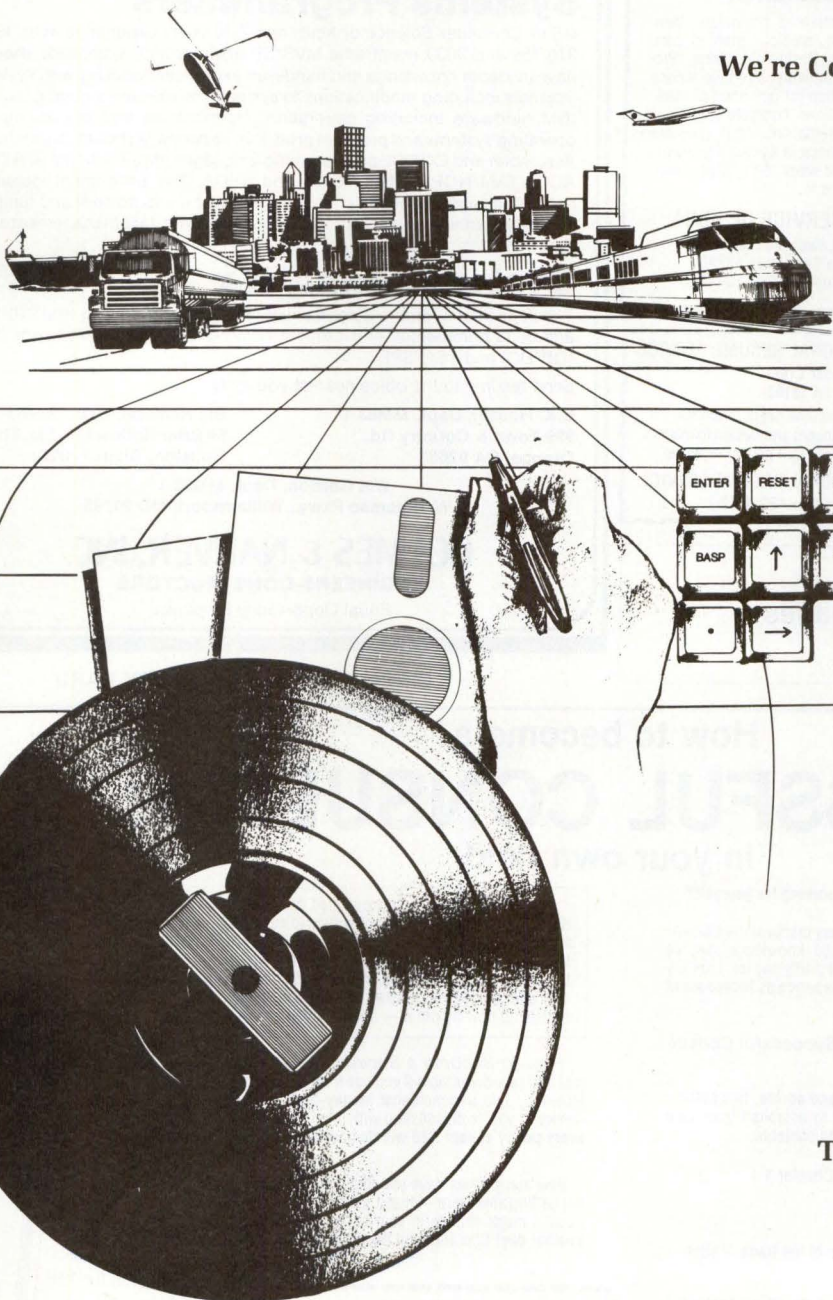
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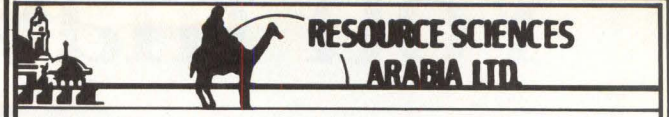
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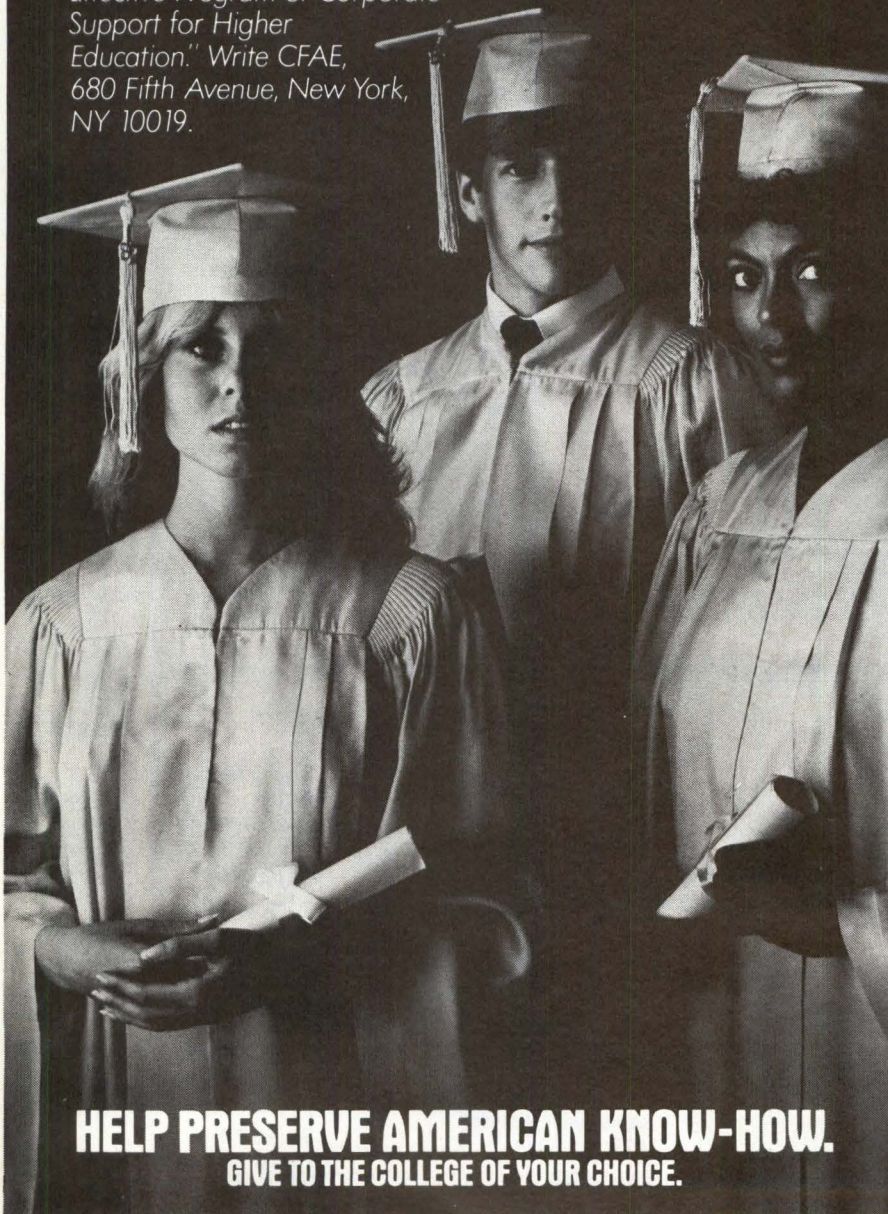
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