

Mini-Micro Systems

A CAHNERS PUBLICATION

FEBRUARY 1984

What's new in Apple's orchard: Macintosh
Ada takes on civilian chores

Plus reports on

- Half-height, 5¼-inch disk drives
- Word processing on minicomputers



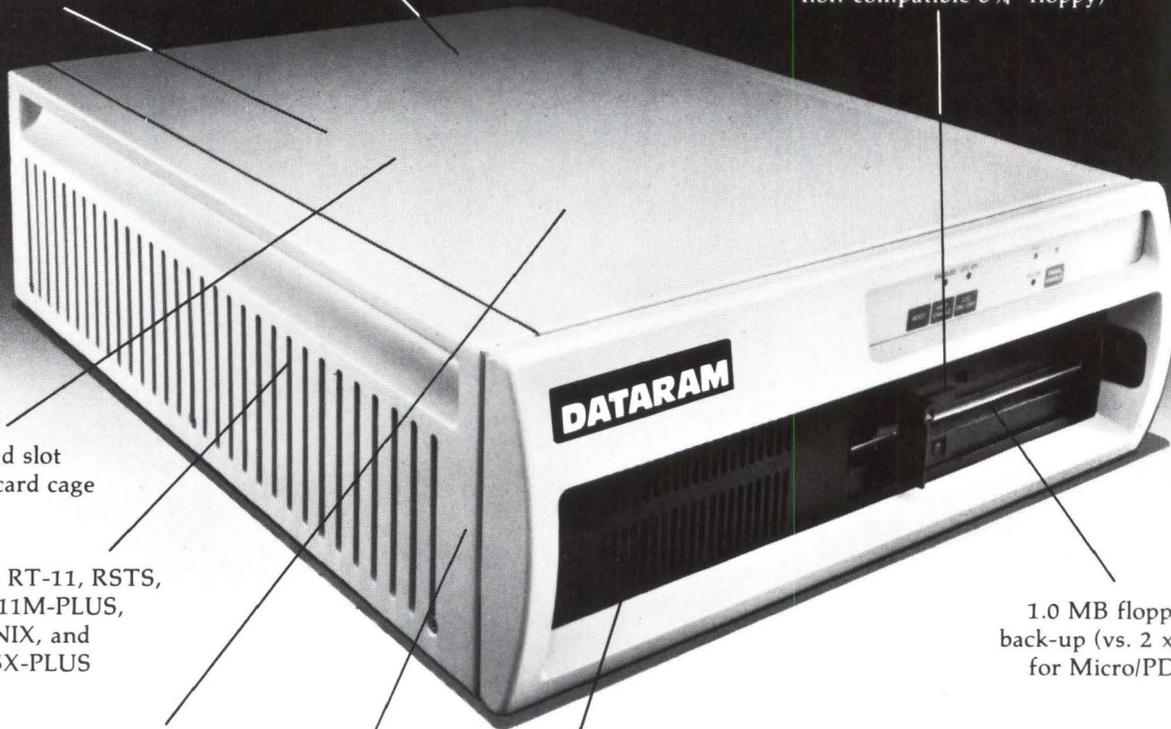
Cipher boosts performance of GCR tape drives

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capability

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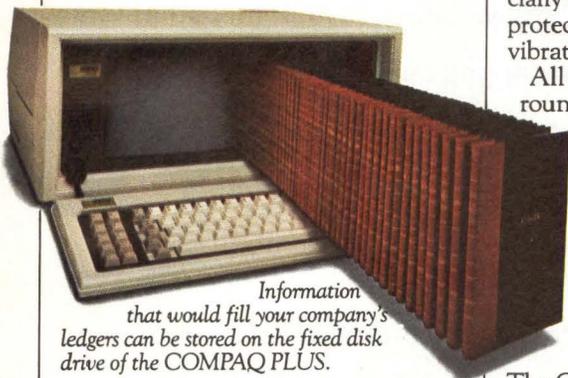
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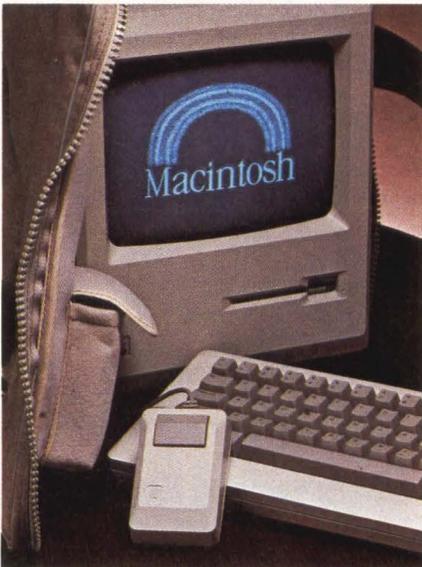
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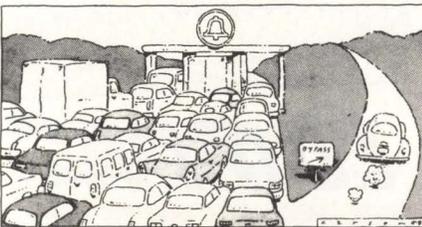
Mini-Micro Systems



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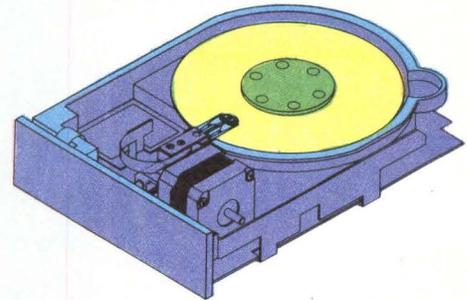
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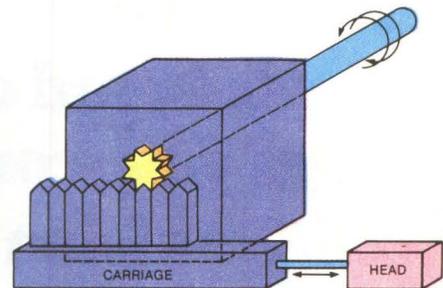
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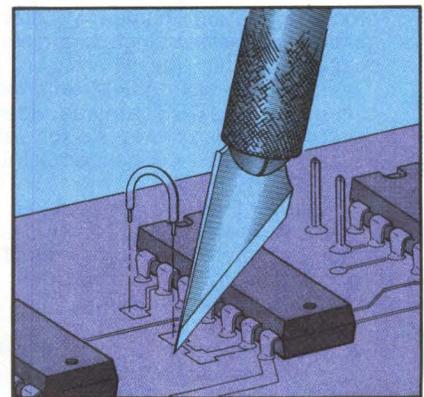
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CIRCLE NO. 4 ON INQUIRY CARD

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Gould... Innovation and Quality in Computers

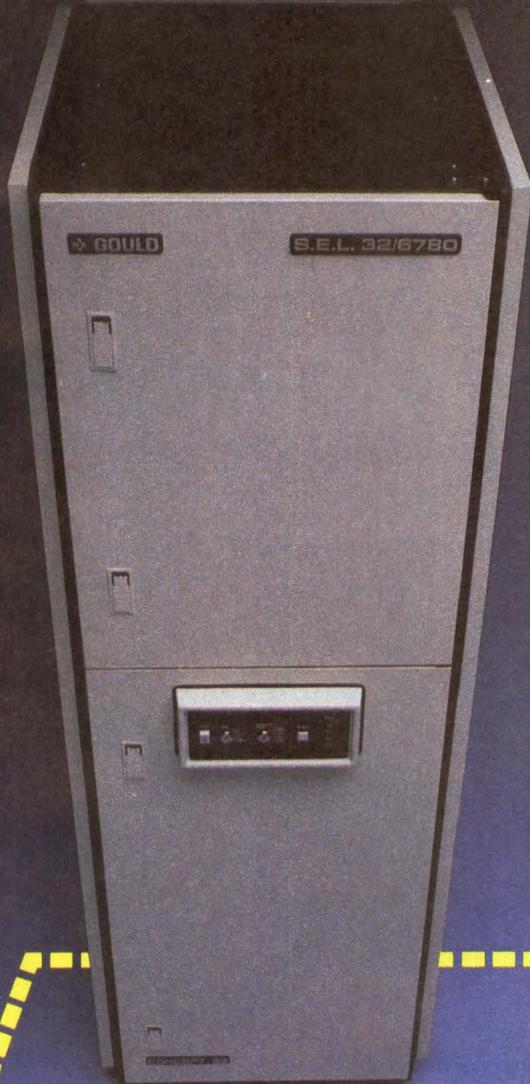
We just gave the computer industry something to reach for. A new standard... performance/footprint.

Introducing the Gould CONCEPT 32/67. Performance in a size as accommodating as its price.

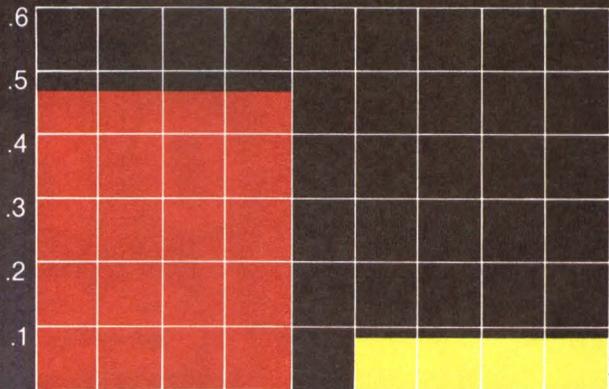
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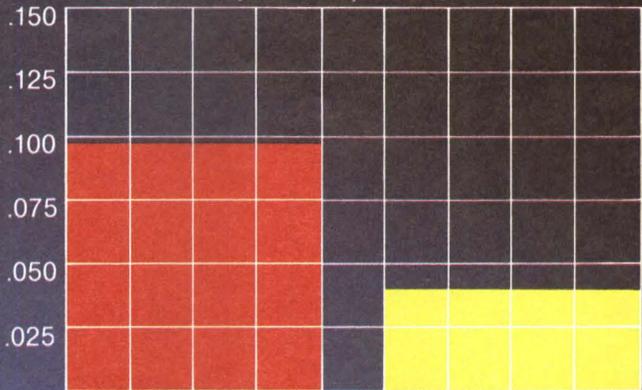
MIPS/SQ. FT.*



CONCEPT 32/6780

VAX 11/782

MIPS/\$10,000 *(Equivalent System Price)



CONCEPT 32/6780

VAX 11/782

* All chart data from published competitive information.

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VAX 11/782



GOULD
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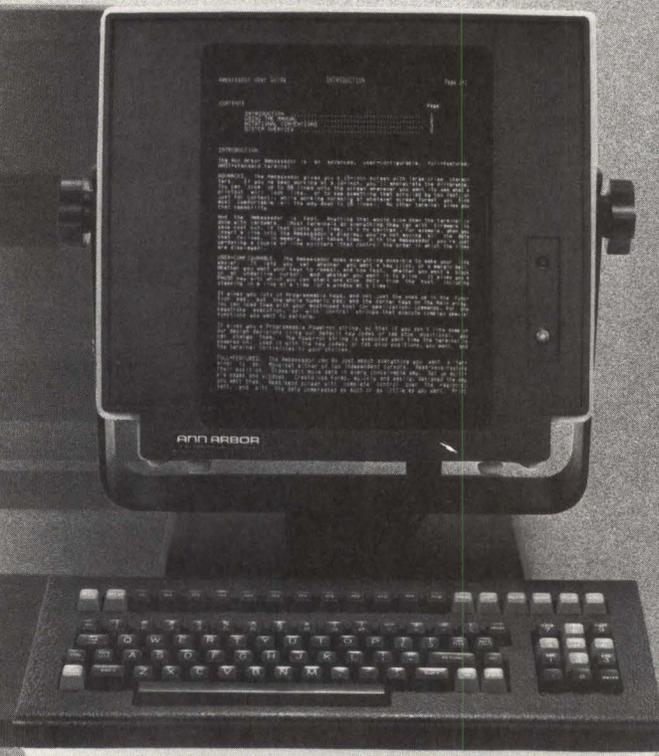
Of course, starting at \$1595, the Ambassador isn't for everyone. Just for the thousands of professionals who really want to move.

For more information, call 313/663-8000. Or write us at Ann Arbor Terminals Inc., 6175 Jackson Road, Ann Arbor, Michigan 48103. But don't wait too long—the Ambassadors are going fast!

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0 to 60 in less than a second.



CIRCLE NO. 6 ON INQUIRY CARD

Tape drive vendors unite on standards

In an unparalleled agreement to create and maintain a stable, orderly market for ¼-inch cartridge tape drives, 11 member companies gathered at Comdex/Fall '83 and voted unanimously to continue the mission of their Quarter-Inch Compatibility (QIC) Working Group. The companies proposed standards for a basic device-level interface, backing up 100M- to 500M-byte Winchester disk drives and sub-4-inch form-factor tape drives. Previously, this group of competing manufacturers developed the QIC-02 device-interface standard and the QIC-24 recording-format standard. To dramatize their commitment to industry-originated standards, nine of the attending companies were represented by their presidents.



Mini-Micro Systems heartily endorses the QIC Working Group's efforts and commends the group's facilitator, or leader, Raymond C. Freeman Jr., president of Freeman Associates, a Santa Barbara, Calif., consulting company specializing in data storage markets and products. As a nationally recognized and respected independent consultant, Freeman has served admirably in the role of an unbiased and impartial moderator.

But what do ¼-inch cartridge tape drive standards mean to value-added systems integrators and users? For one thing, they will result in full interchangeability of tape cartridges recorded on QIC-24-compatible drives. For another, they will promote more widespread use and acceptance of ¼-inch tape drives by adding credibility to this market and technology. Further, they will assure industry-wide tape drive compatibility—regardless of manufacturer. Want more? Consider availability of multiple sources, economies of scale and simplified system integration.

Because of their unusual cooperation for the common good, the original member companies deserve special mention. They are Adaptive Data and Energy Systems, Archive Corp., American Telephone & Telegraph (Bell Laboratories), Cipher Data Products, Data Electronics Inc., Irwin Magnetics Systems Inc., Northern Telecom Inc., Qantex Division of North Atlantic Industries, Tandberg Data A/S, Wangtek Inc. and Western Digital Corp. Shortly after the latest meeting, 3M joined the group as its 12th member. Any other interested companies are welcome.

Other peripheral device manufacturers would do well to adopt a similar unified group approach to standards—under the direction of a non-aligned industry expert—as taken by the manufacturers of ¼-inch cartridge-tape drives.

George V. Kotlly
George Kotlly
Editor-in-Chief



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We've not only made a dent, we're the second-largest company in the business, and we have the capacity in place to be first.

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We solved that problem by building our

UR COMPETITION, POSSIBLE.



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Impossible?

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But not for the Tandon Winchester Company.

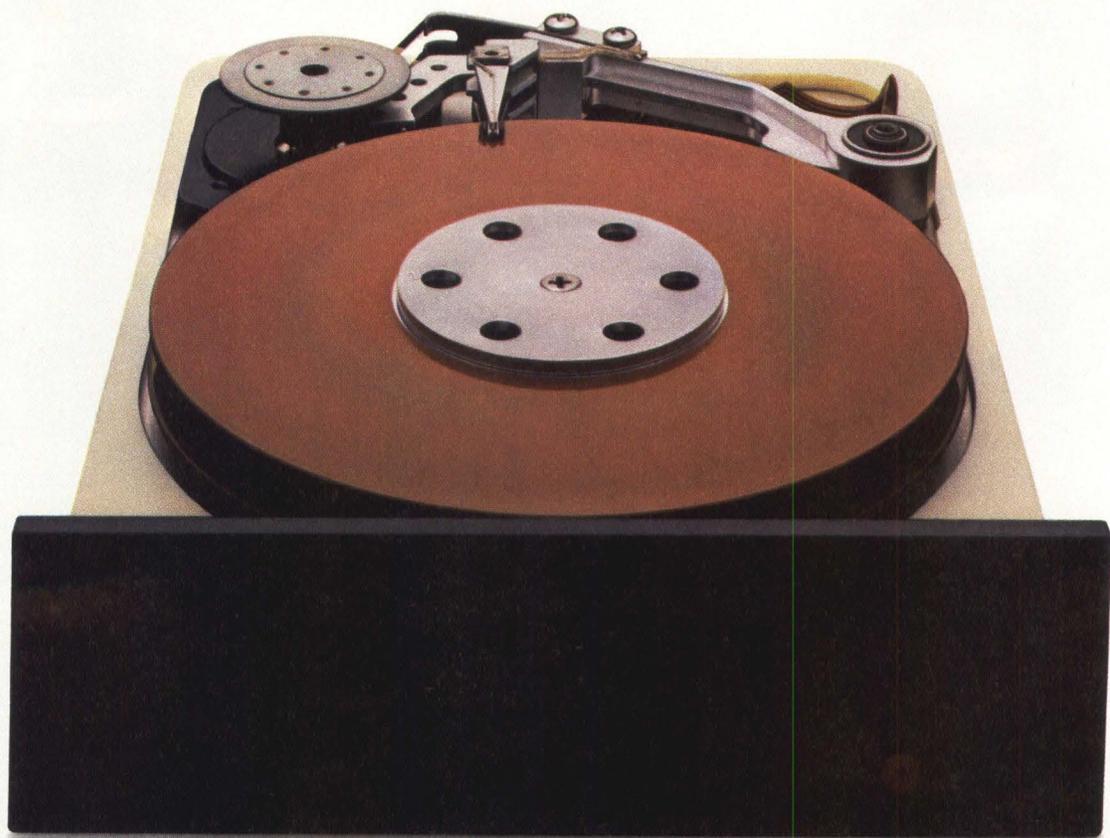
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You've concluded that you need the performance and capacity that only an 8 inch Winchester drive can provide. Which one should you buy? There are 109 different models available. Of this 109, only 39 are 8 inch floppy form-factor compatible. 28 of these 109 perform an average seek in 30 milliseconds or less. And of this 109, only 17 offer true SMD compatibility. Puzzled?

Only one company provides a disk drive with all the features —

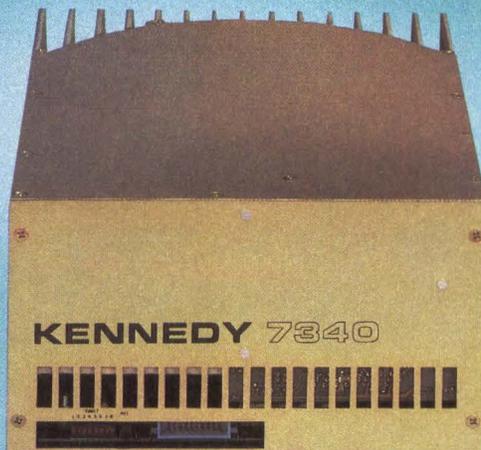
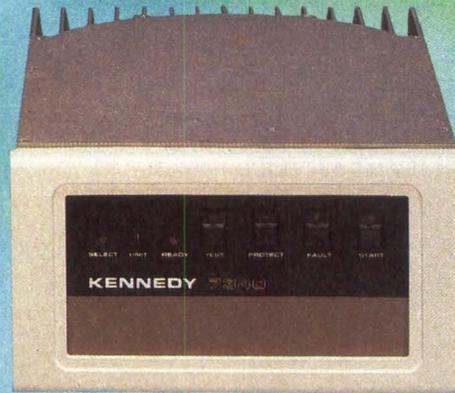
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CIRCLE NO. 10 ON INQUIRY CARD

Breakpoints

UNGERMANN-BASS WILL MARKET FIBER-OPTIC LAN

Ungermann-Bass Inc., Santa Clara, Calif., will introduce a fiber-optic version of its Net/One local-area network (LAN). The network can be extended to cover virtually unlimited areas by connecting optical transmission "stars" (groups of eight device-interface ports) through network repeater units. A spokesman for Ungermann-Bass claims the fiber-optic Net/One is one of the first Ethernet-compatible fiber-optic LANs. In a joint marketing agreement between Ungermann-Bass and Siecior/FiberLAN, a division of Siecior Corp., Research Triangle, N.C., Siecior will provide fiber-optic transceivers and star couplers (devices to connect eight-user stars), and Ungermann-Bass will provide network-interface units (NIUs), repeaters and communications software. Ungermann-Bass expects the fiber-optic LAN to become a specialty product because it is expensive and because it is immune to electromagnetic interference and lightning. Fiber-optic cables do not radiate energy; thus they are difficult to tap. Price of an entry-level system starts at about \$25,000, including the NIUs, a network-management facility, fiber-optic transceivers, star couplers and the network operating-system software. A typical fiber-optic Net/One with 200 device interface ports will be priced at about \$135,000. Delivery time of the fiber-optic Net/One is 60 days.

DIGITAL SOUND CORP. ANNOUNCES DIGITAL VOICE MAIL FOR MICROS

Using a proprietary compression algorithm to reduce digitized voice signals of 64K bits per second (bps) to 8K bps, the new DSC-2000 voice server from Digital Sound Corp., Santa Barbara, Calif., doubles the information capacity of disk storage to current devices and provides compatibility with microcomputer data rates. The DSC-2000 voice server combines voice store-and-forward capabilities with the company's DSC-200 audio data-conversion system voice processor. The voice server performs voice-mail and voice-file functions as a standalone product connected to a private-branch exchange or as part of an office-automation system. A user can access the system using a Touch-Tone telephone for sending and receiving voice messages. The telephone can also serve as a keyboard to initiate standard voice-mail features. Each voice server can be expanded from two to 16 ports, handling 30 to approximately 1,000 addresses, depending on traffic, and storing eight to 32 hours of entries. The system uses the UNIX operating system and the virtual-terminal protocol, providing an open architecture for OEMs/system integrators. Program development is done in C. Digital Sound offers software for voice mail. Single-unit prices of a basic configuration will start around \$20,000, and deliveries are scheduled for the second quarter of this year.

MICROSOFT INTRODUCES PACKAGES FOR MACINTOSH

Microsoft Corp. is showing its commitment to the Apple Computer Inc. Macintosh by announcing five application programs that mark the beginning of a long-term Macintosh program. Microsoft BASIC and Multiplan were available for the Macintosh at its introduction, and Microsoft chart is scheduled for March. Microsoft File and Word are slated for the second quarter of this year. Microsoft File, Word and Multiplan will be priced at \$195 each. BASIC and Chart will sell for \$150 and \$125, respectively. The Chart program will use a "gallery" through which users can see examples of all the possible charts. They can then choose and change the examples to suit their applications. Microsoft Word for the Macintosh will be an enhanced version of Word for the IBM PC. It will include multiple fonts, multiple font sizes, shadowing and the ability to place graphics within documents.

PARALLEL COMPUTER WILL OFFER FAULT-TOLERANT MINI

Parallel Computer Inc., Santa Cruz, Calif., expects to introduce the Parallel 300 minicomputer in April. The system reportedly will employ a novel architecture to provide fault-tolerant operation at a price/performance level competitive with popular

Breakpoints

minicomputers. The system will employ the MC68010 processor and Berkeley UNIX.

PANASONIC DEVELOPS LOW-COST PRINTER

Panasonic Industrial Co., Secaucus, N.J., plans to introduce a seven-color thermal-transfer printer this year. The device will offer resolution of 180 dots per inch and print speed of 45 characters per second. Single-quantity price is expected to be less than \$1,000. The printer will employ a 24-element thermal print head and a four-color segmented film ribbon, producing seven colors by mixing shades on multiple passes. The 80-column device will feature a built-in tractor feed, differential line feeding and transparency printing. Panasonic expects to deliver OEM production units by year-end.

MOLECULAR FILLS PRODUCT GAP WITH SUPERMICRO 16X

Molecular Computer, San Jose, Calif., is filling the gap between its eight- and 32-user systems by introducing the 16-user Supermicro 16X. The 16X will use Molecular's X series of modular plug-in application processor cards, priced at \$995 each. The cards run at 6 MHz using the Z80B microprocessor with 64K bytes of RAM and offer dual asynchronous communications at 19.2K bits per second. Besides the 16 card slots, the system will have two slots for optional print-spooler cards, 8086 processors and communications capability. The 16X's bus rate will be 400K bytes per second, twice as fast as Molecular's Supermicro series, and its file-processor memory will be a 256K-byte RAM, four times the memory of the Supermicro series. A 1M-byte, 8-inch floppy drive and an 8-inch, 30M-byte Winchester are integrated in the \$14,995 Supermicro 16X.

LITTON LIGHT-MODULATOR PROJECT ACHIEVES HIGH RESOLUTION

A development project at Litton Data Systems, Van Nuys, Calif., to produce an iron-garnet, magneto-optic spatial light modulator for display applications has resulted in a 256-by-256-pixel array. The Litton division expects to offer evaluation units of the new array by the second quarter of this year for system houses interested in developing the technology's potential for flat-panel or portable displays. Litton hopes to license the technology to volume manufacturers.

MICROSCIENCE FILES LAWSUIT AGAINST MINISCRIBE

Microscience International, Mountain View, Calif., has filed a \$10 million lawsuit against Miniscribe Corp., Longmont, Colo., charging unfair competition. In the suit, Microscience, a year-old manufacturer of half-height Winchester drives, claims Miniscribe copied its design. Miniscribe officials say the company is in a 90-day quiet period and decline comment. Microscience president Jeff Liu is unavailable for comment. Industry observers note that Miniscribe is the leading shipper of 5¼-inch, half-height drives. The market for such drives is expected to mature this year when more systems are announced with half-height form factor slots. Microscience is reportedly expanding beyond its half-height products to become one of the suppliers of 3½-inch Winchesters. Microscience reportedly will offer a drive to compete with Rodime Plc.'s 12M-byte model 352. Rodime has had the market for sub-5¼-inch Winchesters largely to itself for a year. Most of its rivals have opted instead to push half-height, 5¼-inch drives. Rodime's major competitor is Control Data Corp., which is doubling capacity on its 3½-inch Cricket drive to 12M bytes. The new Cricket is expected in the third quarter of this year.

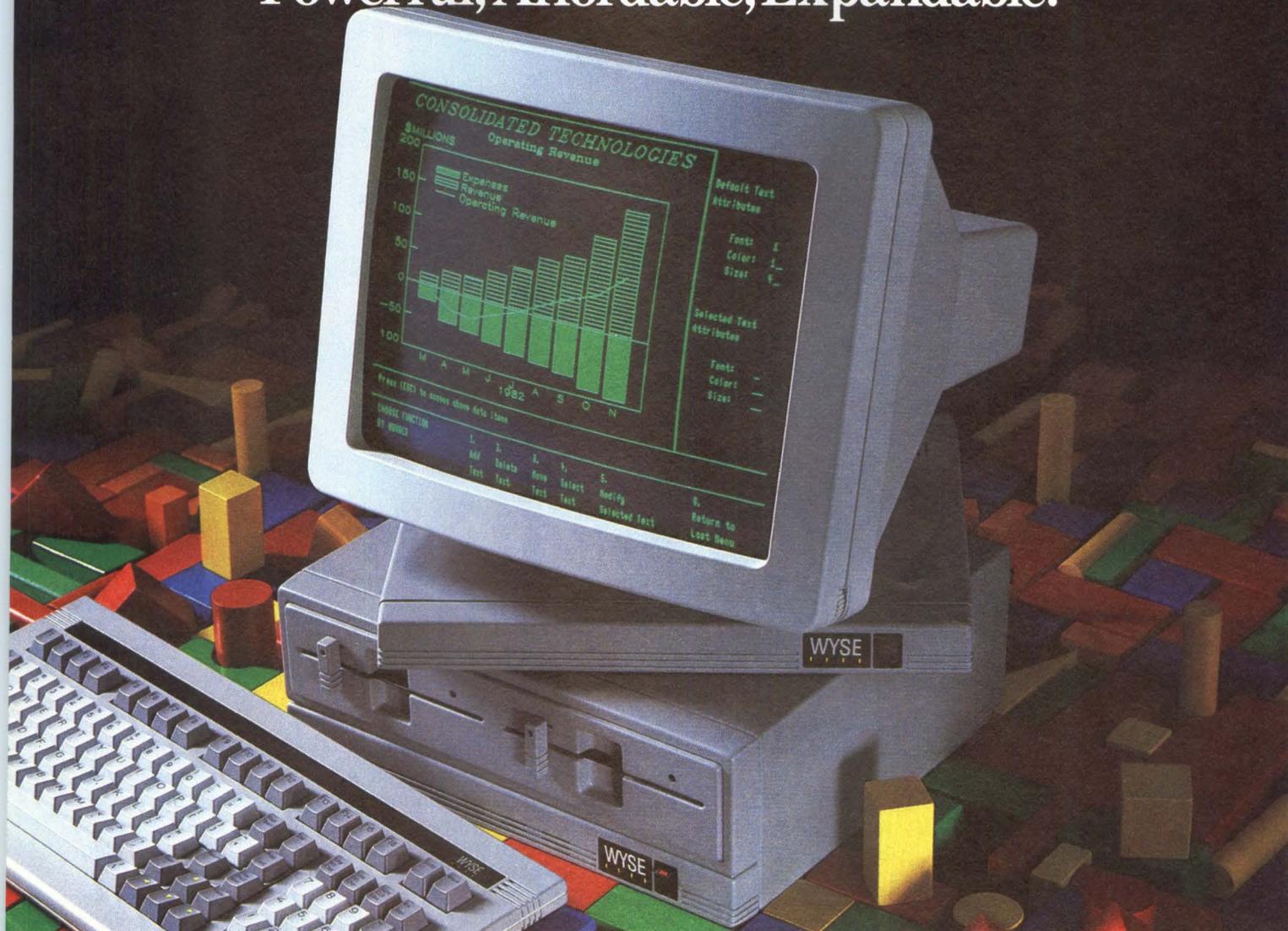
TECH FILES: A quick look at industry developments

Random disk files: DMA Systems Corp., Santa Barbara, Calif., announces a higher-capacity fixed/removable 5¼-inch hard disk drive, the Micro-Magnum 11/11, that has 11M bytes fixed and 11M bytes removable storage. The 11/11 gives 12M bytes more memory space than the company's Micro-Magnum 5/5 and is priced \$55 more at \$1,350

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CIRCLE NO. 12 ON INQUIRY CARD

Breakpoints

in quantities of 1,000. DMA's forethought in designing the original drive with embedded servo-voice-coil technology, along with its history of producing more than 11,000 drives at 5M/5M bytes, gives it an edge in both upping the capacity and moving quickly to volume production, which is scheduled for June. DMA president Dick Troutte says the privately held company has filed with the Securities and Exchange Commission "just to get in the queue" but says not to look for an early public offering, alluding to the generally depressed market for disk drive stocks.... **Irwin Magnetic Systems Inc.**, Ann Arbor, Mich., born out of the remains of short-lived Irwin-Olivetti, **has become one of the first companies to manufacture a 3½-inch form factor tape subsystem**, the model 210. The 210 backs up a 10M-byte drive and features thin DC 600 media within a standard 3M Corp. DC 100 mini-cartridge. The tape drive is a revised version of Irwin-Olivetti's 5¼-inch disk drive with built-in tape backup. Partially because of a non-standard interface, the 5¼-inch disk product did not succeed before the six-month Irwin-Olivetti merger failed. In addition to the 3½-inch form factor, Irwin will also manufacture the 5¼-inch, half-height model 110 cartridge tape.... Less than two months after announcing a multimillion-dollar contract for its 3½-inch Winchester disk drives from portable computer manufacturer Compaq Computer Corp., **Rodime Plc., Glenrothes, Scotland, has announced a non-exclusive contract with TeleVideo Systems Inc., Sunnyvale, Calif., worth as much as \$50 million over an 18-month period** if all purchase options are exercised. The contract covers Rodime's four-platter, 42M-byte RO 208 and 10M-byte RO 252, which was launched last March. The 3½-inch RO 252 twin-platter drive is mounted in a half-height, 5¼-inch chassis. The drives will be used in TeleVideo's single-user and multiuser microcomputers and intelligent terminals. Rodime is delivering 15M-byte, 5¼-inch drives to TeleVideo under an initial contract of an undisclosed amount. Rodime will manufacture the 3½-inch RO 350 series at its new 50,000-square-foot Boca Raton, Fla., facility during the second quarter. The company is producing 1,500 drives per week at its Fife, Scotland, facility, says Malcolm Dudson, Rodime director of marketing.

Uni-Forum wrap-up: Interest in UNIX, the proposed standard operating system developed by the former Western Electric Co. has increased dramatically over the past year if this year's Uni-Forum UNIX users conference is any indication. The number of participants spurted to approximately 6,000 compared with some 1,500 who showed up for last year's conference. The number of exhibits tripled to approximately 150, compared with the previous year. Several announcements from hardware and software vendors of UNIX-based products highlighted the conference. They included:

- **An enhanced version of UNIX System V and three new UNIX software packages from AT&T.** The enhancement comprises improved job control, software generation and electronic mail. The new software packages include a documenter's workbench for text processing, BASIC for novice programmers and a software-generation system for Motorola Inc.'s MC68000 processor.
- **Digital Equipment Corp.'s version of the UNIX operating system, ULTRIX-32.** ULTRIX-32 is based on Berkeley UNIX and will run on the VAX-11/730, 11/750 and 11/780 superminicomputers. Prices for a VAX processor, 2M bytes of memory and ULTRIX-32 software range from \$23,500 to \$150,000. Add-on license fees range from \$12,000 to \$15,500.
- **Data General Corp.'s UNIX System III operating system upgraded to System V.** The enhancements have been integrated into DG's advanced operating system/virtual storage (AOS/VS) software for use with the company's Eclipse MV computer series. The company also announced that it would extend its independent software vendor program to applications developed for the UNIX-VS operating system.
- **An announcement by Microsoft Corp. and National Semiconductor Corp.** that the XENIX operating system, Microsoft's licensed UNIX version, will be made available for National Semiconductor's new 16032 microprocessor.

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- The **Gould Inc.** computer system division's announcement that its universal timesharing executive (UTX) UNIX-based operating system is available on the Concept 32 minicomputer series and that the XENIX operating system has been added to the PS 1000 desktop computer. The UTX operating system is based on the Berkeley 4.1 C UNIX release and includes some System V features. Gould is test-marketing a new desktop microcomputer, the PS-2000, equipped with the UTX operating system. The MC68000-based machine features 4M bytes of virtual memory and is expected to be priced at less than \$25,000.
- **Texas Instruments Inc.'s announcement that it has targeted OEMs for its 32-bit NU Machine**, based on the 37.5M-byte bus technology developed at the Massachusetts Institute of Technology. The operating system is based on UNIX Version 7 with Berkeley 4.1 enhancements, which the company expects to upgrade to System V by June.
- **The announcement by four independent software vendors that they would form a consortium to design standards for information interchange among software environments.** The consortium, the Independent Software Information Standard, includes Access Technology Inc., Quadraton Inc., Software Express Inc. and Unify Corp.

Software files: Digital Research Inc., Pacific Grove, Calif., recently netted a contract with **AT&T Technologies Inc.** and another with **Motorola Inc.** Digital Research will jointly develop a commercialized UNIX System V operating system with AT&T and participate in a committee that will approve independent software vendor applications for inclusion in a UNIX System V library that both companies will sell. In the Motorola pact, Digital Research will provide ports for its CP/M and Concurrent CP/M with PC-DOS support to run on systems using Motorola's VME/10 development system and running under UNIX System V. Applications from the CP/M versions and UNIX System V should be able to run under each other—that is, CP/M applications will run under the UNIX System V operating system and vice versa, reportedly with no source-code modifications. Digital Research also intends to develop an operating system for release next year that will incorporate multiuser Concurrent CP/M, PC-DOS, UNIX System V and a fourth operating system that can be customized as an integrated operating system with common files....**Pick Computer Works** plans to introduce an operating system this year. The company is now developing a C compiler to run under its Pick operating system. The C compiler will allow UNIX applications to run. Other languages will be forthcoming, notes Pick founder Dick Pick....**IBM Corp. has licensed a UNIX version from Interactive Systems Corp. to run on its IBM PC XT.** IBM's National Accounts and National Marketing divisions will sell the \$900 package.

Micro files: Apple Computer Inc. has changed the initial price of its new Macintosh twice. The original price was \$2,495. Apple reduced it to \$1,995 to make it more competitive but then raised it again to \$2,495. An Apple spokesman says the second change was made to prevent competition with the Apple IIe. Because Apple has shown it can afford to sell the Macintosh at the lower price, analysts believe that, within six months, Apple will drop the price of both the Macintosh and the IIe....**Intel Corp.** promises to reduce the price of its 256K-bit erasable programmable read-only memory (EPROM) chips to \$25 in quantities of 10,000 by the fourth quarter. Price for the 450-nsec. 27256 EPROM is \$95 in quantities of 10,000. The 27256 is compatible with the Intel 8086, 80186 and 80286. Intel says the 27256 can be programmed in 3 minutes....**Digital Research Inc.** plans to port its Personal CP/M operating system to Coleco Industries Inc.'s Adam home computer. The announcement was made at a recent Consumer Electronics show in Las Vegas, Nev. The operating system will reside in plug-in ROM modules or floppy disk drives....**IBM Corp.'s recent announcement of the**

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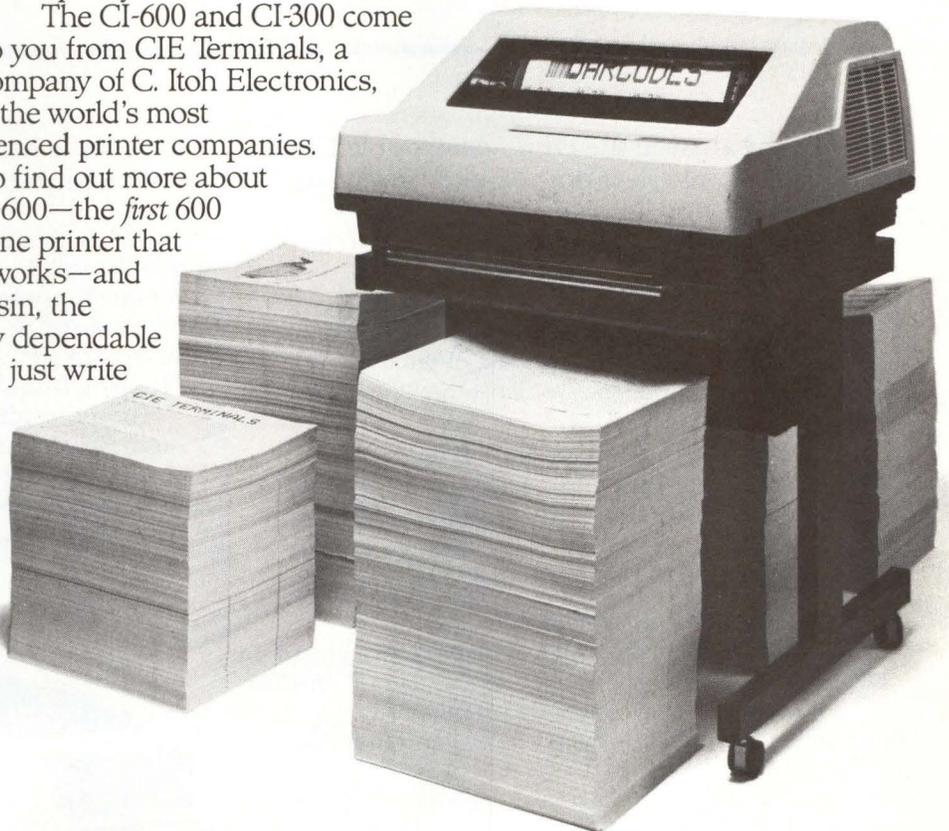
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Pictured here, the 880 Winchester/Floppy. Shown above, the 890 Winchester/Tape.

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CIRCLE NO. 14 ON INQUIRY CARD

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Breakpoints

PC/Interactive Executive UNIX System III operating system for the PC may open the door to integrated decision-support systems on UNIX. UNIX's multiuser, multitasking capabilities should bring such packages closer to true integration. One start-up preparing such a product for mid-year introduction is **Inspiration Systems Inc.**, Sewickley, Pa. Inspiration's package will include spreadsheet, graphics, word-processing, database-management and report-writer functions.

Graphics files: The low-cost market for computer-aided-design (CAD) systems, aimed at bringing the performance of the expensive CAD systems of the early 1970s to personal computers, will gain another competitor this month in **Personal CAD Systems Inc.** (P-CAD), Los Gatos, Calif. P-CAD has been selling PC logic-board design software for the IBM PC. It will enter the architectural-design market with CAD-Plan, a 2-D layout package for architects. The package, expected to be introduced at an architectural show in San Francisco this month, includes a database manager that keeps statistics on individual components for cost and efficiency analysis. Used with an IBM PC and color monitor, the program can achieve 320-by-200-dot resolution. The package will sell for \$1,200—and a less sophisticated package aimed at PC enthusiasts called CAD-Draft will sell for \$495.

Printer files: The high potential of thermal-transfer print technology may soon be realized with the emergence of high-resolution thermal print heads. Japanese printer manufacturers are said to have achieved densities as great as 400 dots per inch (dpi). At least one manufacturer, **Mitsubishi Electronics America Inc.**, Torrance, Calif., is demonstrating a color thermal-transfer device at 400 dpi. Mitsubishi is supplying the printer to Nippon Telephone & Telegraph but is expected to offer the print head as an OEM product after this year....**Burroughs Corp. should soon introduce a 30 page-per-minute laser printer** that has been under development at its Orlando, Fla., facility. Resolution for the new printer will reportedly be 240 dpi. Burroughs has offered OEM versions of Xerox laser printers....**Digital Equipment Corp. reportedly will introduce an 18-wire dot-matrix printer this year.** DEC will employ a print head manufactured by DH Technology, Sunnyvale, Calif., which also supplies or licenses print heads to such companies as Genicom Corp. (formerly General Electric Co.'s printer group), Mannesmann Tally Inc. and Wang Laboratories Inc. DEC and DH Technology spokesmen decline comment on the reports.

Notes from overseas: The first Belgian computer may be introduced in the United States within a year. Antwerp, Belgium, start-up West European Systems Technology (WEST) is beginning deliveries of its WEST 3000 workstation, which Seiko is assembling in Japan. The workstation uses Intel Corp. 8086, 8089, 8088 and 8085 chips for central processing, arithmetic coprocessing, screen/keyboard handling and disk-control functions, respectively. A standard configuration, priced at \$12,000, offers 1M byte of internal memory, a 20M-byte Winchester, a 640K-byte floppy disk drive, a color graphics screen, a printer and communication ports. Bundled with the hardware is Intel's RMX-86 operating system, an extended version of ANSI BASIC dubbed SUPER BASIC, the TM3000 word processor and a proprietary Etna database manager. Seven WEST 3000s can be networked with an optional 8088 controller. Disk capacity can be increased to four 40M-byte Winchesters. Follow-on products include a down-graded box running RMX-86 and a high-resolution computer-aided-design/computer-aided-manufacturing (CAD/CAM) unit. To avoid customs duties, WEST wants to move production and is eyeing sites in Ireland. It hopes to attract sales leads via subsidiaries in France and the United Kingdom. It also plans to open German and U.S. offices. WEST has no OEM contracts but is looking for established computer manufacturers for the 3000.

Breakpoints

England's **Interactive Data Machines**, which distributes the Pick operating system on IBM Corp.'s Series/1 minicomputers in the United Kingdom and is the exclusive European distributor for the Altos Computer Systems' Pick 580, has formed a joint venture with British company **Aston Technology**. Aston supplies the Pick product on Perkin-Elmer Corp. equipment. The companies plan to market the IBM PC running the Pick look-alike Revelation operating system from Cosmos throughout Europe. The equipment will be bundled with the System Builder software generator created by Pick dealer Computermatics in South Africa. Aston and Interactive will bear the costs equally, says Interactive president Neil Radcliffe. OEM Interactive will contribute hardware from IBM and the operating system it has under license from Cosmos. Aston will provide the generator from Computermatics. The venture will seek high-volume end users and dealers for the line.

Digital Equipment Corp. has decided to distribute its Professional and Rainbow microcomputers through department stores. Its alliance is with Horten, Germany's fourth largest merchandiser. Horten has so far opened only one "Professional Shop" in its store in Munster, West Germany. DEC has become Horten's flagship product supplier. Horten is testing the concept until the end of May and plans to open Professional Shops in other stores.

IBM Corp. and Olivetti SpA haven't done all that well selling the IBM PC and Olivetti M20 microcomputers through the big German discount chain Metro. Estimates put Metro's 1983 total for both machines at about 500 units in stores. That has not deterred **Texas Instruments Inc.** from signing Metro as a dealer and introducing its Germanized Professional computer through that channel. **Toshiba** has also gone to Metro to try to sell its T 100 word processor. TI hopes Metro's strategic plans, \$4 billion revenue base and investment schedule will eventually make the chain one of the top European computer retailers. TI is not neglecting the small resellers, however. It is now assembling its German personal-computer dealer network, beginning this month with 20 companies in major industrial locations. TI plans to build the network to 100 or 125 dealers by year-end. TI says it's late coming to market behind such heavy hitters as Digital Equipment Corp. and IBM and only beginning deliveries of the Professional this month or in March. However, dealer acceptance is promising. TI has Germanized the product, simplified dealer discount schedules and warned small shops that Metro will undercut them 10 percent to 12 percent. TI says third-party dealers will not produce significant volumes until the second half of the year.

Cii Honeywell Bull last month upgraded the products it took over from Thomson-CSF after the French government ordered Bull to absorb SEMS, Thomson's minicomputer operation. Observers expected that Bull might minimize the SEMS lines in favor of its own Honeywell gear. Instead, it has upgraded the SEMS transaction-oriented Mitra business systems and the industrially-oriented Solar boxes. Included in the announcement was word that Bull will be jumping on the UNIX bandwagon with a UCOS-6 implementation of UNIX Version 7 for its entire Honeywell DPS-6 minicomputer family. In addition, Bull has salvaged a multiuser, MC68000 UNIX 7 microcomputer originally under development for SEMS by the CNET national telecommunications research center and the INRIA national data-processing research center. Intended for scientific uses, the SM90 is built around a 5M-byte-per-second bus allowing eight SM90s and 16 "exchange units" to share a maximum of 16M bytes of main memory. The SM90s and exchange units are the NSC-800 or the Intel 8080 and are used as peripheral controllers.

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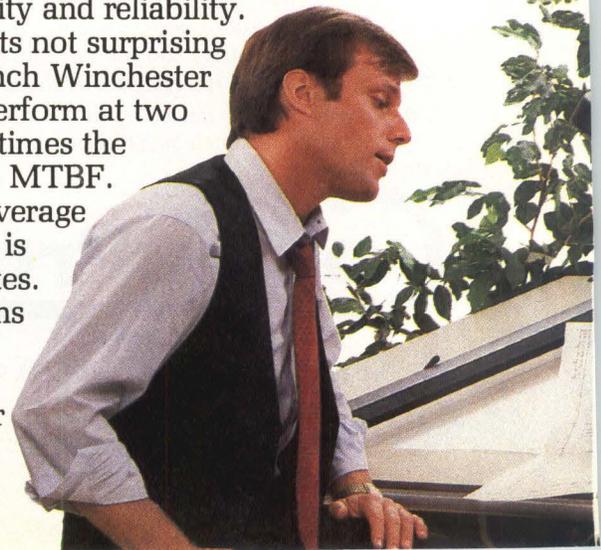
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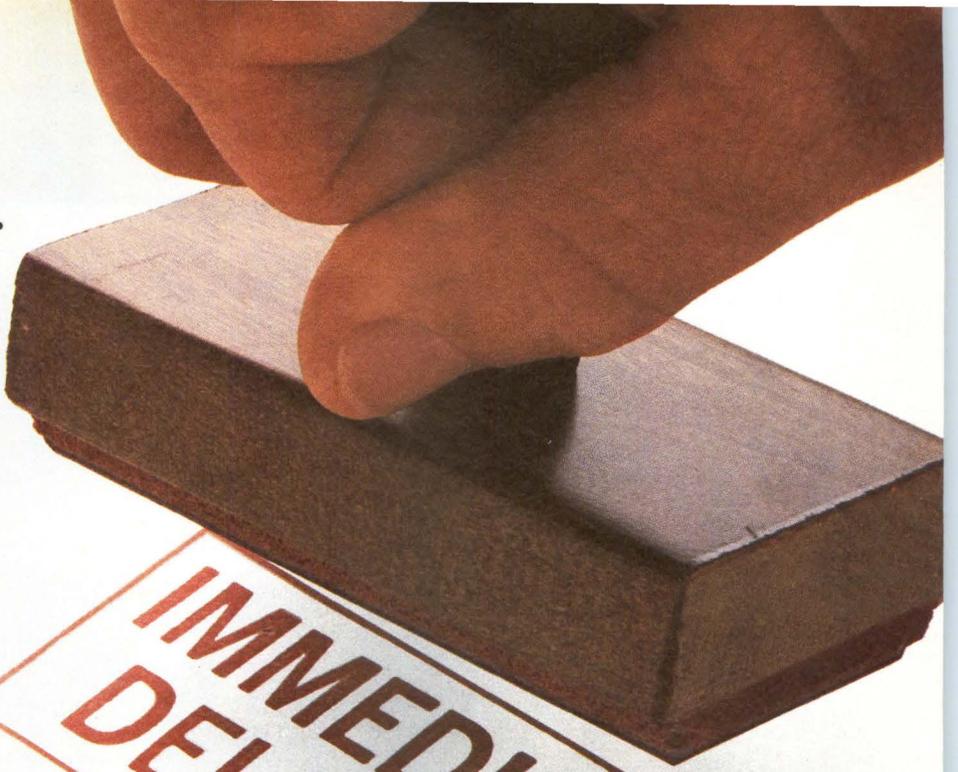
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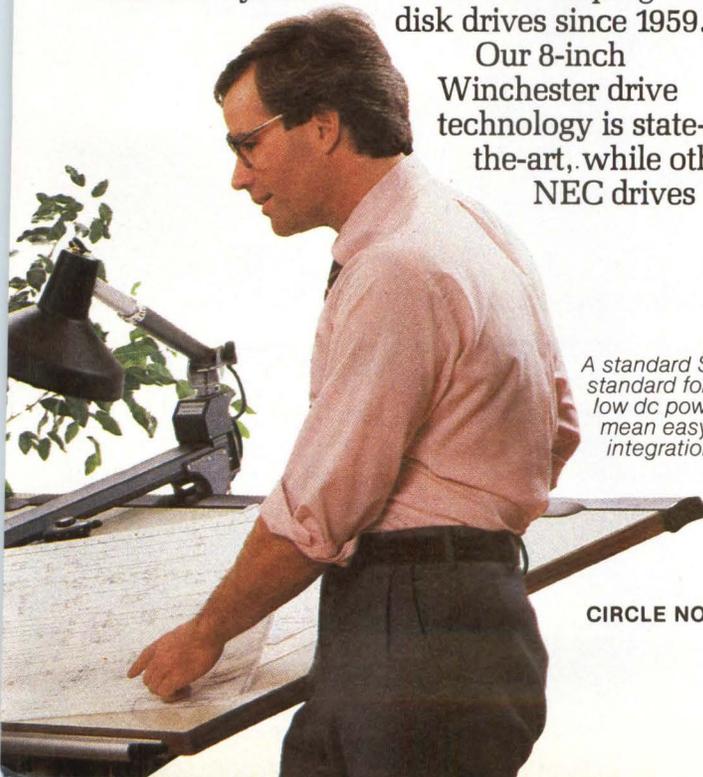
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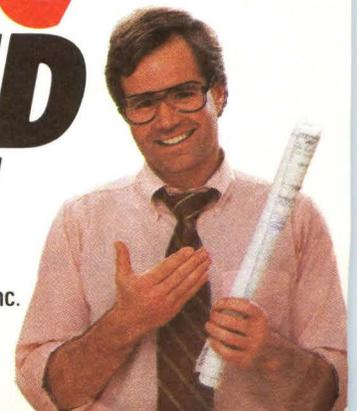


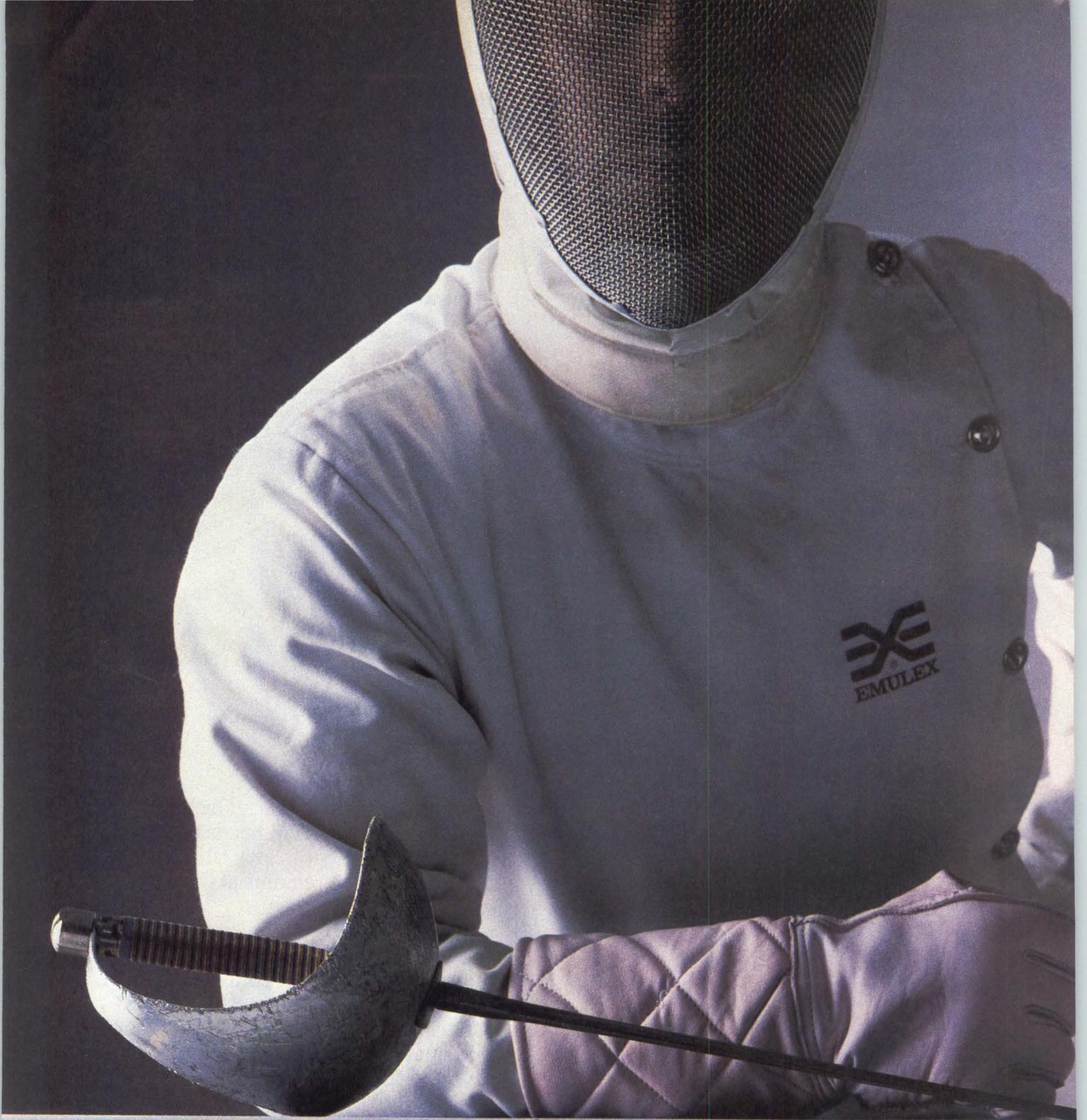
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Apple brandishes Macintosh and Lisa 2 to combat IBM PC

Tom Moran, Associate Editor

Apple Computer Inc. has rolled out the two computers it hopes will be big guns in the computer wars: Macintosh and Lisa upgrades.

The long-awaited 16-/32-bit Macintosh is the second member of Apple's 32-bit family and its first transportable computer. With the Macintosh introduction in late January, Apple is defending its turf in the market for \$1,000 to \$3,000 personal computers while arming itself for battle on the IBM PC's home ground (see "Apple plants Macintosh, hopes for cash crop," Page 71).

The Macintosh uses the same Motorola MC68000 CPU as the powerful Lisa (MMS, February 1983, Page 17). It weighs about 22 pounds, including an optional carrying case. Retail price is expected to be \$2,495. It is transportable and compact: the main system measures only 13.5 inches high by 9.7 long inches by 10.9 inches deep. The system includes a 3½-inch Sony microfloppy drive and sports an integral 9-inch, 512-by-342-dot resolution, bit-mapped monochrome monitor. The bit-mapped screen on the more expensive Lisa has a 720-by-364-dot resolution.

The Macintosh's detachable keyboard and optional keypad can be daisy-chained from the system unit. The system has a one-button mouse that drives the cursor functions of Lisa-like application programs MacWrite, MacPlan, MacChart and MacPaint, as well as Finder utility software that manages other application programs. Of these, only the Finder is included in the base price



The transportable Macintosh, Apple's new MC68000-based microcomputer, sells for \$2,495 and offers almost as much power as the Lisa.

of the Macintosh. The system supports an optional external microfloppy drive, and the company plans to introduce an optional external Winchester drive.

The Macintosh comes with 128K bytes of RAM, with room for expansion when 256K-byte RAM chips become available in large quantities. The computer uses two PC boards—one for the system and the other for the video controller and the switching power supply.

A 64K-byte ROM contains the Macintosh's "handcrafted" operating system, which is basically a subset of the Lisa operating system. Company chairman and co-founder

Steve Jobs thinks that having an operating system other than CP/M or MS-DOS will not be detrimental. "There is no standard operating system for 32-bit systems. If we'd wanted to choose the operating system with the largest installed base, we would have taken AppleDOS. We could have made it compatible with one of the two industry standards—the Apple II or the IBM PC. But neither live up to our vision of what a computer ought to be." A third choice is to try to implement a 32-bit standard.

Besides the original integrated Macintosh application packages, Apple is encouraging third-party

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software development.

Spokesmen for Apple say that one of the largest markets for the Macintosh will comprise small and medium businesses and departments in large companies. A planned interconnect called AppleBus will link Lisas, Macintoshes and Apple IIs in such environments. Apple also intends to offer a 74M-byte Winchester file server for sharing data files among machines and an inexpensive laser printer for higher-quality printing than Apple now offers. Finally, communications servers will connect Lisas and Macintoshes on the AppleBus to IBM Corp. mainframes, X.25 protocol systems and news services such as that offered

IBM VS. APPLE				
	Apple IIe starter system	Enhanced PCjr	Macintosh	IBM PC
CPU	6502	8088	MC68000	8088
RAM	64K bytes	128K bytes	128K bytes	64K bytes
ROM	16K bytes	64K bytes	64K bytes	40K bytes
No. of drives, capacity	1 5¼-in., 140K bytes	1 5¼-in., 360K bytes	1 3½-in., 400K bytes	1 5¼-in., 180K bytes
I/O ports	1 parallel	1 serial	2 serial	1 parallel
Monitor	12-in. green	TV cable, \$30, or color monitor, \$680	9-in. B/W	11-in. green
Software included	OS, BASIC in ROM	BASIC in ROM; PC-DOS 2.1	OS, Desk Manager in ROM, training disk	BASIC in ROM, PC-DOS 2.0 or 2.1
Price	\$1,395	\$1,364 w/cable, \$2,014 w/color monitor	\$1,995	\$2,604

Now that IBM has positioned the PCjr against the Apple IIe, Apple has countered with the Macintosh as a rival to the immensely popular IBM PC.

Low-cost GCR tape drive decreases in size, increases in performance

Robert A. Sehr, Associate Editor

Cipher Data Products Inc. has unveiled its first ½-inch CacheTape group-code-recording (GCR) tape drive, a small, low-cost, high-performance, rack-mounted successor to its CacheTape streaming-tape drive, which was introduced a year ago. Priced at \$6,300 in OEM quantities of 100 and \$9,000 for single units, the model M990 is a product that analyst Ray Freeman, president of consulting company Freeman Associates, Santa Barbara, Calif., believes not only will survive the competition of IBM Corp.'s anticipated "Ocotillo" ½-inch tape drive but also will become the dominant product in the ½-inch tape market.

"This segment will retain interchangeability with all existing reel-to-reel drives," Freeman notes. "That's important in areas like

government records where archival storage must be maintained."

The key to the success of Cipher's short-vacuum-column product lies in the new customer base created by its lower purchase price. Unlike its competitors—Control Data Corp., Fujitsu America Inc. and Storage Technology Corp. (STC)—which also supply traditional short-vacuum-column GCR drives to high-end users, Cipher hopes to move its smaller business-customer base up to GCR technology. "We're not really competing against STC's Avalanche tape drive; they have a higher-end customer base," says Larry Hemmerich, Cipher's vice president of marketing, "although we suspect they may try to reach some of our customers."

The Cipher drive comes in a breakthrough 14-inch-high, rack-mounted box, with much fewer ICs and mechanical parts than competi-

tive boxes that run 24 to 39 inches high. Demand for desktop footprints has driven the computer and disk drive industries to reduce size and costs, and the tape drive industry is the latest beneficiary of these technology trends.

With the arrival of low-cost GCRs, Freeman notes, the long-vacuum-column units have been doomed to "dinosaur" status, giving way to short-vacuum-column units that can now handle transfer rates from 780K bytes per second (average) to 1,200K bytes per second and tape speeds of 125 inches per second (ips) to 200 ips.

The Cipher CacheTape GCR unit provides transfer rates in the traditional range of low-cost GCRs—450K bytes per second and 125-ips streaming speed. The next low-cost Cipher GCR will offer a transfer rate of 780K bytes per second, says Kim Kelly, product

by Dow Jones & Co. This is the first time Apple has created a large system from component Apple machines. Some analysts believe the lack of this feature in the past has hindered Apple's acceptance by MIS managers.

Apple is introducing the Lisa 2 32-bit computer in three versions. The Lisa 2 family uses the same microfloppy drives as the Macintosh, so that file interchange without networking between Apple models will be possible for the first time. The Lisa 2 comes without a hard disk, the Lisa 2 + 5 adds a 5M-byte ProFile Winchester, and the Lisa 2/10 features an internal 10M-byte Winchester. With 512K bytes of RAM, the systems will sell

for \$3,500 to \$4,500 for the Lisa 2, less than \$5,000 for the Lisa 2 + 5 and less than \$6,000 for the Lisa 2/10. All three machines can run Macintosh software using a program called Mac-a-like, so files can be up- and down-loaded between Lisa 2s and Macintoshes using the 3½-inch floppy diskettes. Because at least 768K bytes of RAM is necessary to run Lisa programs, RAM upgrades will be offered for less than \$800 for 256K bytes and less than \$1,400 for 512K bytes.

Apple plans to offer a free upgrade to the original Lisa 2 + 5 or conversion to the Lisa 2/10 for less than \$3,000. The Lisa 2/10 conversion will allow a user to retain the external 5M-byte ProFile drive.

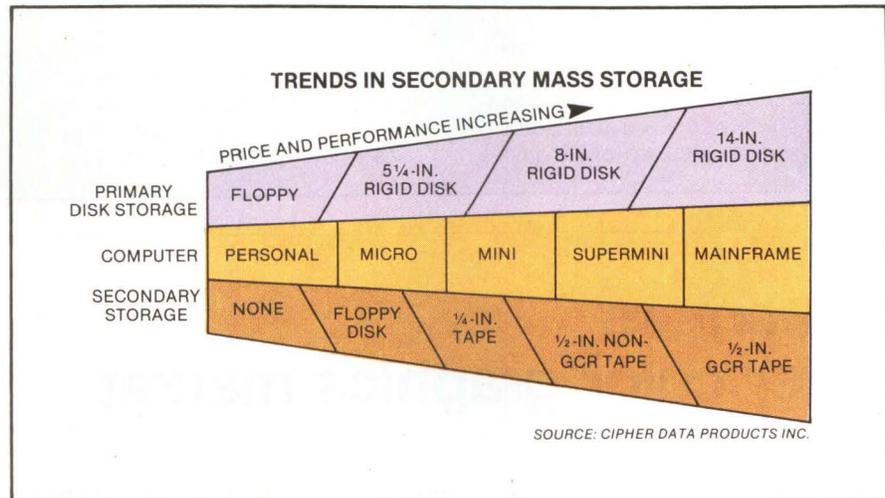
Jobs is enthusiastic about the Macintosh: "There are two great milestone products in our industry because of the volume they have sold—the Apple II in 1977 and the IBM PC in 1981. Macintosh is going to be the third great milestone product in 1984, and it will achieve volumes that I believe will be the highest in the industry within 24 months." He expects the \$20 million Macintosh factory in San Jose, Calif., to produce a system every 27 seconds.

Jobs says Apple plans to provide bridges from Macintosh to data-communications devices, mainframes and remote databases, all products that Apple will demonstrate soon.



Cipher Data Products Inc.'s first entry with a group-code-recording (GCR) ½-inch tape drive is the CacheTape M990. The drive features 128K bytes of cache memory, a 450K-byte-per-second transfer rate and a 125-inch-per-second streaming speed.

marketing manager for Cipher's GCR line. The GCR products will also maintain software compatibility with Cipher's installed base of 20,000 Microstreamers and CacheTape units, Kelly notes. "With this software-transparent interface and low cost, smaller businesses now using Cipher drives will be able to take advantage of a higher level of performance," Kelly adds.



As a result of technology and price breaks, group-code-recording (GCR) tape drives can now be efficiently designed into computer systems smaller than mainframes.

The CacheTape GCR unit, like its CacheTape predecessor, contains 128K bytes of cache memory, allowing for quick retrieval and error correction in ROM and more responsiveness to the host system. This feature will be retained in a forthcoming higher-level GCR product incorporating the anticipated interface standard, IPI. The American National Standards Institute is

now negotiating the interface, which will allow higher tape drive data-transfer rates, much like the enhanced small disk interface and the Seagate Technology ST412HP interface do for high-performance, 5¼-inch Winchester drives. When the new interface is ready—probably this year—Cipher's forthcoming second-generation, 780K-byte-per-second, low-cost GCR will

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also be ready.

Even if IBM's Ocotillo is introduced this year, Hemmerich notes, Cipher will be shipping its Cache-

Tape GCR units by the second quarter. "It will take some two years of design time before system makers are able to integrate a

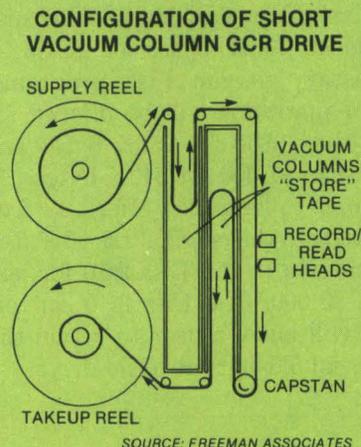
½-inch cartridge," he says. "We also expect that Ocotillo will initially be aimed at a higher-performance market that is now served by

A GCR BACKGROUNDER

Group-code recording (GCR), like many other mainframe tape drive developments, came from IBM Corp. GCR technology pushes linear information-storage densities from 1,600 to 6,250 bits per inch (bpi), and its self-clocking technique enables nine-track vacuum-column systems to correct two-track failures. Its error-recovery systems handled intermittent errors within the read process and included a 2-byte cyclic-redundancy check at the end of each record for error detection.

Don Collier, a market analyst with Freeman Associates, a Santa Barbara, Calif., market research company, says GCR encoding added efficiency to the IBM 3420 series of short-vacuum-column tape drives introduced in 1971.

Vacuum-column drives use negative air-pressure mechanical buffering to cut the mass required for the drive's



SOURCE: FREEMAN ASSOCIATES

start/stop motion. As a result, vacuum-column drives increase tape speeds from 45 ips on tension-arm drives to 200 ips and beyond.

In long-vacuum-column drives, typically used with mainframes, tape is stored in two chambers on each side of the drive capstan and read/write head. A vacuum pump keeps reduced air pressure in each side, drawing tape into each column. Sensors monitor the position of the tape and send a signal to the reel motors to maintain acceptable length within each chamber. Consequently, only the tape itself is speeded up or slowed down in a start/stop operation.

Short-vacuum-column models have the columns alongside the reels. Because short columns have less buffering capability, they have been limited to speeds of 125 ips. Collier notes, however, that Storage Technology Corp.'s new model 4670 has broken that barrier and provides a 200-ips speed, signaling the possible demise of long-vacuum-column drives.

IBM enters raster color graphics market

Robert A. Sehr, Associate Editor

IBM Corp., which made a late entrance into the personal computer market, now threatens to shake up the small-but-growing scientific and engineering color graphics market with another late entrant—the recently introduced 5080 raster color graphics system.

The 5080 features a 1,024-by-1,024-dot resolution monitor that simultaneously displays as many as 256 colors or shades of gray from a palette of 4,096. The basic system

includes a mouse- or stylus-controlled 5083 tablet for interacting with the system. A 5085 graphics processor that fits under a desktop or table controls the 5080. The 5085 allows local processing to be detached from the host. A typical 5080 configuration with 1.1M bytes of memory, two MC68000 processors, a 5¼-inch floppy disk drive, a mouse, a controller and a monochrome monitor sells for \$19,750. The same system with a color monitor sells for \$24,750.

"IBM has set a new price/

performance standard for engineering and scientific graphics systems," says Joel Orr, president of consulting company Orr Associates Inc., Danbury, Conn. Orr speculates that IBM may interface the 5080 to its PC to improve the microcomputer's graphics options.

Like Orr, Jim Warner, president of Precision Visuals Inc., Boulder, Colo., is bullish on the 5080. His company is staking much of its future on expectations of the 5080's success by developing the first device driver—the DI-3000—tailored for the 5080. The DI-3000 supports input and output devices that allow application software to be transferred to the 5080 with few modifications. Although evaluation shipments of the 5080 will not begin

others." Cipher will wait until after IBM's Ocotillo is introduced before introducing a competitive product of its own, Hemmerich adds.

In the meantime, there will be enough customers in the low-cost GCR market to satisfy all current and some future entries, says

Freeman. He estimates the low-cost GCR tape drive market will grow at a 93 percent compound annual growth rate to \$221 million by 1987.

COMPARING THE GCR TAPE DRIVES

Manufacturer	Cipher	Control Data	STC	Telex	Fujitsu	Kennedy
Product name:	GCR CacheTape	Keystone III	Avalanche	Shamrock	Model	Model
Model number:	M990	92185	2920	9250	M2440	9400
Performance (avg. transfer rate)						
*start/stop,	438,	156,	313,	313,	78,	281,
streaming (K bytes/sec.)	N/A	469	N/A	N/A	625**	N/A
Price						
list (qty 1);	\$9,000;	\$8,500;	\$9,500;	N/A;		\$12,000 (est.);
OEM (qty 100)	\$6,300	\$6,350	\$6,779	\$7,500	\$8,000	\$8,900
Size						
vertical height (in.)	14	24	24.5	24.5	24.3	24.5
Interface (STD)	industry standard	industry standard	STC	Telex	industry standard	various
Recording format (bpi)	1,600; 6,250; 3,200 (tri-density optional)	1,600; 6,250	1,600; 6,250	1,600 6,250; 800 (optional)	1,600; 6,250	1,600; 6,250; 800 (optional)

*No streaming software is required.

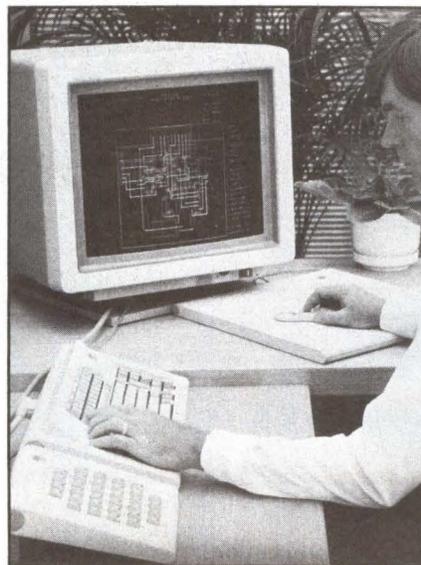
**Where streaming can be maintained (usually requires software modification).

Source: Cipher Data Products Inc.

until March, software application writers can now develop software for it using the DI-3000. License fees for the DI-3000 begin at \$12,000 for the 4300 series host, \$15,000 for the 3030 series and \$19,000 for the 3080 series.

The 5080 allows the graphics processor to switch from graphics mode to a 3270 emulation terminal and vice versa. This provides a user with access to corporate networks and databases from which to chart graphics. Providing hard-copy output for the 5080 is the new IBM 7375 eight-pin color plotter, which accepts paper as large as 24½ by 36½ inches. The plotter is priced at \$24,750.

Warner notes that the 5080 terminal is difficult to program. But



IBM's 5080 is the company's entrant in the color graphics market. The unit sports a resolution of 1,024 by 1,024 dots and as many as 256 colors or gray shades.

the DI-3000's virtual-device interface shields application writers from the low-level control routines specific to the hardware. Since the 5080 is aimed at scientific and engineering users, there is little concern for providing a user-friendly interface.

Some parallels exist between the 5080 and the IBM PC. For example, like the PC, the 5080 is the project of an independent IBM venture group with its own board and decision-making power. The system was 18 months in development at the Information Systems & Communications Group in Kingston, N.Y. Also like the PC, the 5080 is a latecomer to a market. Companies such as Adage Inc., Spectragraphics Corp. and Vector General Inc. appear to be the key competition.

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Industry observers expect the announcement to reduce competitors' prices for IBM mainframe-compatible graphics systems—now more than \$50,000.

Although the 5080 was introduced at the Autofact computer graphics exhibition in Detroit last November, its appearance at last fall's Comdex show in Las Vegas, Nev., caused observers to speculate that IBM may decide to hook into non-IBM mainframes. This would be a major concern of companies such as Tektronix Inc. and Ramtek Corp. that compete in the larger non-IBM graphics market. They fear that IBM will not limit its target market to its own mainframe base but will include the huge minicomputer-compatible market for Digital Equipment Corp., Prime Computer Inc. and Hewlett-

Packard Co. computer-aided-design/computer-aided-manufacturing (CAD/CAM) systems.

Mike Konerat, marketing manager for graphics system products at Tektronix, says, "It's within the realm of feasibility but difficult" for IBM to hook into non-IBM mainframes because "the 5080 has only one RS232 port, and that is to support peripherals." But Orr believes it's unlikely that IBM will enter a "peripheral" market. He believes IBM's goal is to sell systems, not peripherals.

IBM declines comment on whether the 5080 will accept other hosts, including MC68000-based supermicros, in the future. The appearance at Comdex was designed to attract IBM Value Added Resellers that will create vertical software packages, says Henry Sykes, represen-

tative for the Graphics Systems Programs division of IBM's Information Systems & Communications Group.

Many programs running on the 3250 monochrome vector-refresh system, such as CADAM Inc.'s computer-graphics-augmented design and manufacturing (CADAM) program, will be converted to the 5080. In addition, IBM may be fostering a cottage software industry by donating \$50 million in equipment to various U.S. universities. As a result, many new third-party software programs are expected to be available by the time production units become available.

As with every other product, delivery is the key, says Precision Visuals' Warner: "If IBM delays deliveries, other hardware companies will be able to fill in the gap."

ATTIS chief says company will be profitable in 1984



Stephen J. Shaw
Washington Editor

AT&T Information Systems will turn a profit this year, according to its chairman, Charles Marshall. Others in the telecommunications industry aren't so sure. ATTIS, the divested subsidiary of American Telephone and Telegraph Co. whose business it is to sell and lease phone equipment, itself predicted last year it wouldn't see black ink much before 1987.

ATTIS' new optimism apparently is founded on higher hopes for sales of some products, notably the System 85 private-branch exchange (PBX) and the Merlin communications system.

Enhancements to the System 85



After a rocky start, "we're on a paved road now," says ATTIS president and chief executive officer Charles Marshall.

allow it to manage office communications networks with as many as

7,000 stations. ATTIS plans to add advanced workstations to the system this year. "The stature of System 85 is now becoming apparent," says a company executive. "We're moving the product as fast as we can manufacture it."

The Merlin key system is aimed at low-end, four-line, 10-telephone applications. "We'll sell the Merlin like hotcakes," predicts Marshall.

Harry Newton, president of The Telecom Library and a telephone industry analyst, agrees with all this happy talk about profits. "They'd have to be bloody fools not to make a profit this year," he says.

Putting ATTIS in the black may involve accounting magic more than sales volume, Newton adds. He cites the recent write-off of \$7.3

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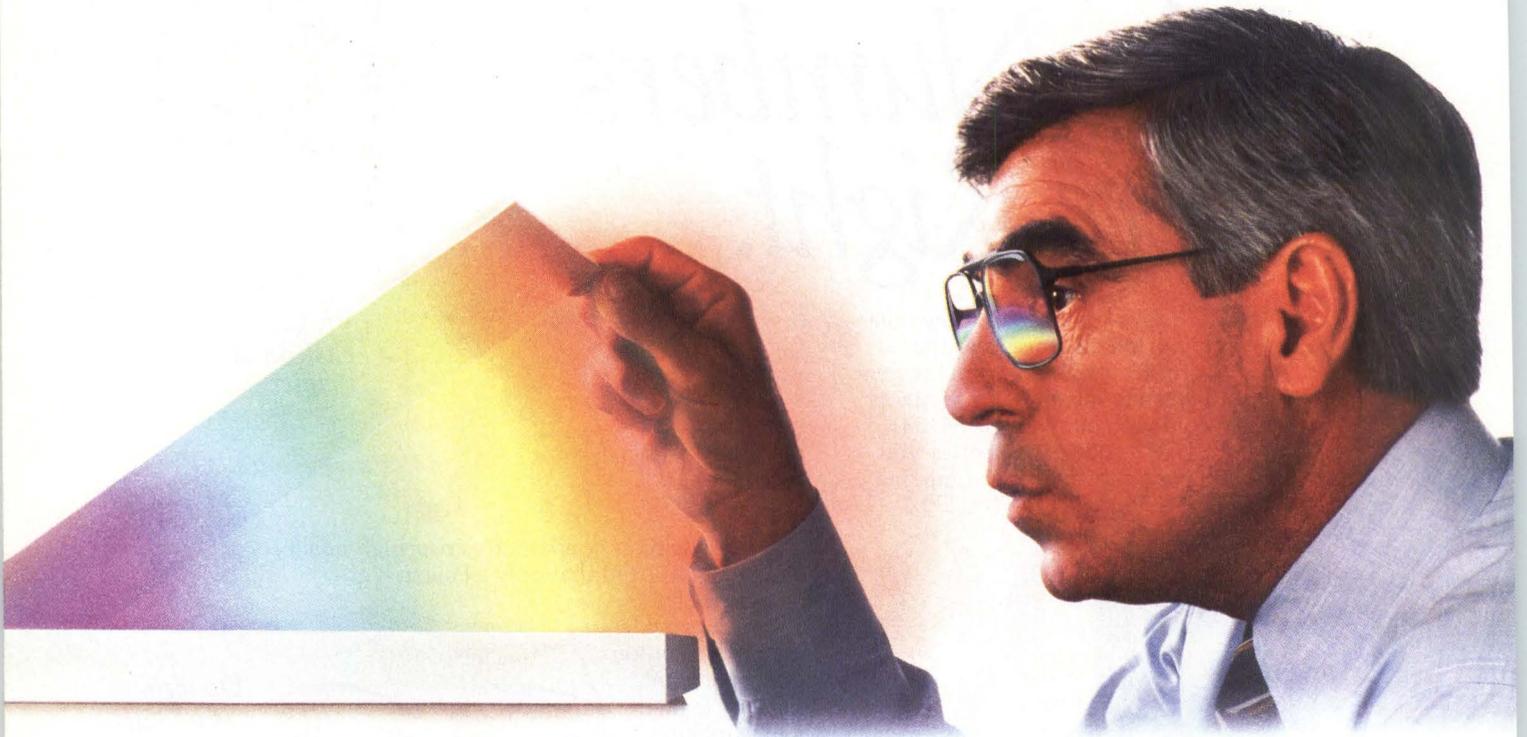
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A DRAMATIC ADVANCE IN HALF-HEIGHT WINCHESTERS...

STRAIGHT TALK

With all the claims and counter-claims regarding capacities, availabilities and shipments of half-height 5.25" Winchester, it's sometimes difficult to determine the facts.

FACT. In early 1983, Microscience asked over 40 OEMs to participate in a 120-day evaluation program of our HH-612 10 MB half-height drives.

We randomly selected 150 drives for these field tests.

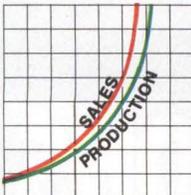
The evaluation proved that Microscience has the performance, quality and price today's small business and portable computer manufacturers demand.

FACT. Microscience ended 1983 with a significant order backlog. We could have shipped more, but we will not sacrifice quality for quantity.



Our returns are less than 1%.

Every drive undergoes rigorous testing in our advanced, computer-controlled test facilities.



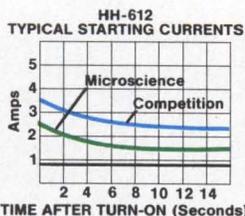
FACT. Microscience is rapidly expanding its highly automated manufacturing operation in California.

By the end of the first quarter, 1984, we will be able to meet more of the demands of large OEMs and distributors. And by the end of the year we will have expanded production by a factor of five.

Until then, when we commit to a quantity and shipment date, those commitments will be met. No ifs... no ands... no buts.

FACT. Microscience disk drives have extremely low voltage requirements... the lowest in the industry.

Small business and portable computers don't have the luxury of a lot of excess power capacity.

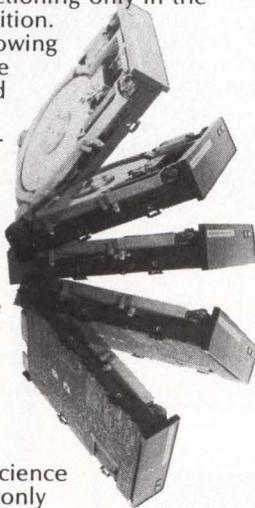


In every stage of our design we used procedures and components that would be misers with power yet still provide long-term performance and reliability.

FACT. Microscience drives aren't limited to functioning only in the horizontal position.

With the growing use of portable computers and increasingly compact packaging, we designed our stepper motor and head carriage assembly to permit flexible placement of the disk drive.

Positioning that is best for you, not us.



FACT. Microscience engineers use only proven technology advances in an innovative manner to produce disk drives that perform reliably.

That's why we incorporated plated media, microprocessor-controlled spindle motors and servo-positioning, embedded guard bands, extensive self-diagnostics and optional signal processing.

Plated media will stand up to the rigors of portable computer usage.

Microprocessor-controlled servo-positioning keeps the heads precisely on track by reading servo information written in the gaps on both sides of each data track.

Microprocessors constantly monitor drive performance and report irregularities to the user. They make repeated checks during operation and test themselves during Power Up.

Media-embedded guard bands keep the carriage head from exceeding pre-determined limits and protect the drives against "wall crashes."

Microscience uses only standard, off-the-shelf mechanical and electronic components in our drives so we can meet your demands as your system sales grow.

And, every component is second-sourced to ensure tested and approved availability.



FACT. In addition to our 10 MB half-height Winchesters, we have several other major advances in development.

But we will not announce them until they have been thoroughly tested and proven in our manufacturing and test operations as well as in the field.

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CIRCLE NO. 22 ON INQUIRY CARD

Mini-Micro World

NEWS



ATTIS' System 85, the company's flagship office-information system, offers integrated voice/data, sensor-based energy and security management and networking.



The Merlin communications system is ATTIS' key system. It serves small business customers with as many as four lines and 10 telephones. The control unit is on the left, and the 10-button telephone is on the right (five- and 34-button sets are also available.)

billion in assets of which approximately \$3.65 billion was taken off the estimated value of the equipment base transferred from the local telephone operating companies to ATTIS.

George DeSalvo, analyst with market research company International Data Corp. (IDC), is not so sure about profits for ATTIS this year. The anticipated sales leader, the System 85, has reached only "a handful" of customers, he says, adding that even the enhanced version of the PBX has been surpassed by offerings by competitors. He says IDC predicts that ATTIS' share of the PBX market will drop from 65 percent last year to 50 percent in 1985.

"I don't know what they're going to make a profit on," DeSalvo says.

How about the personal computer ATTIS is said to be developing? Chairman Marshall told a meeting of ATTIS employees in December that the computer would be introduced "when appropriate," leaving that issue up in the air.

The timing of the announcement of the personal computer may rest on factors other than production capabilities, say ATTIS officials. Issues that take priority include

integrating the 10,000-person sales force inherited from the Bell operating companies (BOCs) and consolidating the BOCs' 1,000 to 1,500 distribution outlets with ATTIS' 250 retail telephone stores.

In the meantime, ATTIS is building bridges with computer manufacturers and distributors. The company has reached an agreement with Infomart, a computer retail mall in Dallas, to lease space for business telephone equip-

ment sales. ATTIS has also reached agreements with Hewlett-Packard Co. and Wang Laboratories Inc. to develop a digital multiplexed interface to allow connection of their computer systems through the ATTIS System 85 PBX at 1.544M bits per second.

Other plans call for a local-area network, additional peripheral devices and a medium-capacity, all-digital PBX using Intel 8086 chips as application processors.

UNIX VERSION ACCESSES COMBINED RESOURCES

Users of the Net/One local-area network (LAN) from Ungermann Bass Inc. can run a UNIX-based operating system called NETIX from ITT Inc. subsidiary Bell Telephone Manufacturing Co., Antwerp, Belgium. NETIX provides transparent access to the combined resources of all the computers associated with an LAN as though they resided on a single large computer. Bell Telephone sales manager Aime d'Helft says Bell is seeking U.S. distributors for the product. He notes NETIX supports NETIX Version 7, and at the same time, its facilities are being ported to UNIX System III, System V and Berkeley 4.1 and 4.2 versions. NETIX is also available with the IS/3 LAN from Interactive Systems Corp., Santa Monica, Calif. Bell Telephone sells the IS/3 in Europe.

Graphics start-up latches onto UNIX standard

Robert A. Sehr, Associate Editor

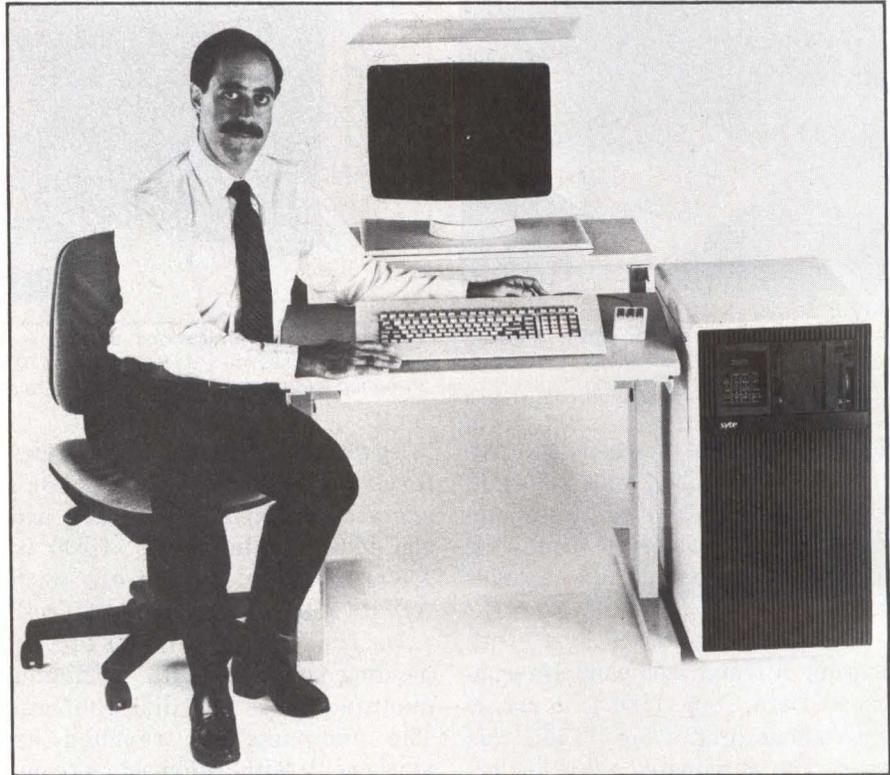
The U.S. government may have partitioned Ma Bell, but her Bell Laboratories UNIX operating system has become a unifying force in the graphics market. Several start-ups have emerged, confident they can quickly plug into a segment of the large UNIX-compatible market.

One start-up "plugging into" UNIX is Syte Information Technology Inc., San Diego. "UNIX standardization—even by some of the big-name manufacturers—has helped start-ups," says Peter J. Shaw, Syte's president and chief executive officer. He believes that using a standard operating system like UNIX allows third-party software writers to generate the applications a small company needs to sell a system.

Syte is the latest entrant in the growing market for supermicro-computer graphics workstations that includes Apollo Computer Inc., Sun Microsystems Inc. and Ridge Computers. Shaw hopes Syte's Series 3000 will compete against Digital Equipment Corp.'s VAX supermini and low-end mainframes such as IBM Corp.'s 4300.

Joel Orr, president of research and consulting company Orr Associates Inc., Danbury, Conn., says Syte has made a good impression in the market. "It's too early to tell what will happen in the long run; that will depend on many things—most importantly, manufacturing ability and [product] reliability."

Syte's Series 3000 graphics workstation system is available in two models—the 300 and 400. They each include a National Semiconductor NS16032 CPU, an Intel 80186



Start-up Syte Technology is using UNIX's popularity to boost sales of its NS16032-based supermicrocomputers in graphics applications. Company president Peter J. Shaw is shown with the Syte Series 3000 graphics workstation.

processor for direct-memory access and two Intel 8051s—one for communications and the other for diagnostics. The model 300 has a 1,024-by-800-dot monochrome resolution and 640-by-480-by-4-dot, bit-mapped color graphics. A single-user configuration displays 256 colors from a palette of 16 million.

The model 400 includes a graphics module with a 128-bit processor that performs raster-fill operations as fast as 300M bits per second and vector generation at 2.2 million pixels per second. It has 1,024-by-800- and 1,024-by-1,024-dot graphics resolution.

Standalone stations can be con-

nected via a local-area network without software modifications, and multiple stations can be hooked into distributed networks. Key to the system is Syte's proprietary global environment manager (GEM) software, which allows different operating systems to be used concurrently—even on the same node—in a network. GEM, a software base for all applications in the network, allows users to move from one operating system to another by pointing a mouse or light pen to an on-screen window.

A model 300 with a monochrome CRT, a CPU, GEM, Syte's adaptation of UNIX System V and three

EMULEX TALKS DEC

9

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Think about it. Over 40 megabytes of system software, application programs, data files and archival records in a compact package that fits in the palm of your hand. With storage costs as low as 60¢ per megabyte. It's the ¼-inch streaming tape cartridge—rapidly becoming the exchange medium of the decade. And only Emulex makes it as simple to join in the exchange as plugging in another TS11 tape system from DEC.

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Software transparent? Of course. But the new Emulex streaming tape couplers and subsystems not only make the ¼-inch tape cartridges look like ½-inch tape to your RT11, RSX11M and RSTS-E software, they also make them perform like a standard TS11 tape system. CDC's new Sentinel drive, for example, can emulate all the start-stop features of a reel-to-reel drive. The Emulex couplers perform standard TS11 data reliability diagnostics and on power-up also perform extensive self-tests.

COUPLERS TO COMPLETE SUBSYSTEMS...

Nothing halfway about it. Designing a new system or upgrading an old one? Emulex streaming tape cartridge couplers are available for the full range of DEC micro/mini computers. Just plug the new Emulex TC05 coupler into your LSI-11 QBus or a TC15 coupler into your PDP-11 or VAX-11 Unibus. Both units are designed to interface with the Sentinel streaming tape drive. Or if you want to add streaming tape to an existing LSI-11, PDP-11 or VAX-11 installation, take a look at Emulex's new Vault subsystems—plug-in coupler, cable (up to 10 feet) and a compact desktop cabinet that houses both a Sentinel drive and its own 115-volt or 250-volt power supply.

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Emulex is preparing you, too, for the next step up in 5¼-inch disk capacities. It's simple mathematics. Disk data-transfer rates equal the speed of rotation times the bit density. Double the disk capacity (above the present practical limit of about 70 megabytes) by doubling the number of bits per inch (no problem, with present-day media and heads) and you've raised the transfer rate far above the 600 kilobytes-per-second limit of the standard ST-506 disk interface. Solution: Emulex's new SC05 controllers for linking LSI-11 processors to the new generation of ESDI (Enhanced Small Disk Interface) high-capacity disk drives. The new limit? Up to 1.8 megabytes per second.

FROM THE EMULEX FILE...

Emulex continues to expand. Our headquarters facilities in Costa Mesa, California, will soon have a new two-story building with 60,000 extra square feet of floor space. By the end of next year we'll have 212,000 square feet in the Costa Mesa complex. Thank you DEC end users and OEMs!



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programming languages sells for \$21,900; with a color monitor, the price is \$24,900. Peripherals are not included in the price. The model 400 with the graphics module sells for \$29,900.

Syte's sales offices will sell the system in the United States, and Nissho Iwai subsidiary Nissho Electronics will sell it in Japan.

Shipments of the model 300 are scheduled to begin this quarter, and the model 400 should be shipped in the second quarter.

Shaw, former president of Megatek Corp., founded Syte a year ago. He brought three other Megatek executives to Syte, leading to a lawsuit by Megatek alleging trade-secret theft. "It's the classic case of

the big company against the little guy," says Shaw, who believes Syte and Megatek are not competing in the same market. "I can see our system interfacing with a Megatek unit in some situations, but for us to compete with Megatek we would have to come out with a much faster graphics processor." He expects the suit to be handled out of court.

Tandem rebuffs competition with faster NonStop system

David Bright, Assistant Editor

The market for fault-tolerant computers, pioneered by Tandem Computers Inc. in the mid-1970s, is

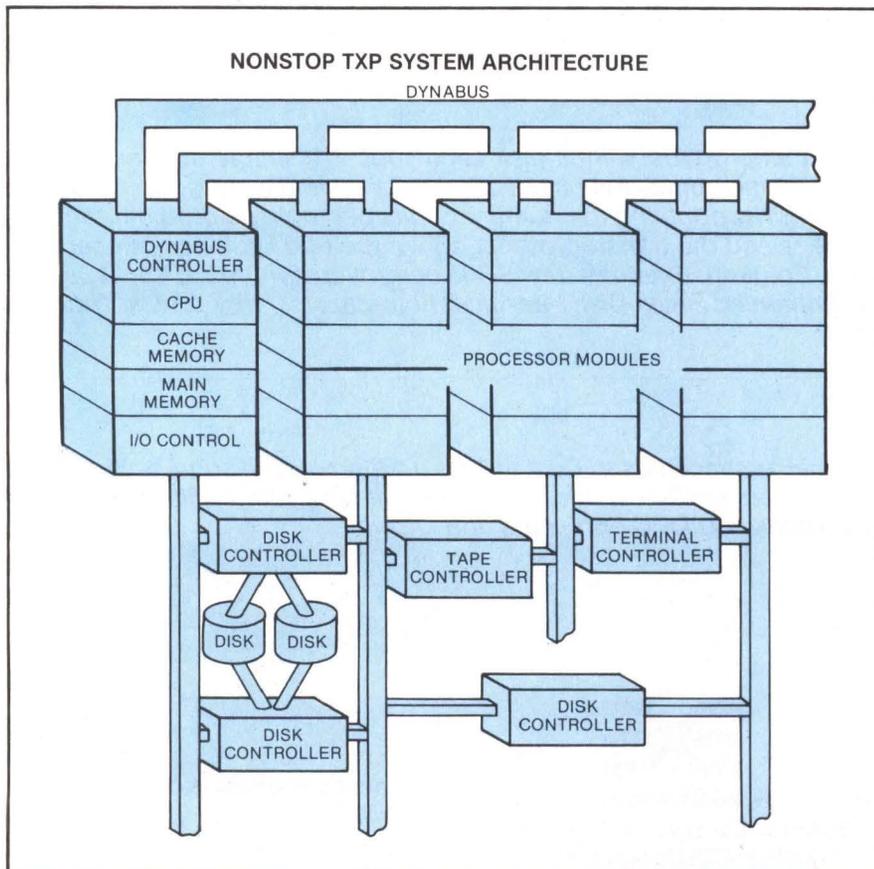
growing—from \$500 million last year to \$1.1 billion by 1986, according to estimates by research company Infocorp. Until recently, Tandem virtually owned the mar-

ket: the company's fiscal year revenues for 1983 were \$418.3 million, and net income was \$30.8 million. In fact, Tandem's revenues have increased every year since it was founded.

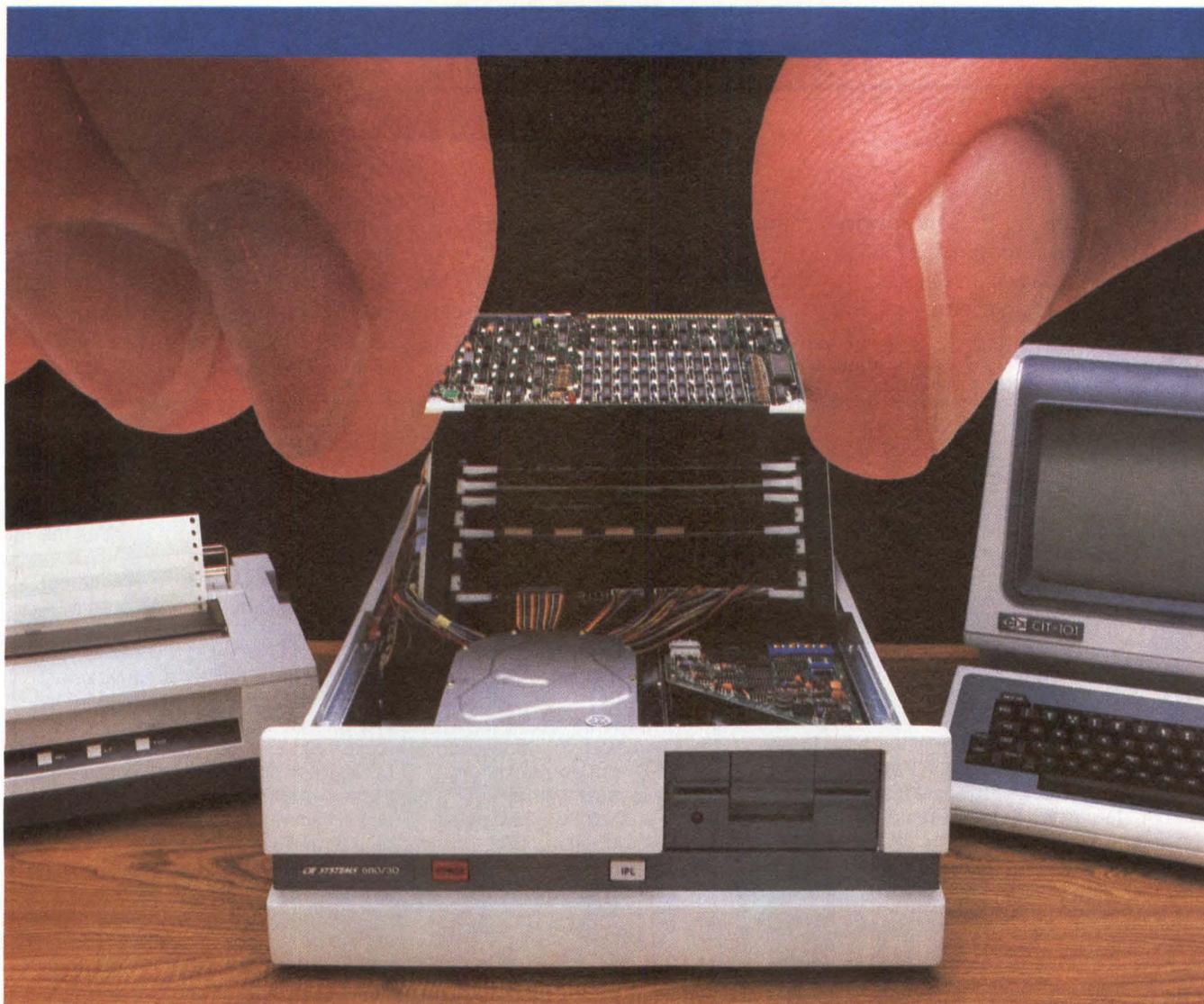
Several new companies envision snatching a sizable share of the action (see "Start-ups enter fault-tolerant market," Page 44). Tolerant Systems Inc., Arete Systems Corp. and Stratus Computer Inc. are but a few of the new contenders. Giants such as IBM Corp. and Perkin-Elmer Corp. have also added fault-tolerant capabilities to some systems.

Tandem is attempting to stave off the competition with more powerful, more efficient offerings. The company recently introduced its top-of-the-line 32-bit NonStop TXP system and the 6100 communications subsystem front-end processor. Tandem has also announced price cuts on the NonStop II System.

Tandem claims the NonStop TXP performs as much as three times faster than the NonStop II. The NonStop TXP is aimed at the high end of the \$16 billion transaction-processing market for applications, such as banking, videotex and on-line factory automation, in which hundreds of transactions per second must be processed. Tandem president James Treybig claims the NonStop TXP reduces the cost per transaction by as much as half.



Tandem's NonStop TXP system comprises two to 16 processors, a proprietary Dynabus, dual-ported controllers and multiple shared power supplies.



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CIE Systems is committed to being your source for the very latest in micros and all that goes with them.

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Disk capacities range from 10 to 300 Mbytes, memory from 256K to one Mbyte.

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Language processors include BASIC, FORTRAN, COBOL and PASCAL.

Applications offered are general accounting, financial worksheet and word processing, as well as a wide range of vertical applications.

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Mini-Micro World

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The NonStop TXP is hardware and software compatible with NonStop II systems. NonStop II systems can be upgraded by adding TXP processors.

Like the NonStop II, the Non-

Stop TXP has two to 16 processors. Connected to local-area networks with fiber-optic links, the TXP can support as many as 224 processors; a worldwide network can support as many as 4,080 processors. Features

include 64-bit memory access, 64K bytes of 32-bit native-addressing cache memory per processor and instruction pipelining. Each processor can address more than 1G byte of virtual memory and 16M bytes of

START-UPS ENTER FAULT-TOLERANT MARKET

Most of the start-ups in the fault-tolerant field are focusing on the \$16 billion transaction-processing market. Tolerant Systems Inc. and Arete Systems Corp., both of San Jose, Calif., join Stratus Computer Inc., Natick, Mass., Fail Safe Technology, Los Angeles, Parallel Computers, Santa Cruz, Calif., No Halt Computers, Farmingdale, N.Y., and others in the scramble for the burgeoning market. "There is still room for new companies in this market, as long as they have a strategy different from Tandem's," notes Skip Bushee, an analyst at

research company InfoCorp.

Arete has chosen to occupy a low-end niche with OEM systems ranging from \$15,000 to \$80,000. The company is targeting the users of Digital Equipment Corp. VAX systems as potential customers. Arete believes that, except in a few technical and scientific applications, most VAX users are interested in transaction speed rather than computational power. "Our system provides a slightly higher bus speed—33M bytes per second—at a fraction of the cost of a VAX," claims John R. Vrolyk, president of Arete. The system has no

floating-point processors as does the VAX.

Arete's system is a clustered-processor arrangement with multiple buses. As many as three 12.5-MHz, 32-bit processors and a controller are contained in a memory-management unit with a capacity of 16M bytes. The system's CPU, main memory and disk drives have eight hours of battery backup. In addition, Vrolyk explains, there is no 30-second gap between a power failure and the implementation of battery backup because sensors immediately notify the CPU to switch to backup.

Tolerant is seeking its market niche in the on-line financial-transaction market. Price of its first system is \$74,000. The product is configured around dual 32-bit microprocessors that run at 1.5 million instructions per second (MIPS) in an entry-level system and as fast as 5 MIPS in a high-end version. If one processor fails, the second continues at a lower performance level. "When a failure happens, a user is usually only too happy to put performance second," observes Eli Alon, president of Tolerant.

The Tolerant system is similar to Tandem's systems in that it uses software checkpoints to alert the backup system to the primary processor's failure, says Omri Serlin, president of Itom International, a Los Altos, Calif., consulting company.

The Tolerant system, designed to be modular, provides an 84M-, 165M- or 474M-byte hard disk, a 20-msec. average access time and a nine-track, 1,600-bit-per-inch tape drive for backup. The system stores as much as 240M bytes in main memory and has as many as 2,500 data-communications lines. The price includes the Berkeley UNIX operating system.

—Robert A. Sehr



Arete Systems Corp.'s 32-bit fault-tolerant system provides eight hours of battery backup. When a power failure occurs, sensors immediately notify the CPU to switch to backup.

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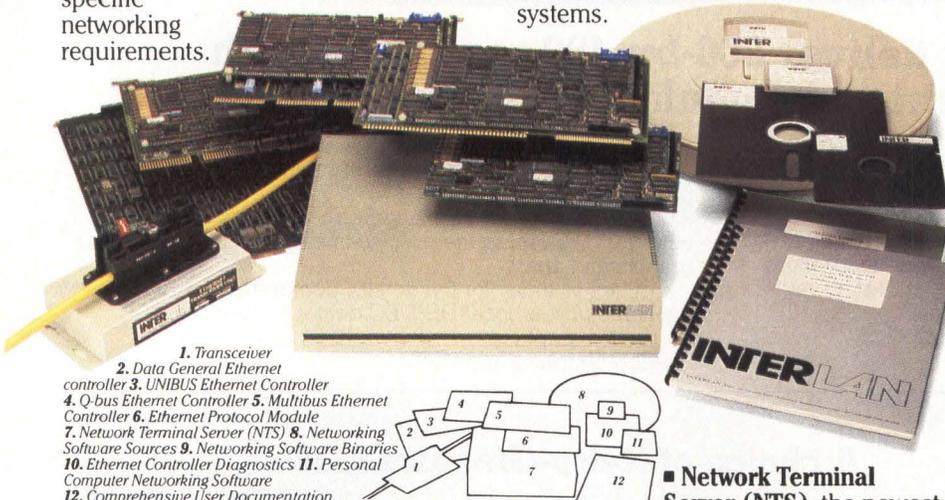
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- port contention
- port switching
- resource sharing
- personal computer networking
- simplified RS-232-C wiring

and printers. Typical applications include:

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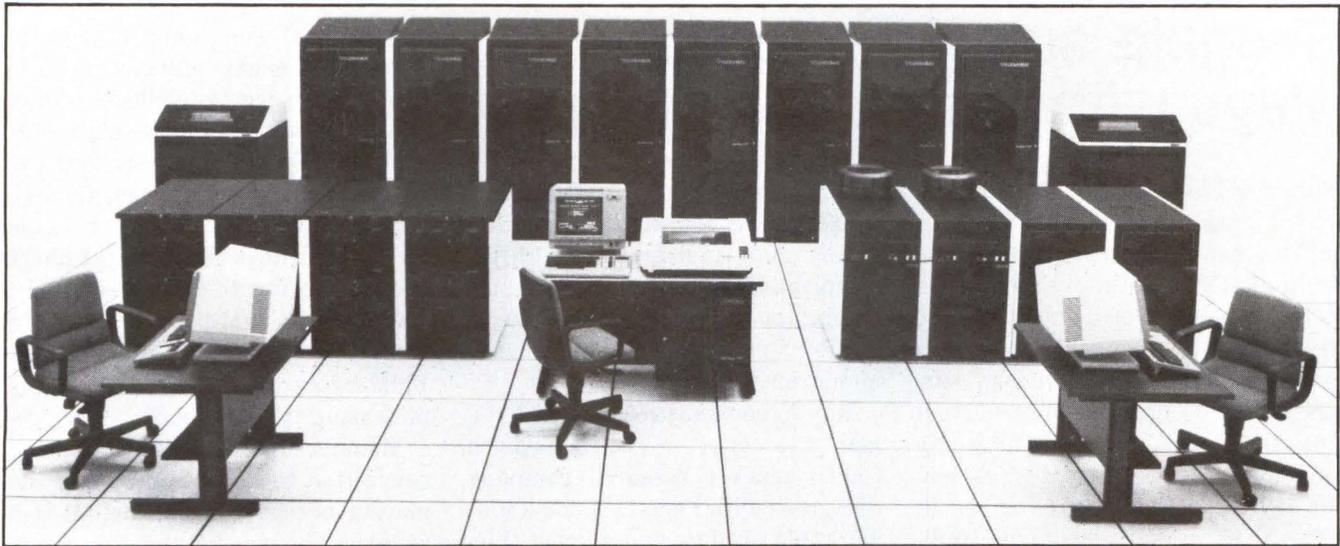
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Mini-Micro World

NEWS



Tandem Computers Inc. says its 32-bit NonStop TXP system performs at least twice as fast as other Tandem systems. A system with two CPUs, 4M bytes of main memory, two 128M-byte disk drives and software sells for \$328,550.

physical memory. In addition, each manipulates 32 bits of data via dual data paths and dual arithmetic-logic units. Tandem increased the size of the cache memory to 64K bytes per processor to reduce average memory-access time and to minimize the number of times the CPU must access main memory. Tests have shown that the CPU can find the information it needs in the cache, rather than main memory, 98 percent of the time, Treybig says.

A NonStop TXP system with two CPUs, each with 2M bytes of memory, two 128M-byte disk drives and controllers, a tape drive, an operation and service processor, Tandem's Guardian operating system, the Encompass database-management system and COBOL sells for \$328,550.

To serve front-end processor needs, the 6100 communications subsystem targets large terminal networks, such as those involving automatic teller machines and point-of-sale terminals. The Non-Stop II and TXP off-load certain CPU, interrupt-handler and controller functions to the 6100, allowing the main system to manage

several hundred communications lines simultaneously. The lines can handle data rates as fast as 56K bits per second in asynchronous, byte-synchronous or bit-synchronous mode. Point-to-point and multipoint supervisor-line disciplines are available for each communications line, each of which is separately configured. The 6100 supports the X.25,

IBM 3270 and 2780/3780 and Tandem terminal and network-communications protocols, as well as the RS232 interface.

Price of a basic 6100 subsystem with a cabinet, two communications interface units, two power supplies and cabling is \$23,900. Communication-line interfaces sell for \$1,940 each.

MULTIBUS II SUPPORTED BY 68 VENDORS

At least 68 vendors support the specifications for the Multibus II microprocessor data bus, say officials at Intel Corp. They expect the Multibus II's market to be twice as large as that of the Multibus. The Multibus II consortium now includes Altos Computer Systems, Hewlett-Packard Co., NCR Corp., Nixdorf Computer Corp., Prime Computer Inc. and Zilog Inc. Multibus Manufacturers Group members include Callan Data Systems, Analog Devices Inc. and Systime Ltd.

GRID OFFERS TEMPEST-TESTED PORTABLE COMPUTER

GRiD Systems Corp., Mountain View, Calif., becomes the latest computer supplier to address the potentially huge market for "militarized" systems designed for low RF emissions. GRiD's Compass portable has been tested to meet Tempest security requirements governing those emissions. The Tempest-tested version of the Compass, the model 1107, is priced at \$14,995 and is available now. Applications for such a computer may include use by military personnel in a mobile unit to access a database containing information on battalion locations. The system can transfer information to a map on the Compass display.

Seagate surprises industry, stays with 8-inch Winchester

Robert A. Sehr, Associate Editor

Although many manufacturers of high-capacity Winchester disk drives for desktop computers are readying high-technology, 5¼-inch products, Seagate Technology surprised many industry observers at the recent Comdex show by unveiling the half-height, 8-inch, 100M-byte ST-8100 drive aimed at the same market. Had any traditional manufacturers of 8-inch drives taken this conservative approach, the industry probably would have regarded the resulting drive as a last-ditch—and ultimately hopeless—effort to save a dying drive size.

Ironically, Seagate was the first to threaten the 8-inch drive industry, already troubled by a lack of interfaces, by introducing a popular 5¼-inch drive. The company now believes it may be one of the few that can revive that industry.

Analysts disagree about whether Seagate is right. "The only way this product will succeed is if others fail," says Jim Porter, market analyst and author of *Disk/Trend*

Report, referring to drives with capacities of 100M bytes or more from manufacturers of high-performance 5¼-inch drives, such as Maxtor Corp., Vertex Peripherals Inc. and Applied Information Memories.

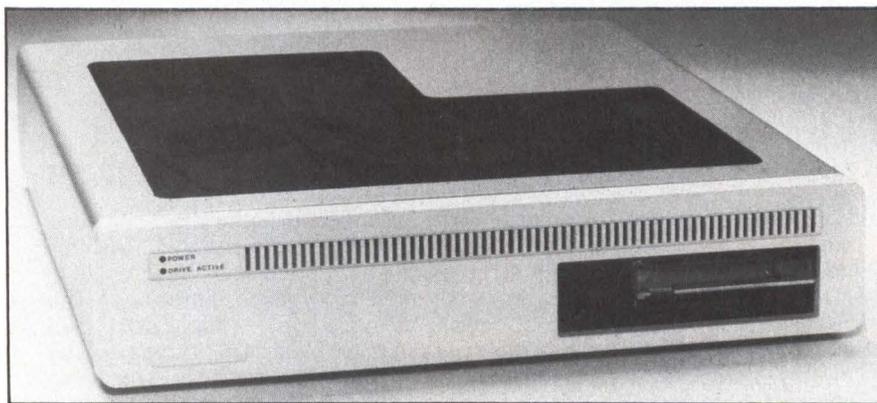
Ray Freeman, president of Freeman Associates, a Santa Barbara, Calif., market research company, disagrees with Porter: "I think it's a workable product and a great thing for the 8-inch drive industry."

Even Seagate's current and potential competitors disagree about the company's motives. To some, the product represents a major manufacturer's blessing of the 8-inch drive market. To makers of multiuser systems, it is a message that 5¼-inch technology and manufacturing efficiencies cannot yet meet the demands of high-capacity requirements. To others still, the product is the biggest mistake made in the disk drive industry since IBM Corp. introduced its non-standard, 4-inch floppy disk drive.

Maxtor, a contender in the market for 5¼-inch Winchesters,

did not react well to one interpretation of the Seagate announcement—that high-capacity drives cannot be manufactured in high volumes at low cost. "Seagate may not have the talent [to manufacture such drives], but we are doing it at Maxtor," says vice president of marketing Robert Teal, referring to Maxtor's 140M-, 190M- and 380M-byte drives. He notes that Maxtor is shipping 45 140M-byte drives per day and is increasing production.

Manufacturers of 8-inch drives rejoiced at Seagate's entry into the market because they believe it will squelch rumors of the industry's death. Richard E. Stusek, director of sales and marketing at Northern Telecom Inc., has been preaching to customers for a year that high-performance 8-inch products exist and can be delivered. He believes that high-performance, 5¼-inch products are not widely available. "This [Seagate announcement] is testimony to the fact that the real players in the 8-inch market are just standing up," says Stusek. Companies such as Pertec Peripherals



Seagate's 100M-byte ST-8100 Winchester disk drive (shown with the ST-9100 controller) is the company's bid in the high-capacity market. The ST-8100 takes the safe road in technology and manufacturability—an 8-inch form factor.

A GLANCE AT SEAGATE'S 8-INCH ST-8100 WINCHESTER

- **Height:** 2.312 inches
- **Capacity:** 100M bytes
- **Average access time:** 30 msec.
- **Actuator:** proprietary voice-coil linear
- **Transfer rate:** 10M bits per second
- **Technology:** three 8-inch, oxide-coated disks, a DC spindle motor, manganese-zinc ferrite read/write heads
- **Controller:** ST-9100, provides multiuser memory system support and supports the small computer system interface standard
- **Price:** less than \$1,500 in large volumes
- **Availability:** evaluation units scheduled for the second quarter of this year



FEBRUARY 1984

Satellite network guides oil exploration at sea and on land.

A satellite data transmission system developed by Talon Technology Corporation enables speedy and accurate data collection from oil exploration and production crews on offshore platforms, exploration ships and remote land operations. The system, based on WD's X.25 protocol controller, the WD2511, enables centralized data processing centers to receive large amounts of incoming seismic or production data, analyze it and rapidly provide useful feedback. The WD2511 was chosen because the X.25 protocol checks and corrects transmission errors, improving data integrity.

Honeywell targets office micro market.

Honeywell's new microSystem 6/10, which combines corporate data base access capabilities with personal computer convenience, is the latest system to incorporate a custom Winchester disk drive controller designed and manufactured by WD. Honeywell has awarded WD a three year, multi-million dollar contract to supply the board, which is a specially modified version of the WD1002-HDO controller. The microSystem 6/10 uses a wide variety of software developed for Honeywell's DPS 6 minicomputer, as well as accepting many popular CP/M-86 and MS-DOS software packages.

Mainframe-type data security plugs into micros.

The proliferation of personal computers has created a sizable data security problem. Marketing plans, payroll records and other proprietary information are now commonly processed on desktop micros. Now Jones Futorex of Fair Oaks, California has introduced THE ENCRYPTOR, a computer board which plugs into the Apple, IBM and S-100 computers to provide the same National Bureau of Standards Data Encryption Standard (DES) used by corporate and government mainframes. THE ENCRYPTOR is based on Western Digital's WD2001 encryption/decryption device. The WD2001 implements the DES standard in a single VLSI chip and is a complete solution which offers data security in a wide range of applications.

WD employment up 38% over a year ago.

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HIGH-CAPACITY, 5¼-INCH WINCHESTERS GO INTO OVERDRIVE

With the proliferation of multiuser desktop computer systems, business graphics packages and user interfaces, the demand for mass-produced 5¼-inch, 100M-byte Winchester disk drives is increasing. Several manufacturers promise to deliver high performance at low cost in such drives this year.

As in the low-end, 5¼-inch Winchester market, the high-performance market champion will be decided on the basis of cost, manufacturability and quality. It is clear that a market exists for 50M-, 70M- and 100M-byte drives. "The early reception [for 100M-byte drives] from system manufacturers has been good," says Jim Porter, a market researcher and author of *Disk/Trend Report*.

One manufacturer that delivered high-capacity, 5¼-inch Winchester drives last year is Maxtor Corp., Santa Clara, Calif., which began manufacturing production volumes of its 140M-byte, eight-platter, multi-actuator drive. In mid-1983, Priam Corp., San Jose, Calif., a traditional 8-inch supplier, challenged Maxtor by introducing a six-platter, multi-actuator, 111M-byte, 5¼-inch drive resembling Maxtor's. Applied Information Memories (AIM) followed last fall with a 133M-byte, 5¼-inch, four-platter drive using sputtered media.

5¼-INCH, 100M-BYTE OR HIGHER-CAPACITY WINCHESTERS

Company	No. of platters	Unformatted capacity (M bytes)	Average access time (msec.)
Applied Information Memories	4	133	18
Maxtor Corp.	8	140	30
Priam Corp.	6	111	32
Vertex Peripherals Inc.	4	100	25

Vertex Peripherals Inc., San Jose, Calif., added a 100M-byte, four-platter, plated-media 5¼-inch drive to its V100 family at last fall's Comdex show. The new drive offers a 40 percent increase in capacity over Vertex's previous top-of-the-line 70M-byte drive with only a 5 percent increase in cost, says Vertex executive vice president James Adkisson. He believes the limitations of the Seagate Technology ST-506/-412 interface handicapped Maxtor's 140M-byte drive. Maxtor has championed the Enhanced Small Disk Interface (ESDI) standard and its 10M-bit-per-second (bps) transfer rate and plans to use that standard, rather than the ST-506/-412, on future drives, including a 380M-byte model.

Vertex, meanwhile, decided to use a different interface, capitalizing on Seagate's new ST-412HP interface, which also has a 10M-bps transfer

rate. With the new interface standard—supported by Seagate, Priam, Tandon Corp., Computer Memories Inc. and others—the data separator remains on the controller. ESDI puts the separator on the drive itself, keeping the drive simple and inexpensive, Adkisson asserts.

Adkisson says Vertex is taking a risk in using plated media to increase track density to 960 tracks per inch. However, Vertex is assured of adequate supplies of media for its production requirements, and Adkisson hopes media yields will improve as well.

Vertex is shipping its drive in evaluation quantities and is expected to begin shipping production quantities in the second quarter of this year. "Since the drive is an evolutionary step for us, there is very little involved in ramping up for production," Adkisson notes.

Corp., International Memories Inc., BASF Systems Corp. and others that have withdrawn from the 8-inch market "did not recognize the value of what is still an emerging market," he adds.

Stusek says he is not worried that Seagate's strong manufacturing capability will set off a price war in the once-sedate market because "there is a lot of room in the market."

William Schroeder, president of Priam Corp., one of the largest remaining shippers of high-performance, 8-inch drives, agrees there is plenty of room in the 8-inch

market, partly because the Seagate ST-8100 will not compete directly with Priam products. "On the one hand, I welcome the entry of a manufacturing force like Seagate in the 8-inch market," Schroeder says. Because Priam has introduced a family of high-performance, 5¼-inch drives storing as much as 111M bytes, Schroeder adds, "On the other hand, I disagree with Seagate's message in regard to producing high-performance 5¼-inch products."

Some competitors in the market expressed surprise that the ST-8100 is half-height. Although half-height,

5¼-inch drives are expected to dominate shipments this year, no one but Seagate has introduced a half-height, 8-inch Winchester. Typically, 8-inch drives are mounted in a rack or non-desktop location and thus do not depend on a small footprint. "If Seagate is serious about this product—and indications seem to be that it is—it is likely the company lined up a major customer for this before it brought it out," says the marketing director of a controller manufacturer who asked to remain anonymous.

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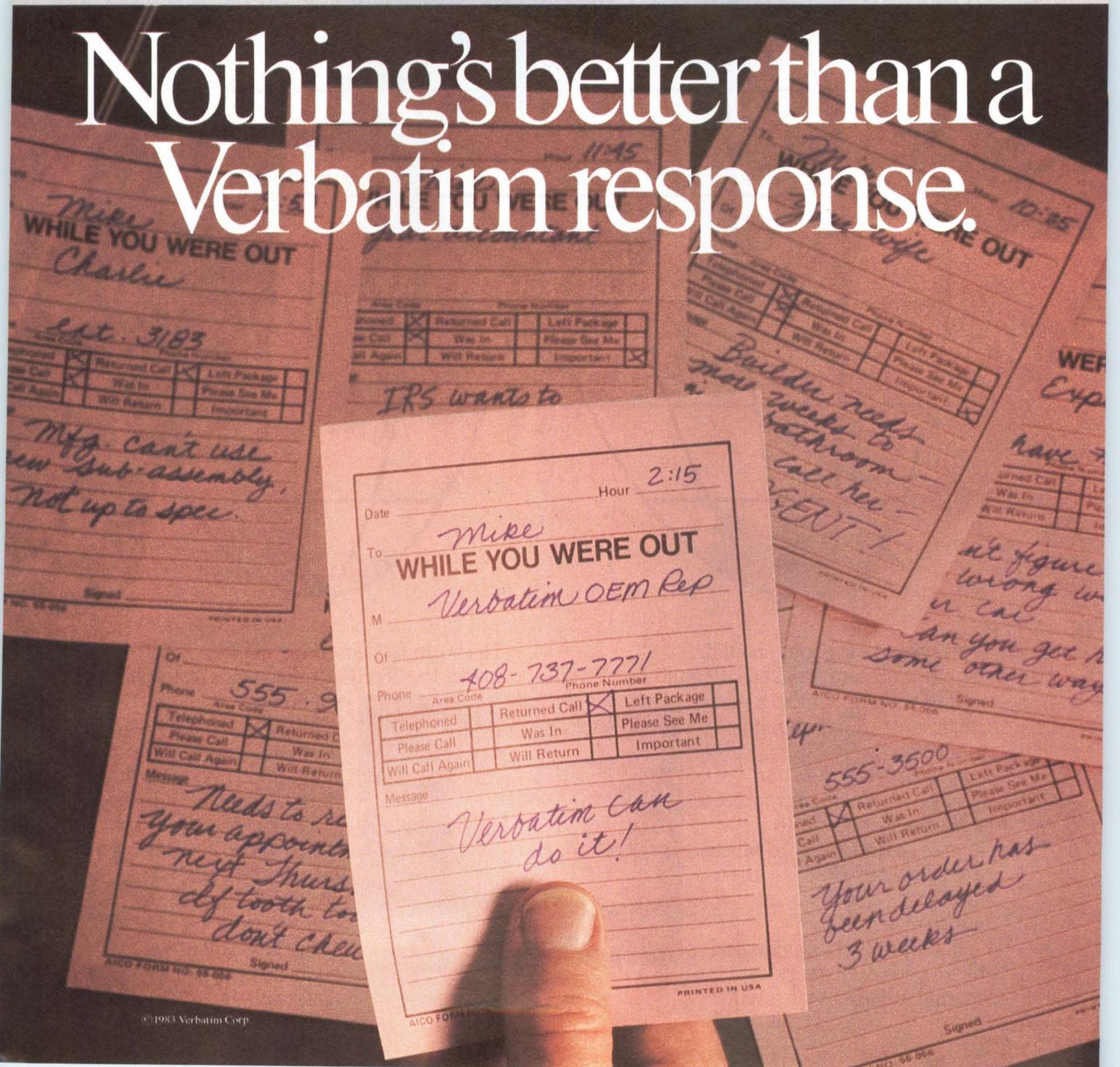
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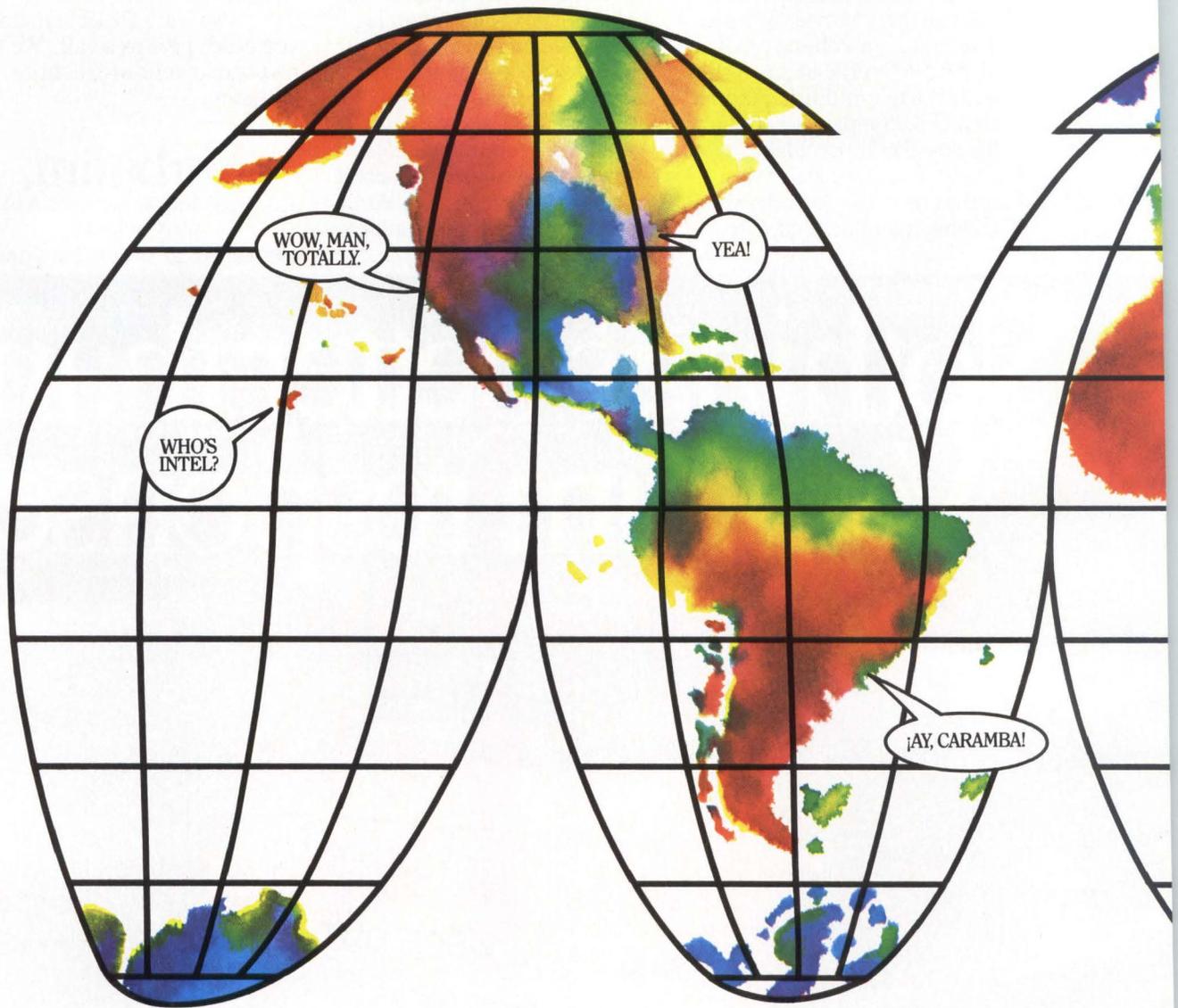
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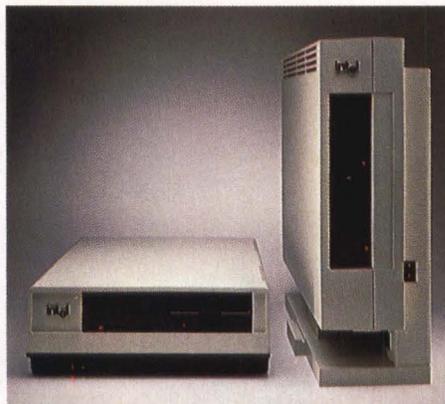
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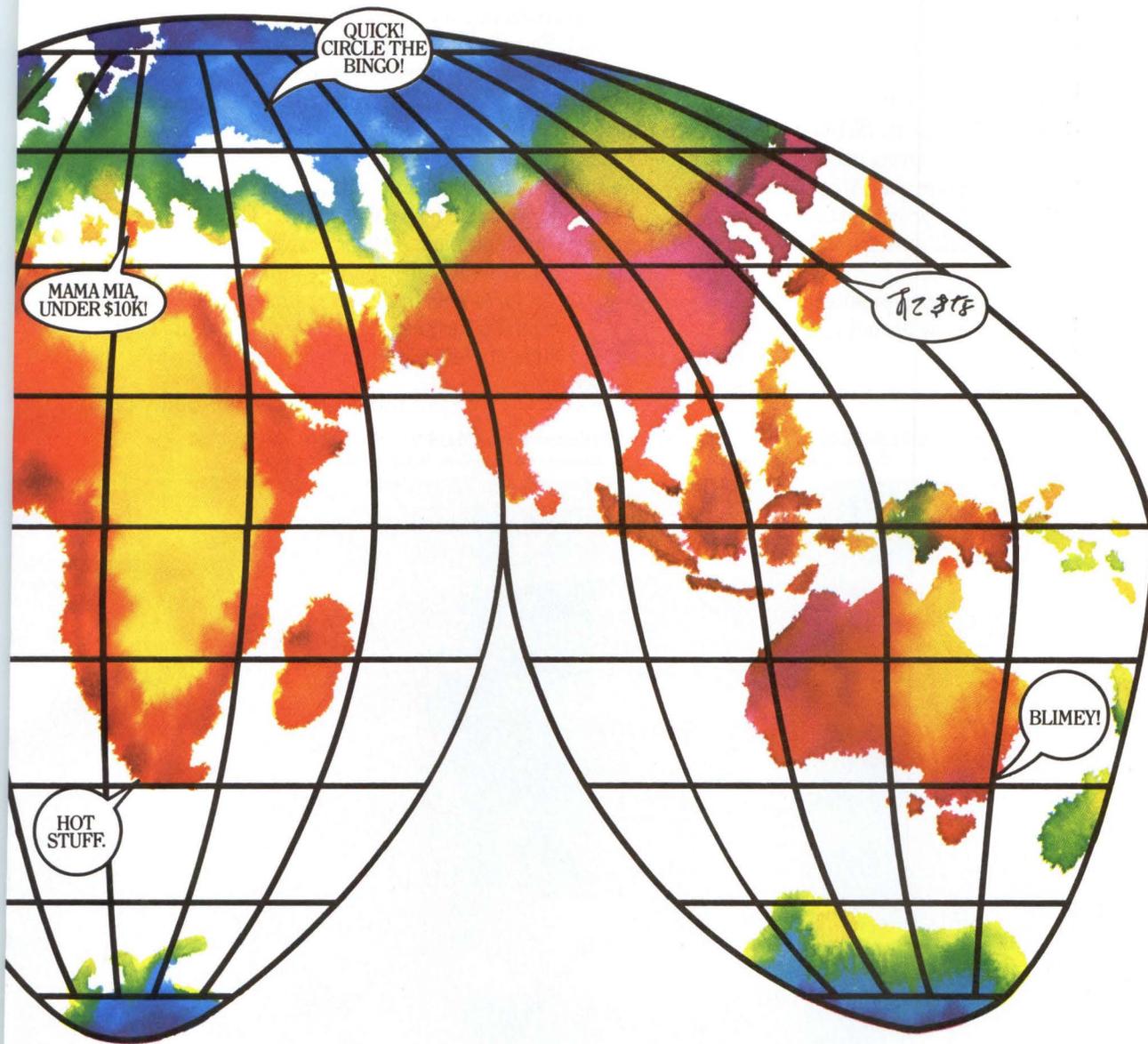
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Able's new Easyway/E Ethernet port controller makes tying together networks of UNIBUS PDP-11 and VAX computers easier than ever.

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And this lifesaving implementation of protocol on-board also offloads the CPU, freeing up the processor to handle other tasks.

What's more, Easyway/E meets IEEE 802.2, 802.3 and NBS-4 standards for ISO/OSI layers 1 thru 4, so current and future communications with other DEC systems will be smooth sailing.

In fact, Easyway/E's architecture is designed to accommodate future networking needs. The single board is comprised of two modules, so tomorrow's protocols can be implemented quickly with less expense. Additional protocol support including X.25, SNA and TCP/IP will soon be available, as will software support for DECnet and UNIX.

Able offers a broad range of devices for DEC computers providing communications, memory expansion and inter-processor connectivity. All complying with FCC regulations.

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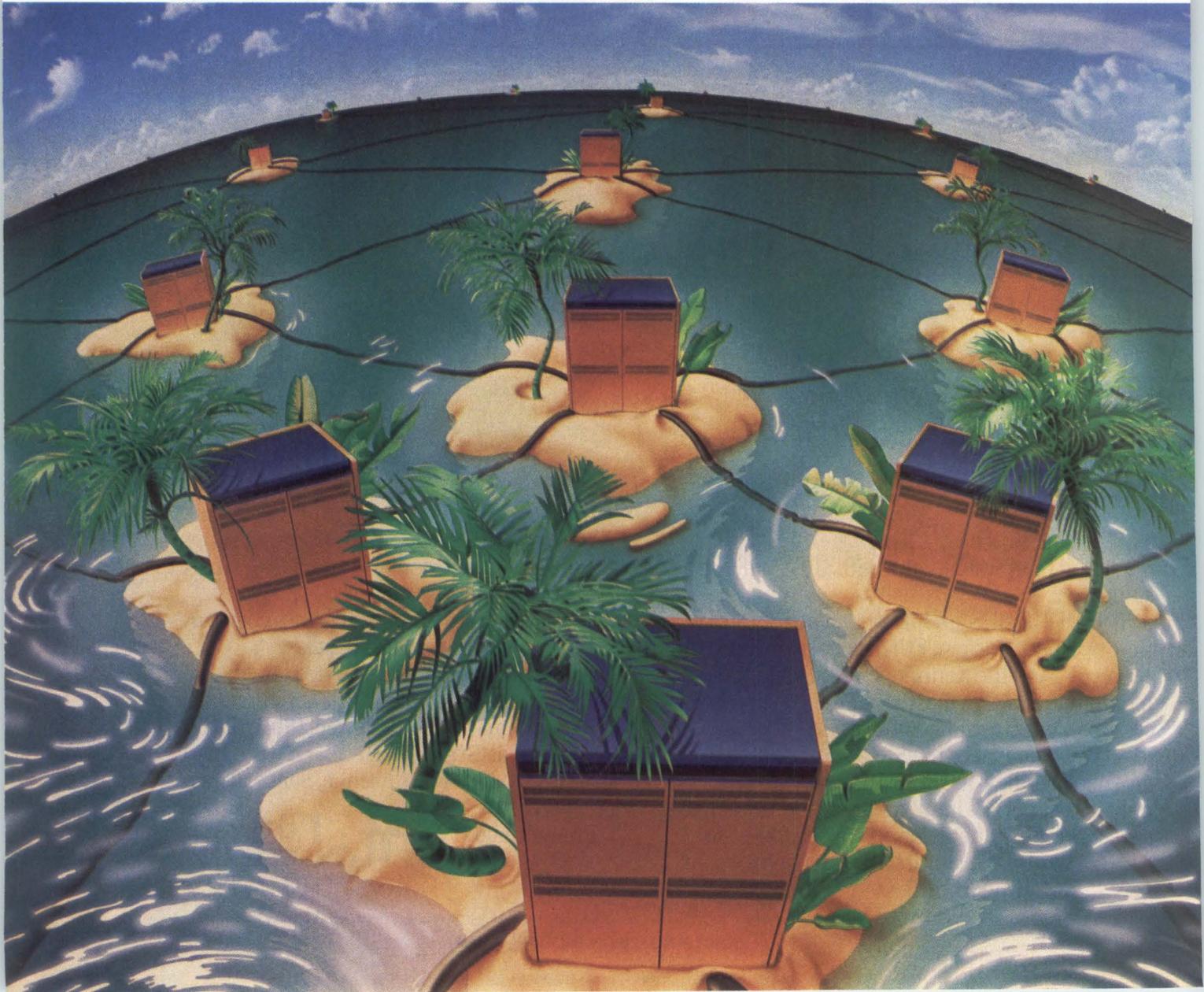


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HEARD ON THE HILL

Harris poll shows public is high on computers

Stephen J. Shaw
Washington Editor

To find out how computers and other high-technology products are affecting the lives of Americans, veteran pollster Louis Harris has made a landmark survey. One finding: almost nine in 10 of those surveyed think computers will improve their lives.

Southern New England Telephone Co. commissioned the poll, and Louis Harris and Associates Inc. conducted it. It surveyed a cross section of 1,256 adults along with members of Congress and their senior staffs, corporate executives, science editors and school superintendents.

Southern New England Telephone chairman and chief executive Alfred Van Sinderen says the company commissioned the survey because it has "a vested interest in technology and its impact. To be successful in our business, we must gain a grasp of technology and all it represents. Our profitability is tied to what people think."

The survey, entitled "The Road After 1984: The Impact of Technology on Society," reveals Americans' views of computer products and their impact in business, government and private applications.

Of those surveyed, 88 percent are convinced that computers will improve the quality of life. Almost half—45 percent—report they know how to use a computer, 10 percent

say they own a home computer, and 39 percent expect to buy one within five years. Record-keeping and education lead the list of computer uses (70 percent and 71 percent, respectively). Only 16 percent of those surveyed believe playing computer games is useful.

Those surveyed view other computer-spawned technological developments as having concrete benefits. Almost three of four (73 percent) view electronic-mail systems positively—a dramatic turnaround from the negative attitude held by 64 percent of those surveyed by Harris two years ago. The apparent reason: people—especially office workers—have gotten used to the idea of computers during the past two years. Many—82 percent—like the idea of having access to libraries through computers; 72 percent look forward to computerized news and at-home shopping. Of those surveyed, 88 percent see computers in their work place as a boon. They anticipate communicating with co-workers without leaving their desks.

On the negative side, the survey quantifies some disturbing trends that pollster Harris characterizes as "down-side nightmares that ought to keep us awake at night."

For example, familiarity with computers follows socioeconomic divisions. Two out of three (67 percent) of those with incomes over \$35,000 claim some computer literacy. Only 23 percent of those with incomes of

\$7,500 or less report the same competence. Of the professional workers surveyed, 72 percent report familiarity with computers; only 34 percent of the unskilled workforce say the same. Compared with the 68 percent of those with college degrees, only 16 percent of those who have not finished high school say they know how to use computers.

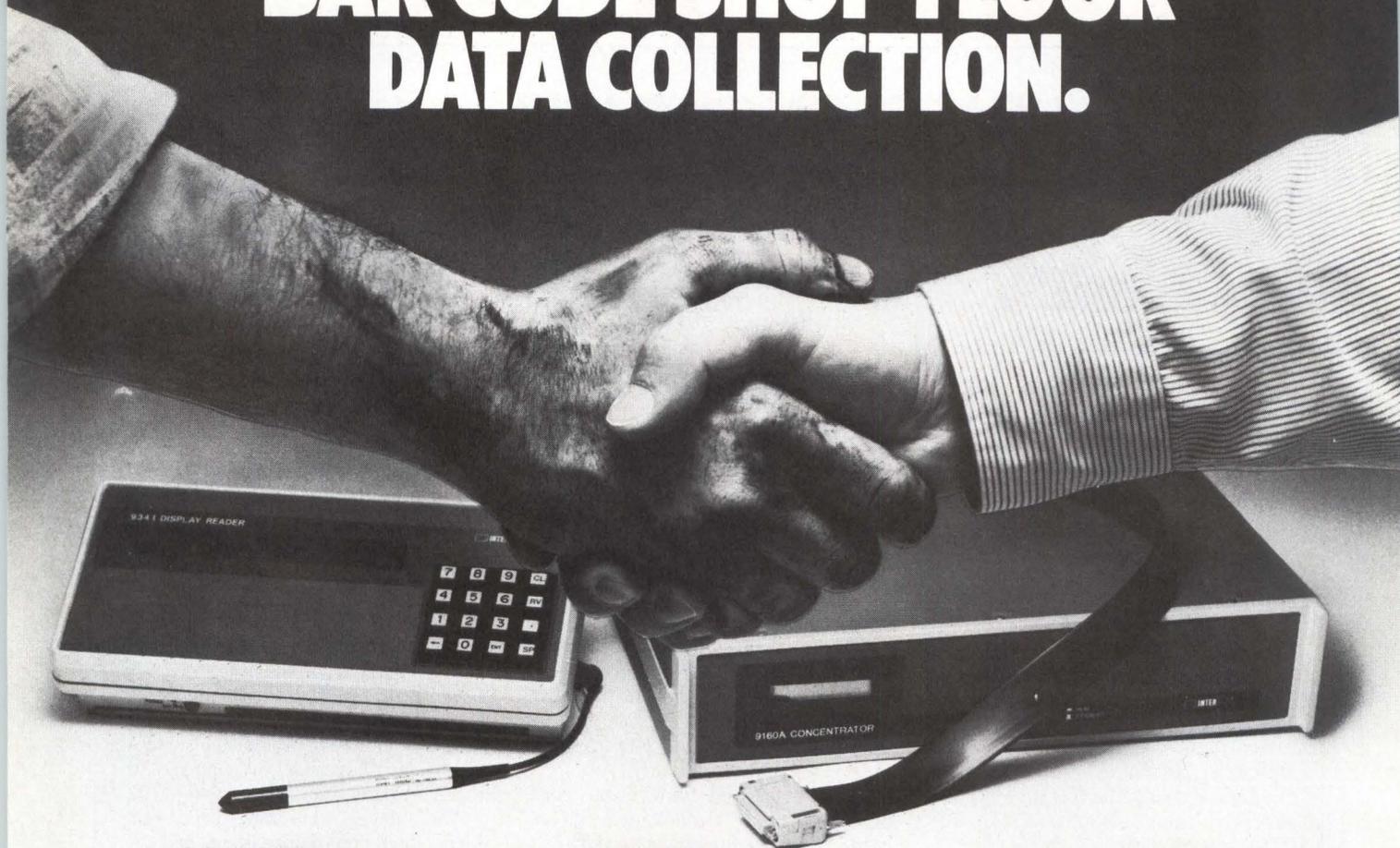
"The penetration of computers into the lives...of the adult public who claim they know how to use them suggests the real prospect of a new 'have' and 'have-not' division in our society," said Harris.

The survey also uncovered concerns about job displacement and the threat to privacy. Of those surveyed, 71 percent believe that factory automation will immediately cost hundreds of thousands of jobs; 51 percent feel that computers threaten privacy; 67 percent believe computer use must be sharply restricted in the future if privacy is to be preserved.

Harris presented the survey results at the National Museum of Natural History in Washington as part of a three-day symposium sponsored by the Smithsonian Institution. The survey has been donated to the museum to become part of its permanent collection.

According to museum officials, historians usually have little documentation on the social impact of technological development. "Survey research was unknown during the earlier waves of technological development...Southern New England Telephone Co. and Harris are helping now to correct this," stated Wilton Dillon, director of Smithsonian symposia and seminars.

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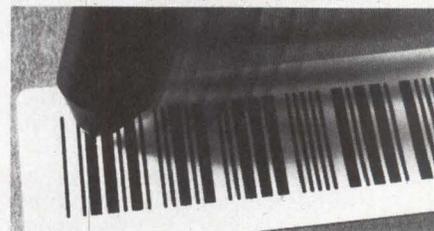
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Canon laser printer challenges daisy wheels

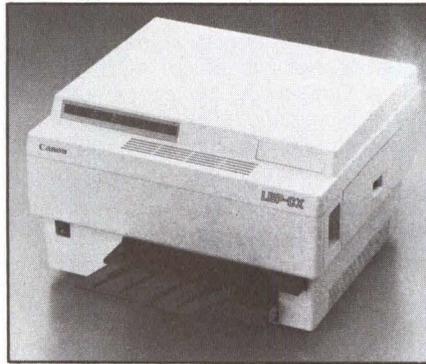
Edward S. Foster
Associate Editor

Whether or not Canon U.S.A.'s LBP-CX laser printer turns out to be a sales success, its Comdex introduction will be remembered as a turning point for the computer printer industry. It marked the first time a non-impact printer would compete directly against printers using traditional impact technologies. Officials at Canon U.S.A. headquarters in Lake Success, N.Y., acknowledge that the LBP-CX targets the impact printer market—high-end daisy-wheels for word-processing applications.

The LBP-CX prints on cut-sheet paper at 8 pages per minute. It uses the removable-cartridge technology that Canon introduced with its PC-10 and PC-20 copiers that incorporate all consumables in a cartridge that contains a photoconductive drum and enough dry toner to print about 3,000 sheets.

Canon officials are closemouthed about the price of the LBP-CX, which they plan to sell with a simple video interface exclusively on an OEM basis, at least for now. "We believe our OEM customers will be able to offer the product with an interface and controller to emulate standard daisy-wheel functions for the same end-user price as higher-cost daisy-wheel printers," says Hideo Yamamoto, assistant director of Canon's Laser Beam Printer Division. Widely accepted reports put OEM price of the LBP-CX at less than \$1,000 in quantities of 10,000 or more.

Canon officials say the end-user price will depend on how Canon's OEM customers configure the system. "If the interface and



The Canon LBP-CX laser beam printer puts all printing functions, except for a semiconductor laser imaging system, in a removable cartridge. Canon is selling the device with a video interface to OEM customers.

controller are done properly by the customer, it is possible to have a price of less than \$4,000," says Koichi Kadokura, technical coordinator for laser beam printers. "The word 'properly' means that they must take advantage of up-to-date technology and production techniques to keep their costs low."

For end-user applications requiring a high degree of graphics rather than simple daisy-wheel emulation, the Canon LBP-CX is likely to be priced at more than \$5,000, at least for now. The first graphics product on the market incorporating the LBP-CX will probably be the Imagen 8/300 from Imagen Corp., Mountain View, Calif. Imagen sells its image-processing system mixing text and graphics on a number of non-impact devices, including high-speed Canon laser printers. It will sell its version of the LBP-CX for less than \$10,000. However, Imagen president Robert Wallace is not ruling out the possibility of selling a lower-priced version. "This unit provides us with the opportunity to field multiple models targeted at different applications, and daisy-

wheel functions and the line-printer environment are obvious ones," he suggests.

The LBP-CX cartridge is not compatible with the cartridge used on Canon's cartridge copiers, and Kadokura expects the LBP-CX cartridge's end-user price to be a little higher than the \$65 to \$75 charged for the copier cartridges. "It is up to our OEM customers," he says. At a minimal monthly duty cycle of 3,000 sheets, cost per page in word-processing applications should be as low as 3 cents.

Peter Steiner, director of Dataquest Inc.'s Electronic Printer Industry Service, believes the LBP-CX will prove reliable. "With this technology, most of the troublesome parts of copier techniques are right in the cartridge. If you do have a failure, the probability is going to be very high that you can fix it by replacing the cartridge. Even without a warranty on the cartridge, that's like getting an immediate service call for under \$100."

Steiner sees the LBP-CX as the first of three or four low-cost, non-impact printers he expects will be competing with serial printers by year-end. "We are going to see end-user prices for these units at less than \$3,000," he asserts. "There are a number of word-processing companies looking very seriously at this technology, and by the end of the year the market will begin to grow."

Few in the industry doubt that the LBP-CX is the first of a wave of non-impact printers that will move into a variety of applications. Art Hyzer, executive vice president of Quality Micro Systems, Mobile, Ala., compares the market potential of the LBP-CX to Epson America Inc.'s low-duty-cycle MX-80 dot-matrix printer. "The Canon printer is a low-duty-cycle device, and that is going to keep it from being the

answer for everything. I strongly suspect, however, that won't keep Canon from selling an impressive number of units, just as Epson did."

Imagen's Wallace, who has been working with the LBP-CX since last April, believes Canon may be conservative in putting its duty cycle rating in the 3,000-page-per-month category. "We've run it as high as 10,000 a month and not had a mechanical failure," he notes. Wallace also cites other advantages of the Canon printer: "The cartridge not only removes the need for a lot of preventive maintenance but also keeps print quality consistent," he says. "Another attractive aspect for word-processing applications is the alternate paper path for manual feeding," which allows the printer

SPECIFICATIONS OF CANON'S OEM LBP-CX PAGE PRINTER

- **Type:** dry mono-component electrophotographic
- **Print speed:** 8 pages per minute (all paper sizes except legal)
- **Dot pitch:** horizontal: variable with horizontal clock, vertical: 240 or 300 lines per inch (factory set)
- **Warm-up time:** 2 minutes (room temperature 20 degrees Celsius)
- **First printout:** 18 seconds (during standby)
- **Noise level:** less than 55 decibels adjusted (dBa) during printing, less than 45 dBa during standby
- **Interface:** serial video signal
- **OEM specifications:** specified body color, specified dot pitch (240 or 300 dots per inch) and specified overseas model

to print on envelopes. "It also makes it possible to use almost any type of paper; we've used rice paper, cut-up manila folders and business cards."

Evaluation units of the LBP-CX will be available in the second

quarter of this year, and production deliveries will begin in the second half. Companies reportedly readying similar products—some employing cartridge technology—include Ricoh Co. Ltd., Konoshiroku Ltd., Xerox Corp. and Minolta.

Telephone companies told how to sell some gear, services

Stephen J. Shaw
Washington Editor

The Federal Communications Commission has told the newly divested Bell Operating Companies (BOCs) to establish separate subsidiaries to sell certain equipment and services. The subsidiaries will sell customer -premise equipment (CPE), like telephones and branch exchanges, and enhanced communications services, like protocol conversion and store-and-forward services for computer data. The commission has also decided to continue its requirement that another unregulated subsidiary handle cellular mobile telephone services offered by regional BOCs.

The rules follow a year of inquiry into how the BOCs should re-enter those service and equipment areas closed to them before the Jan. 1

breakup of American Telephone & Telegraph Co. (MMS, August 1983, Page 32). The FCC and its competitors feared that the BOCs would cross-subsidize their offerings with revenues from local exchange services. This could restrict competition within the BOCs' regions by limiting outside suppliers' access to local telephone lines and exchange facilities.

In imposing the rules, the commission recognized that it was significantly altering the BOCs' position in CPE markets. Specifically, says the FCC, the BOCs will re-enter CPE markets with virtually no market share and will no longer provide inter-exchange services.

The FCC's ruling did not impose the full structural separation requirements set forth in the commission's 1980 Computer II decision,

which outlined the organizational requirements by which AT&T was to offer CPE through an unregulated subsidiary. Instead, the FCC will permit the BOCs:

- joint billing for CPE and dial-tone services for four years following divestiture,
- the referral of dial-tone customers to the subsidiaries, provided customers are informed that alternative CPE suppliers exist,
- joint installation and maintenance for residential CPE (business CPE is required to go through the subsidiary),
- sharing of the same administrative services as allowed between AT&T Communications and AT&T Information Services (legal).

The BOCs have until June 30 to establish the independent subsidiaries, subject to the filing and approval of a permanent capitaliza-



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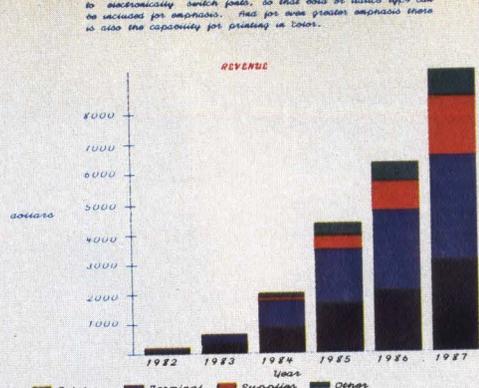
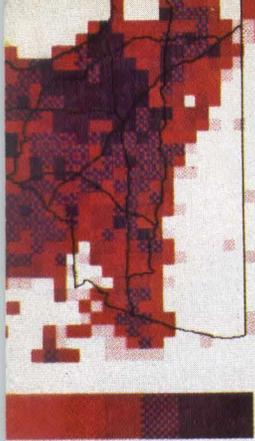
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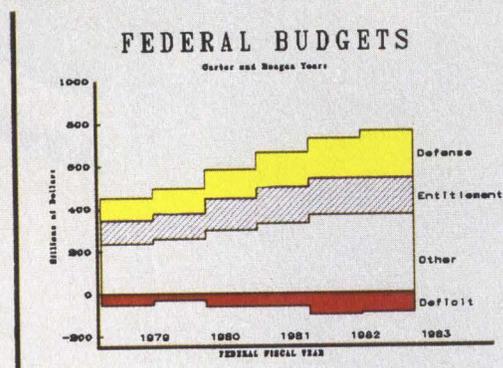
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● CAD / CAM
● PROCESS CONTROL
● OTHER

The Computer Graphics Market



of having the single state 2P. Similarly, state 3D becomes th (n = 3), the D signifies J = 2

2P
2S

Fine structure of the n = 2 s of hydrogen

We return now to our original q the energies of the states? We state, obtained from J + s = J. That is the implication of add moments associated with L and

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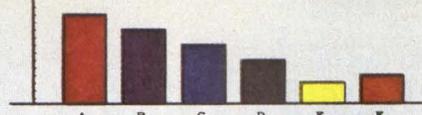
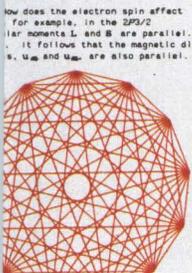
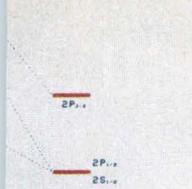
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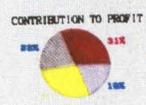
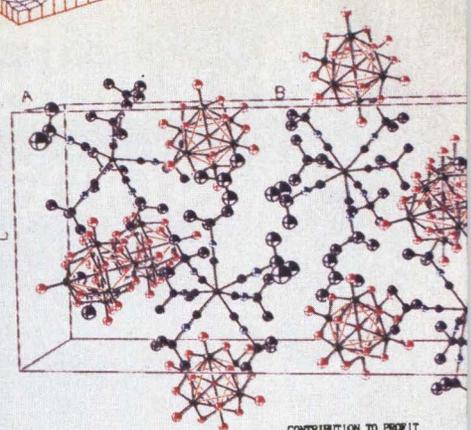
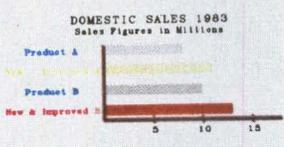
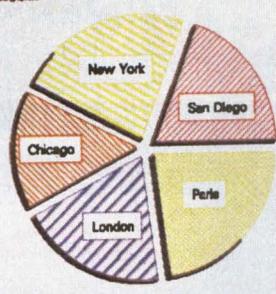
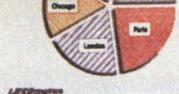
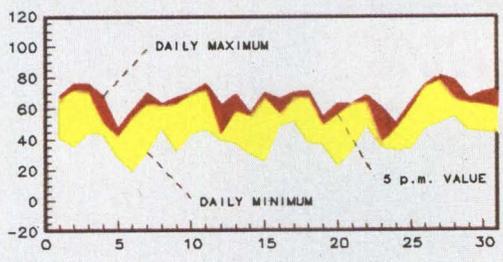
And our 430 comes with optional letter-quality character fonts like **BOLD, italic, SCRIPT** and **ORATOR**. Plus you

$J = 1 - 1/2 = 1/2$, so that inst...
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 2 and $3D_3/2$. The 3 means shell 3
 $1/2$ means $J = l - a = 2 - 1/2$.



The Envision 430 VectorPrinter uses four separate color ribbon cassettes. Each cassette is advanced only when actually being used for printing, and can be replaced independently reducing printing cost while providing sharp, crisp multicolor text and graphics hardcopy. Fabric or mylar film ribbon cassettes are available in black, red, blue, green, yellow, cyan, and magenta.

The 430 prints graphics at 144 by 144 dots per inch resolution, and accepts graphics data either in raster format, or as VECTORS directly from the host reducing CPU and communications overhead.



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a print control microprocessor which tracks the carriage through a unique closed-loop servo system and adjusts for carriage speed and direction during dot placement. That permits it to print while the carriage accelerates. Which is another reason it gets your job done a lot faster.



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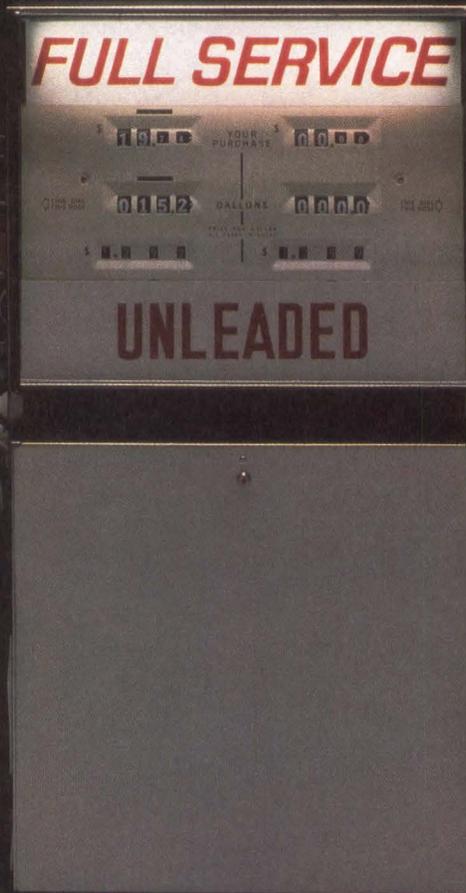
Text and graphics samples courtesy of: ISSCO, Megatek, Molecular Structure Corporation, and Precision Visuals, Inc.

MM 2/84

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NEWS

tion plan with the FCC. Until then, the regulated carrier organizations will provide CPE and enhanced services on approval of an interim one-year capitalization plan filed on Jan. 1.

The BOC representatives' referral of dial-tone business and residential CPE customers to the subsidiaries must be "neutral," says a member of the FCC's enforcement bureau. BOC representatives must state that there are other CPE vendors. Ken Levy, an FCC attorney, says the procedure could be likened to a police officer's reading a "Miranda card" informing a suspect of his rights. "It may come to [a Miranda card] if we receive complaints that the telephone company representatives are not complying," Levy notes.

The structural separation requirements for enhanced communications services are tighter than those for CPE. They do not allow billing, installation, marketing or maintenance services to be shared with a regulated carrier's organization. Instead, the subsidiary must offer all computer services. "Computer II applies the way it always did [for enhanced services]," Levy says.

The FCC did not resolve an apparent conflict between its definition of "enhanced services," which it prohibited the BOCs from offering before divestiture—and "information services"—which it prohibits them from offering after divestiture. Both types of service involve the processing of information—primarily data—to enhance its value to service subscribers. The Association of Data Processing Service Organizations, a Washington trade association, calls the definitions of "enhanced" and "information" services "virtually indistinguishable," and, Levy adds, "the differences between enhanced and

ORGANIZATION OF THE DIVESTED BELL OPERATING COMPANIES	
New regional companies	BOC components
NYNEX	New England Telephone & Telegraph Co. New York Telephone Co.
Atlantic Bell	Diamond State Telephone Co. Bell Telephone Co. of Pennsylvania Chesapeake & Potomac Telephone Cos.
Bell South	Southern Bell Telephone & Telegraph Co. South Central Bell Telephone Co.
Ameritech	Ohio Bell Telephone Co. Michigan Bell Telephone Co. Indiana Bell Telephone Co. Illinois Bell Telephone Co. Wisconsin Bell Telephone Co.
U.S. West	Northwestern Bell Telephone Co. Mountain States Telephone & Telegraph Co. Pacific Northwest Bell Telephone Co.
Pacific Telesis Group	Pacific Telephone and Telegraph Co. Bell Telephone Company of Nevada
Southwestern Bell	Southwestern Bell Telephone Co.

Source: Federal Communications Commission

The breakup of the Bell system has created seven regional telephone operating companies that are expected to be strong not only in providing basic telephone services, but also in providing value-added enhanced communications services, customer-premise equipment and mobile telephone services through separate subsidiaries.

information services are not resolved."

Levy cites BOCs' assertions that differences between the two service categories permit the BOCs to develop and market enhanced services on Jan. 1 without requesting a waiver from federal district court. One such service—which the BOCs call an enhanced service—is protocol conversion through the local public-switched telephone network to allow communications between otherwise-incompatible computers.

In another rule-making proceeding, the FCC reaffirmed its definition of enhanced services that are subject to Computer II separation requirements. The FCC holds its stance, despite arguments that new, basic transmission services are using more protocol- and computer-code conversion techniques. This

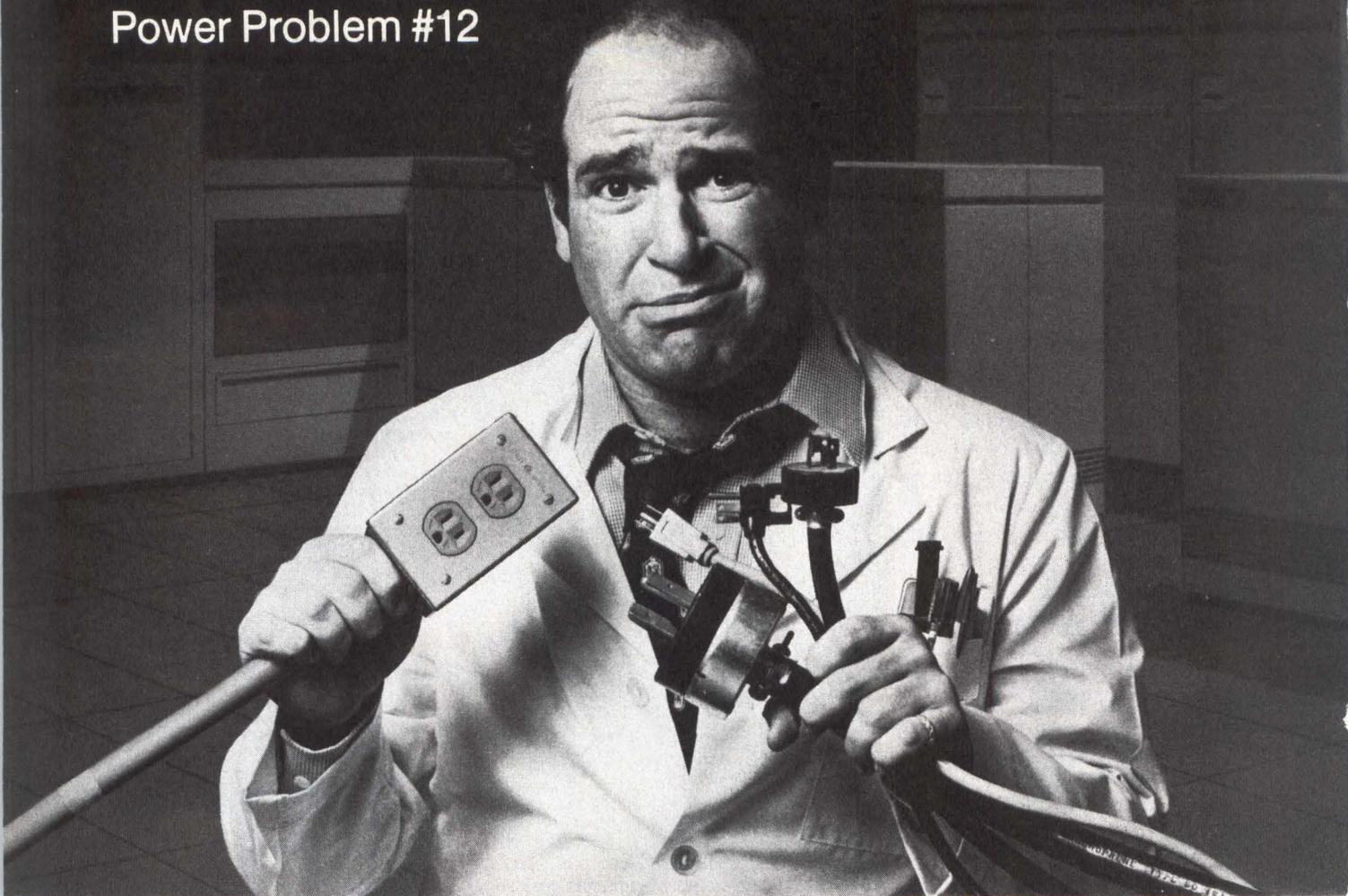
blurs the distinction between conventional telephone service and enhanced, value-added offerings.

NEXT MONTH IN MMS

March is data communications month in Mini-Micro Systems. Feature surveys are planned of more than 20 expansion board modems and more than 70 modem support software packages.

Also scheduled for the March issue:

- Criteria for selecting local area networks.
- A call-back security system that prevents unauthorized computer access.
- A UNIX-compatible network operating system that provides virtual file access.



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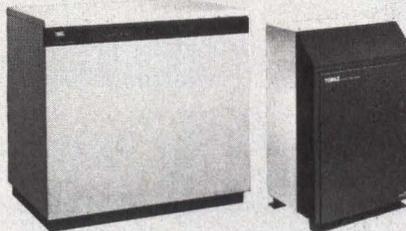
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CIRCLE NO. 32 ON INQUIRY CARD

Cache-memory subsystem speeds data search

Robert A. Sehr, Associate Editor

As subsystems evolve, they get smaller footprints and greater capacities. But observers everywhere doubt whether all end users need huge storage capacities on their desktop computers. Everywhere, that is, except in Washington—users of desktop computers in the Capitol never seem to have enough storage capacity. It's not surprising, therefore, that a company not far from Washington—U.S. Design Corp., Lanham, Md.—has developed a high-performance, 760M-byte subsystem using cache memory and fitting in a compact 5¼-by-19-by-26-inch package.

U.S. Design has incorporated four Maxtor Corp. 190M-byte, 5¼-inch Winchester disk drives, combined with 512K bytes of on-board, multiported cache memory into the VIP/X subsystem, giving the system a 10-msec. average access time. The VIP/X plugs into Digital Equipment Corp. VAX-11 and PDP-11 minicomputers. It eventually will be compatible with Multibus systems.

The use of the Maxtor 190M-byte drives gives U.S. Design a price advantage over its DEC-compatible subsystem rivals, believes Lawrence F. Tashbook, vice president of marketing at U.S. Design. The subsystem, including a DEC host adapter, has a list price of \$23,995.

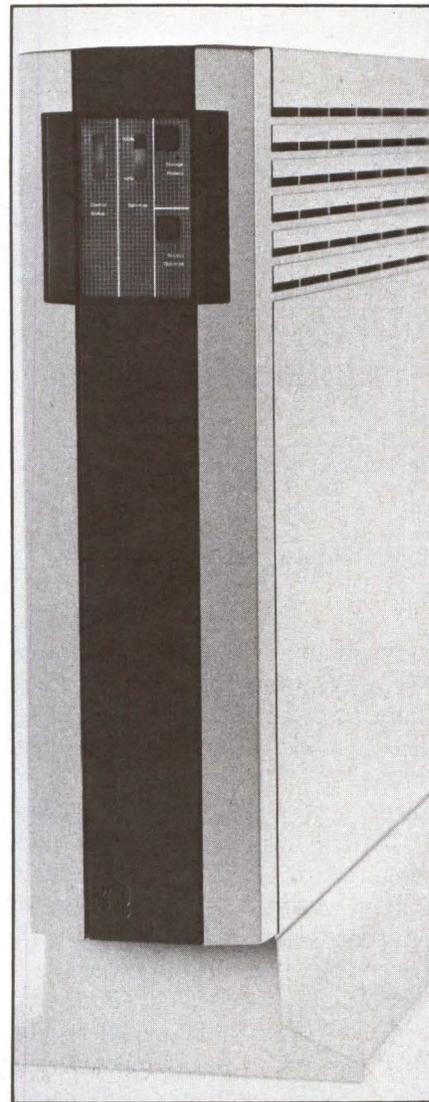
Like U.S. Design's first-generation CSS-800 compact storage system, the VIP/X is aimed at the company's Pentagon customers and other high-volume users. The system is designed so that it is transparent to users, says Tashbook. A user removes a 456M-byte

DEC RUA 81 or 205M-byte removable RA 60 drive and plugs in one of U.S. Design's drives.

The subsystem appears as a "slimline," 19-inch-high pedestal resembling a sleek stereo speaker. With the multiple disk actuators controlled by several microprocessors on the controller, the system keeps the most frequently accessed data within its cache memory so that it is available quickly. Tashbook likens the cache-memory system to a desk blotter: "Instead of always searching the telephone book for numbers you may need frequently, you can write some of them down on a desk blotter. That way, they are in front of you when you need them. When the blotter gets crowded with numbers, you throw it away. Our cache-memory system works much the same way."

At a recent Dataquest Inc. disk memory conference, U.S. Design president William R. Anderson stated that typical transaction processing requires 56 msec., and 89 percent of that time is spent on electromechanical aspects—the physical search for data. The time spent in physical searching could be dramatically reduced, he claimed, if the information were in cache memory.

Arnold L. Cooley, vice president of marketing for Applied Information Memories (AIM), shares Anderson's views. AIM recently announced its "Lance" drive, which is similar to the VIP/X. The Lance includes four 5¼-inch head/disk assemblies in a single box. It stores 8M bytes and achieves an 18-msec. average access time. "With cache memory [in a subsystem] our average access time could be

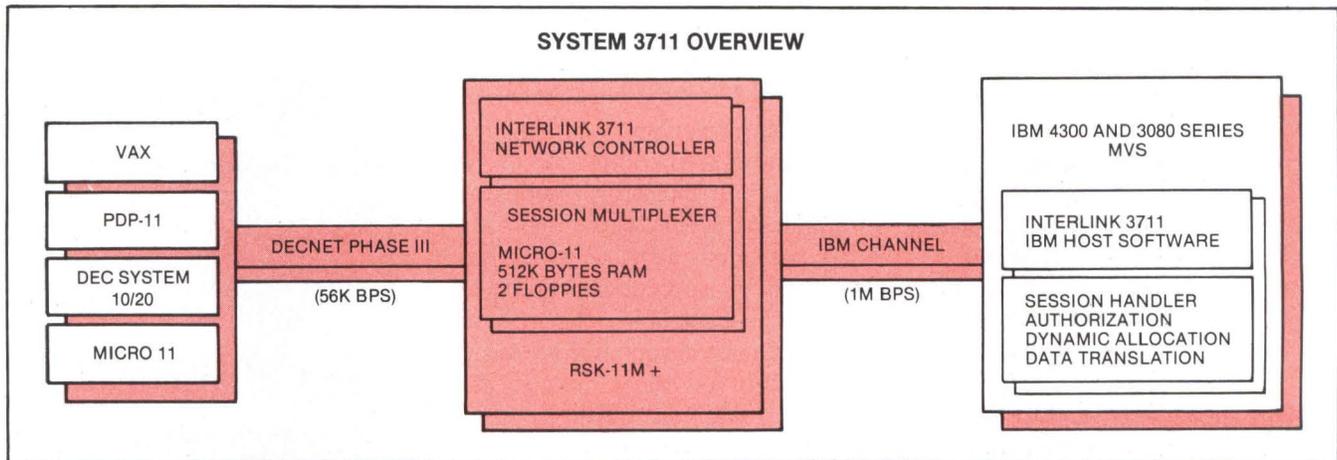


U.S. Design's 760M-byte VIP/X disk subsystem uses cache memory to speed access times and "bypass" slower electro-mechanical data-search processes.

reduced to 5 or 6 msec.," says Cooley.

U.S. Design has been assured sufficient deliveries of the Maxtor drives to meet its first-quarter 1984 volume production deadlines, Tashbook says.

System links DECnet to IBM/MVS without a job-control language



The Interlink System 3711 connects a DECnet with IBM/MVS systems without the use of JCL. Prices start at \$98,500.

David Bright, Assistant Editor

A year-old Fremont, Calif., company has developed the System 3711 hardware/software package that makes an IBM mainframe look like a node in a DECnet. The System 3711 from Interlink Computer Sciences Inc. differs from IBM Corp.'s Systems Network Architecture (SNA) gateways in that it does not require the use of job-control language (JCL), says Interlink president Lambert Onuma. System 3711 connects Digital Equipment Corp. Micro-11s, PDP-11s, VAXs and System 10s and 20s to IBM 4300 and 3080 series systems running the MVS operating system or MVS as a guest operating system under the VM operating system.

System 3711 consists of network controller and software that resides on an IBM host. The network controller has a DEC Micro-11 processor, 512K bytes of memory and a 10M-byte Winchester disk drive. The controller runs DEC's RSX-11M+ operating system with Phase III DECnet software. The

link to an IBM system is through a 1M-bit-per-second data channel. The controller has its own terminal for configuration, diagnostics and monitoring.

The System 3711's IBM-resident software reportedly provides transparent data translation of all types and allows dynamic file access to the record level without entering batch mode. The Interlink software translates IBM EBCDIC error messages

to the DEC ASCII format. The participating DEC systems must perform a partial system generation, Onuma says.

Unit prices for the network controller and the IBM-resident software begin at \$98,500, and shipments are set for this month. Interlink plans that the system will eventually support DECnet Phase IV, network job entry and 3270 emulation.

DRI WILL DEVELOP SYSTEM V PORT FOR INTEL 286

Digital Research Inc. (DRI), Pacific Grove, Calif., has agreed to develop a version of System V UNIX to port to Intel Corp.'s 286 16-bit microprocessor. An Intel spokesman says the agreement expands Intel's commitment to support standard operating systems and give its OEMs access to those standards. Intel already supports Microsoft Corp.'s XENIX operating system on that family of processors. Microsoft has been shipping XENIX-286 since October. The UNIX System V port is scheduled for delivery in the third quarter of this year. Western Electric will own the System V version and must validate it under an earlier agreement. Intel and DRI will have the non-exclusive right to market object-code versions of the software.

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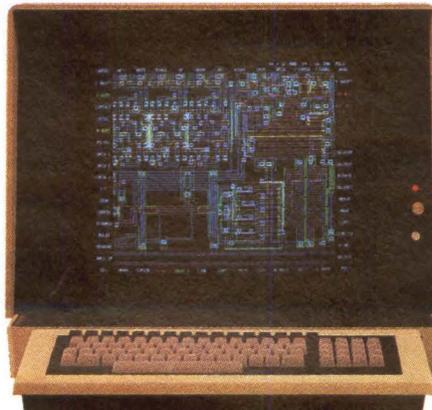
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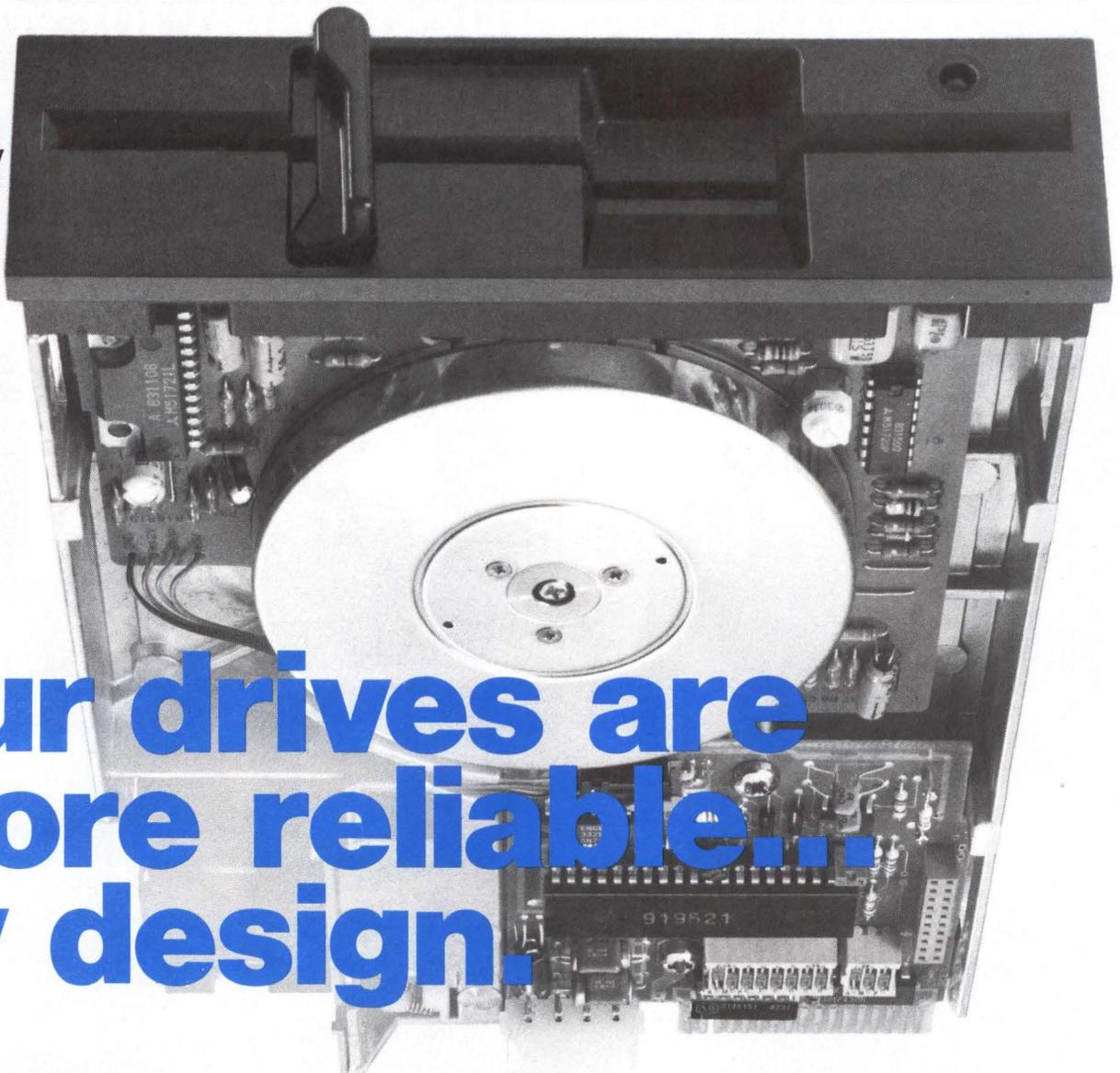
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Positioning time (track to track)	6 msec.	6 msec.	3 msec.	3 msec.
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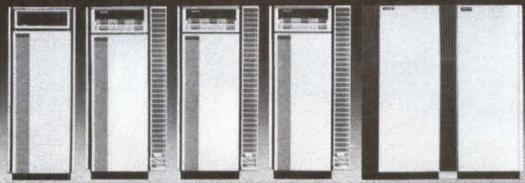
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Apple plants Macintosh, hopes for cash crop

Tom Moran, Associate Editor

To many analysts, Apple Computer Inc.'s Macintosh—the second member of its 16-/32-bit personal computer line—is a “make-it-or-break-it” product that has arrived just in the nick of time. If Macintosh succeeds, Apple may be able to defend its position in the market for \$2,000 to \$4,000 personal/business microcomputers against IBM Corp. and other competitors—and return to strong financial growth as well.

Apple is perhaps the most severely affected by, yet most able to combat, the IBM PC in that market. “We believe Apple may be the only company capable of establishing a strategic foundation for growth based on a real difference [in product] against IBM,” says John Scully, Apple’s president and chief executive officer.

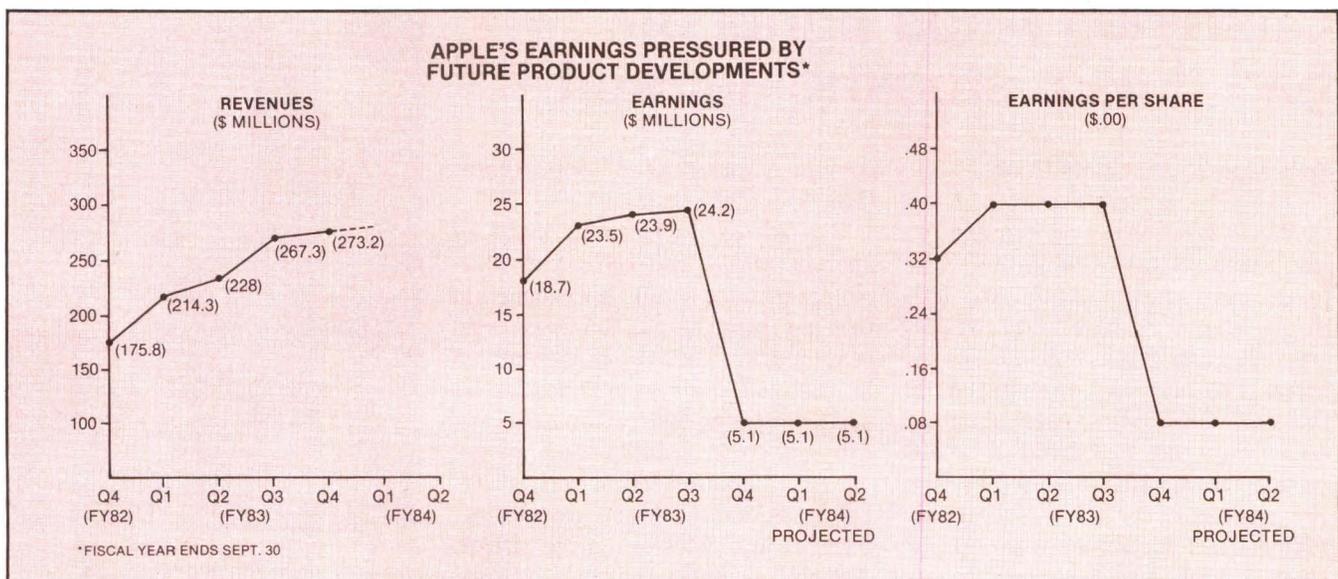
Macintosh is an expensive gamble for Apple. Its development costs ate into earnings, and Apple invested about \$20 million in an automated plant to produce it. These and other factors—including the great success of the IBM PC—contributed to lower earnings for Apple, prompting some industry observers to discount Apple as a major presence in personal computers.

Scully says the earnings sacrifices were planned. He says it would not be in the best interest of Apple’s long-term business and its shareholders to compromise new product development and marketing support or to limit the competitiveness of existing products merely for the sake of favorable short-term quarterly earnings. Scully projects that earnings per share in each of the first two quarters of fiscal year 1984 should not exceed the 8 cents

reported for last year’s fourth quarter, which ended Sept. 30.

Much depends on the Macintosh. “The Apple IIe will be a billion-dollar-plus product line for the next two to four years,” says Apple chairman and co-founder Steve Jobs. “I expect Macintosh to be a multibillion-dollar product line within the next 24 months.”

Senior analyst John Kiefer of Infocorp, a Cupertino, Calif., market research and competitive-analysis group, expects both the Macintosh and the Apple IIe to be strong competitors in the market for \$2,000 to \$4,000 microcomputers. He believes factors in that success will be Apple’s strong management, its engineering talent and the fact that it should be a billion-dollar company this year. “The death knell for Apple sounded by a lot of analysts is premature,”



Apple has made a long-term investment in future products, bypassing short-term earnings fixes, says company president John Scully. As a result, there was a drop in earnings during the fourth

quarter of last fiscal year that will extend at least into the first two quarters of this year.

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Kiefer contends. "Apple will have some tough times ahead of it, but it will be a survivor."

Jobs notes that, after recent price cuts, an Apple IIe with a monitor, a disk and an operating system typically retails for \$1,400 to \$1,500 compared to a list price of about \$1,600 for the IBM PCjr without a monitor or a full keyboard. Jobs does not expect a price war between the PCjr and the Apple IIe because he believes there will be a product shortage this year. "I don't think you're going to be able to get enough PCs, enough Peanuts [PCjrs], enough Macintoshes or enough Apple IIes," he says.

Apple's past successes are part of its current problems. Alex Stein, senior industry analyst for market research company Dataquest Inc., San Jose, Calif., believes IBM is pressuring Apple but adds, "There isn't anybody out there who isn't being squeezed by IBM. The reason Apple is more vulnerable than

everyone else is that there are higher expectations on Wall Street and in the banking community for Apple than there are for 95 percent of the other competitors in that market." Other reasons for Apple's vulnerability, says Stein, are that the high-end Lisa is a "future" product in its price and capabilities and that the low-end Apple IIe is in a very competitive market. "In terms of overall revenues and margins, the IIe is the mainstay of Apple's product lines. That product has been increasingly under margin pressure," he says.

Stein believes that pressure could mean problems for Apple, even though the margins on the Apple IIe are quite high. "The company has developed a large management contingent and very much depends on the higher margin in this product [the Apple IIe]. Anything that affects the IIe even mildly is going to have effects throughout Apple," says Stein. He believes that's why

the company is attempting to re-establish itself in the market for \$2,000 to \$4,000 personal computers. "Selling at the very high end is prestigious, and selling at the very low end is necessary for short-term survival, but selling in the mid-priced market will determine Apple's ability to compete effectively with IBM, DEC and HP," he says.

Apple's Jobs does not believe Macintosh will hurt the Apple IIe: "I don't think you could kill the Apple IIe if you wanted to. There's just so much software. We have 70 percent of the education market with the Apple IIe, and that market's going through the roof. We're shipping more than 10,000 computers a month to that market."

Stein thinks the investment community will adopt a wait-and-see attitude about the Macintosh. If so, it may take Apple's stock longer to return to higher levels, even if the Macintosh is a hit.

Cash-rich Altos fights off bad times, stockholder suit

Tom Moran, Associate Editor

There are signs of trouble at fast-paced Altos Computer Systems, San Jose, Calif. In late September, Altos laid off 36 employees, or 8 percent of its work force. The company then reported that sales for the first fiscal quarter, ended Sept. 30, had dropped to \$18 million from \$21 million in the previous quarter. In November, Altos stock, once as high as \$39 per share, tumbled to less than \$8 per share. And, to make matters worse, a group of stockholders is suing the

company, alleging misrepresentation.

But Altos officials and industry analysts insist that the seven-year-old company is solidly entrenched in the multiuser, small business systems market. Altos has \$56 million in the bank, about \$20 million in earned income, \$96 million in assets, \$15 million in liabilities and a net worth of about \$80 million, states Dave Jackson, Altos president, founder and chief executive officer. Altos also owns a one-third interest (\$10 million) in Wyse Technology, which manufactures terminals and



Altos Computer Systems president Dave Jackson expects the company's XENIX-based Altos 586 to sell well. He predicts that Altos will be a \$500 million company within five years.

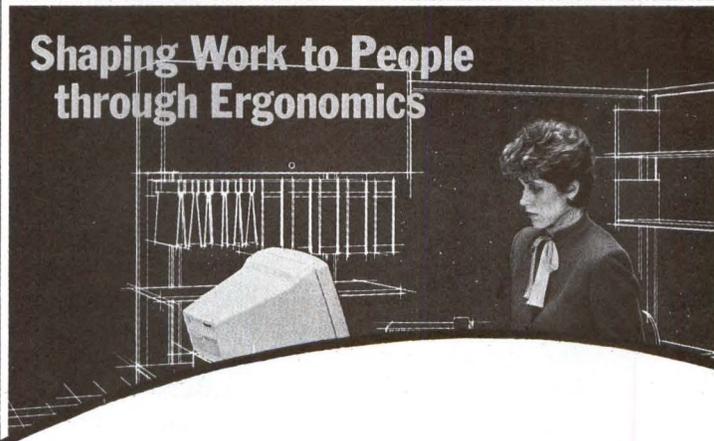
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ALTOS COMPUTER SYSTEMS FINANCIAL SUMMARY (\$ MILLIONS)

	1Q83 (end 9/30/82)	2Q83	3Q83	4Q83	1Q84
8-bit systems (hardware)	13.2	11.4	11.1	9.4	5.4
16-bit systems	2.2	2.3	6.4	8	9
Total sales (including software)	17	16	20	21	18
Net earnings	1.9	1.4	2.3	2.3	1.1
Net earnings per share	16¢	11¢	16¢	15¢	8¢

Source: Altos Computer Systems

microcomputers, bringing Altos' liquid assets to approximately \$100 million.

The reason for the layoff was to bring costs in line with sales figures, Jackson says. He expects sales to rebound to \$20 million in the second quarter, as the company smooths its transition from 8- to 16-bit systems. Meanwhile, the 8-bit sales curve is declining, while the 16-bit curve, as exemplified by the company's XENIX-based, 16-bit model 586 system, is rising. "We're ramping nicely with the new product, the 586, and we finished a record month in October," he says. The company has stopped emphasizing the stable Z80 market as the target of its main product line. "There was about a \$60 million to \$70 million yearly sales rate in that market," Jackson says. As the company shifts to the 16-bit market, he says, it can expect \$80 million to \$90 million in annual sales at the start, mostly in multiuser XENIX "true business systems, which in no way compete with the IBM PC," Jackson says.

Jackson attributes the company's first-quarter sales decline to three factors: the IBM PC, the transition to 16-bit systems and the competition. "The slowdown was due to loss

of the 8-bit market to PCs, and we had to ramp from zero to \$80 million per year with our new systems." As for competition, Jackson cites Burroughs Corp. Although Digital Equipment Corp. and Data General Corp. are becoming focused in their efforts to gain share in the 16-bit market, they are not true competitors, he adds.

Jackson says stock prices were hurt because investors are staying away from the industry as a whole. According to some analysts, the fall of Osborne Computer Corp. has deflated stock prices for small system manufacturers.

But, despite industry turmoil, Jackson recently predicted that Altos would grow to a \$500 million company in five years, the same

prediction he made in November 1981. "Since Altos is dominating this market, I see a good five years ahead. Our profits are over 10 percent and going to 15 percent," he claims. (According to company figures, first-quarter profits were closer to 6 percent.)

Not all the company's investors are as sanguine. A lawsuit filed in U.S. District Court in San Francisco claims to represent investors who purchased stock between the company's first public offering on Nov. 4, 1982, and Jan. 20, 1983. The suit alleges that, at the time of the offering, Altos and some of its officers failed to disclose material facts concerning production delays and technical problems with hardware and software.

Dave Zacarias, Altos vice president of finance, says that the allegations are "without any merit" and that the company and its officers will fight the suit. The company does not comment on whether the alleged delays occurred.

Many analysts argue that Altos is basically sound. "As opposed to companies like Osborne or Victor Technologies, Altos still has all the money in the bank that they received from their public offering," says Ralph Gilman of research concern InfoCorp, Cupertino, Calif. "Basically, Altos is fiscally very

APPLE ADDS COMMUNICATIONS PRODUCTS TO LISA

Apple Computer Inc. has announced two communications products for its Lisa microcomputer: LisaTerminal software and the Apple cluster controller. LisaTerminal enables Lisa to emulate VT100, VT52 and teletypewriter terminals and to communicate via a modem with computers supporting asynchronous protocols. The Apple cluster controller is a protocol converter that emulates an IBM 3270-type cluster controller. Using both LisaTerminal and the cluster controller, the Lisa can emulate the IBM 3278 model 2 terminal. Both products will be available soon. Retail price of LisaTerminal is \$295. A three-port cluster controller sells for \$4,500.

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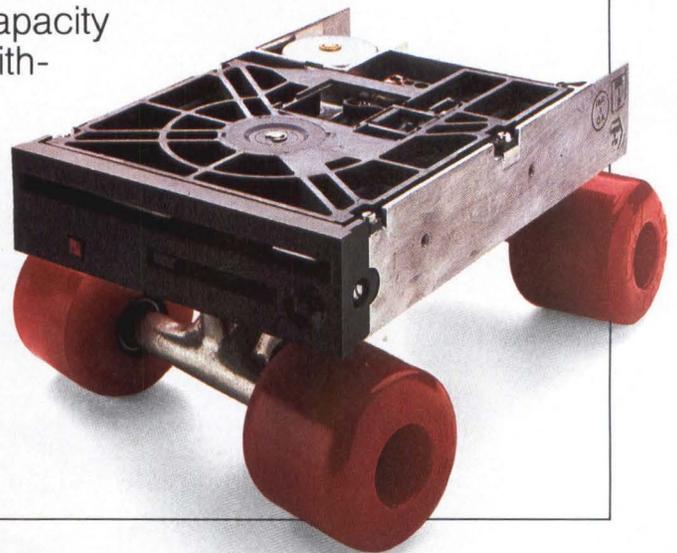
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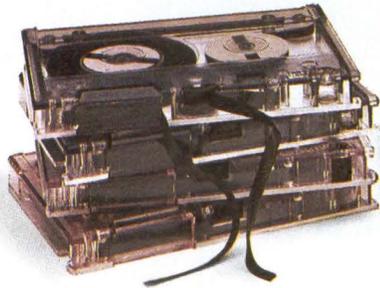
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1983	Introduced first integrated voice/data modem for IBM PC
1983	Granted patent on command-driven modem

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conservative and careful about making sure that expenses match revenues." Like Jackson, Gilman attributes Altos' flat mid-year sales to the large number of IBM PCs being sold. "In general, the market is in transition because of IBM. Altos was the first single-board, multiuser computer company. As a result, it has a reputation for being price competitive, having reasonable-quality products and keeping up with the latest technology."

Mary A. Simpson, research analyst for Dataquest Inc., San Jose, Calif., says the layoff wasn't an indication of anything serious. "What happened at Osborne [has] just put a magnifying glass on the whole industry, and it looks twice as bad. Altos is being conservative and conscientious about its approach, and that's why it's doing so well." She points out that cutbacks in a company are no indication that the company will fold.

According to consultant Jean Yates of Yates Ventures, San Francisco, Altos' shift from commodity hardware to a heavy software orientation is a long-range plus. "The Altos software availability program (ASAP) dealer program was one of the first third-party UNIX application-software programs, and that set Altos apart from the other UNIX microcomputer vendors," she says. Yates believes Altos' commitment to UNIX initially cost the company. "It's had to shift its distribution channels because UNIX-based systems require higher technical ability, and revenues suffered a little from that shift." But she now believes that Altos' involvement with UNIX is starting to pay off. "AT&T's introduction of microcomputers with UNIX early this year will give Altos a big boost because it will lend credibility to UNIX," she says.

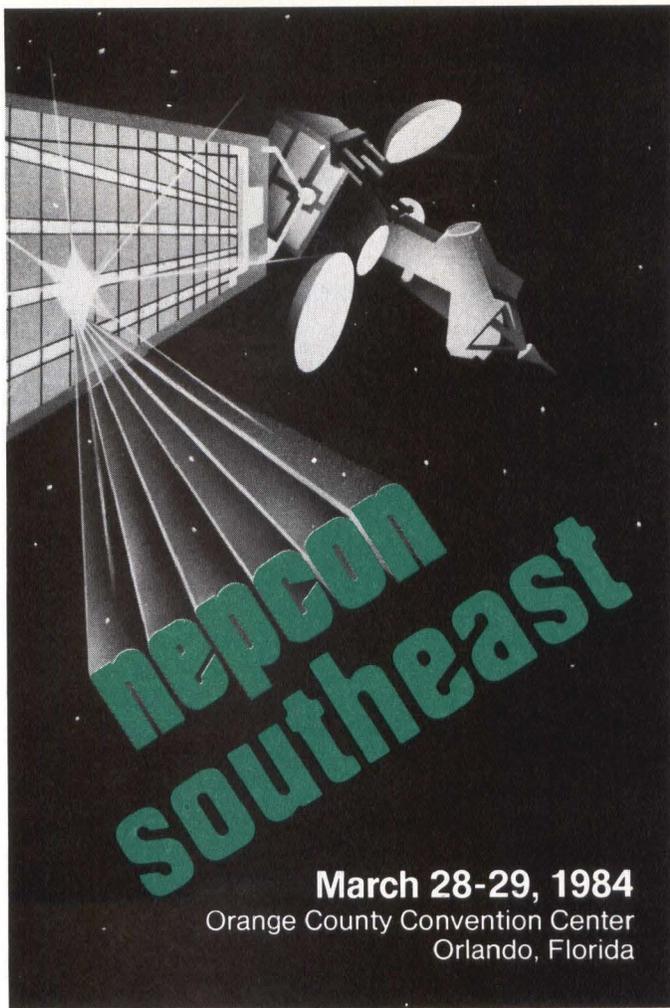
BOX SCORE OF EARNINGS

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
Centronics Data Computer Corp.				
	9 mos. 10/2/83	\$127,277,000	(1,492,000)	(.13)
	9 mos. 10/3/82	96,841,000	(27,183,000)	(3.39)
Computervision Corp.				
	9 mos. 9/30/83	288,384,000	24,901,000	.87
	9 mos. 9/30/82	243,524,000	25,185,000	.92
Datapoint Corp.				
	3 mos. 10/31/83	139,724,000	5,435,000	.27
	3 mos. 10/31/82	132,044,000	461,000	.02
Dataswitch Corp.				
	9 mos. 9/30/83	25,279,788	4,277,452	.48
	9 mos. 9/30/82	12,364,994	1,935,582	.28
Docutel/Olivetti Corp.				
	9 mos. 9/30/83	170,328,000	(812,000)	(.12)
	9 mos. 9/30/82	82,905,000	5,280,000	1.10
Eagle Computer Inc.				
	3 mos. 10/1/83	14,295,000	81,000	.01
	3 mos. 10/2/82	2,309,000	(717,000)	(.10)
Harris Corp.				
	3 mos. 9/30/83	349,609,000	14,264,000	.45
	3 mos. 10/1/82	341,823,000	14,702,000	.39
Management Assistance Inc.				
	year 9/30/83	375,885,000	(1,048,000)	(.14)
	year 9/30/82	358,387,000	(7,534,000)	(.92)
Management Science America Inc.				
	9 mos. 9/30/83	87,013,000	(574,000)	(.03)
	9 mos. 9/30/82	59,638,000	(262,000)	(.02)
Micom Systems Inc.				
	6 mos. 9/30/83	55,956,000	8,982,000	.59
	6 mos. 9/30/82	39,691,000	6,191,000	.43
Paradyne Corp.				
	9 mos. 9/30/83	153,620,000	5,450,000	.24
	9 mos. 9/30/82	145,869,000	19,401,000	.90
Perkin-Elmer Corp.				
	3 mos. 10/31/83	247,684,000	8,649,000	.20
	3 mos. 10/31/82	235,253,000	10,982,000	.25
Sanders Associates Inc.				
	3 mos. 10/28/83	147,800,000	8,121,000	.42
	3 mos. 10/28/82	122,800,000	5,612,000	.32
Tandem Computers Inc.				
	year 9/30/83	418,282,000	30,805,000	.76
	year 9/30/82	312,143,000	29,856,000	.76
Texas Instruments Inc.				
	9 mos. 9/30/83	3,280,500,000	(222,900,000)	(9.36)
	9 mos. 9/30/82	3,219,700,000	101,500,000	4.30
Timplex Inc.				
	3 mos. 9/30/83	13,247,000	785,000	.12
	3 mos. 9/30/82	9,327,000	522,000	.10
The Ultimate Corp.				
	6 mos. 10/31/83	29,554,001	4,068,369	.42
	6 mos. 10/31/82	16,781,347	1,854,882	.21

Comments: Centronics Data Computer Corp.'s third-quarter revenues dropped to \$38.9 million from \$40.8 million in the comparable quarter a year earlier. The printer manufacturer reported a net loss of \$2.1 million, or 19 cents per share, for the quarter, vs. a loss of \$13.5 million, or \$1.20 per share, a year previously. (The nine-month figures for 1982 do not reflect the printer business of Computer Peripherals Inc. before its acquisition on June 25, 1982.) Although Centronics garnered several large OEM contracts, volume product shipments had not yet begun; in addition, revenue from short-term contracts was limited, the company said. The continuing weakness of the European economy contributed to the sales drop. After the earnings announcement, Centronics replaced president John Tindler. **Datapoint Corp.** chairman Harold E. O'Kelley

said first-quarter earnings had improved because of reduced operating expenses and product costs. Domestic orders had decreased; international orders had improved modestly. The backlog was up slightly from the \$103.7 million at the end of fiscal year 1983. Although **Management Science America Inc.'s** third-quarter revenues increased 45 percent to \$30.2 million from \$20.8 million a year earlier, the company reported a net loss of \$350,000, or 2 cents per share, compared with earnings of \$43,000 a year previously. **Tandem Computers Inc.** reported its eighth consecutive year of record revenues. Net income was flat due to a decrease in net interest income and a higher tax rate, the company said. Although **Texas Instruments Inc.** left the home computer market, Professional Computer sales are still growing.



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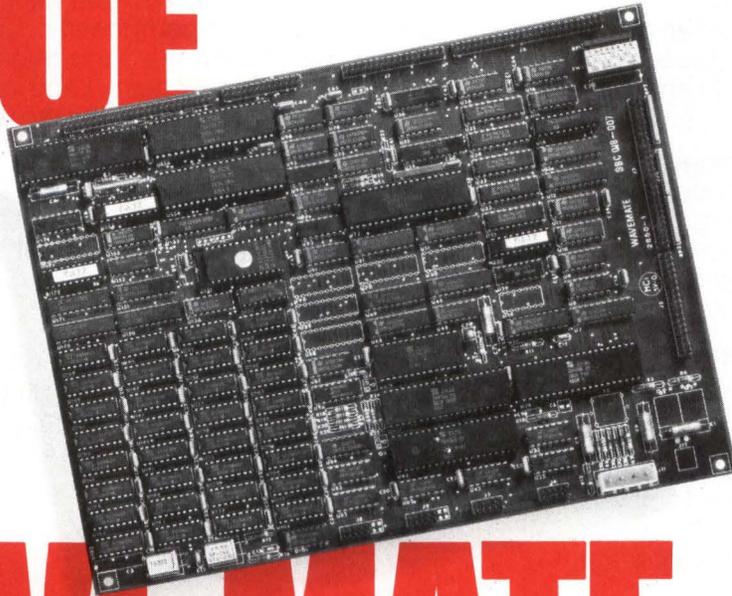
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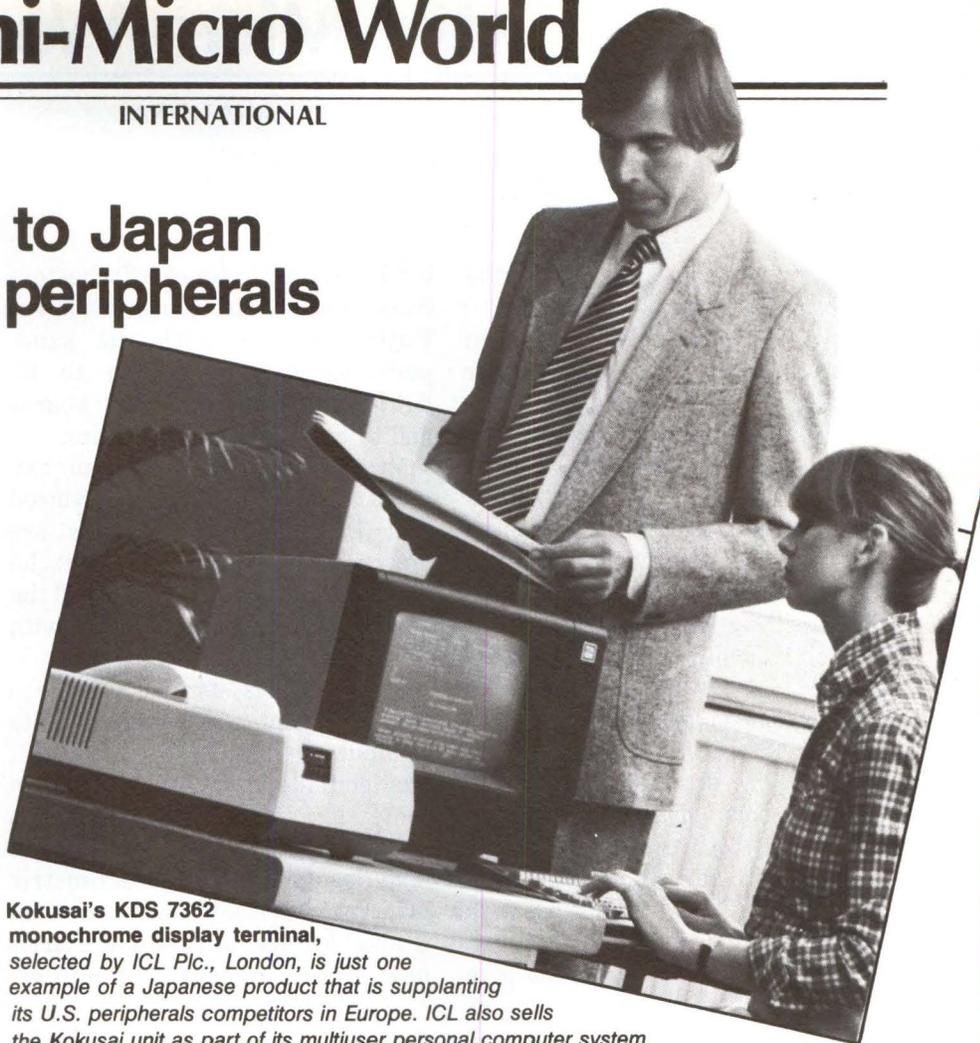
Europeans turn to Japan for high-quality peripherals

Keith Jones, European Editor

Citing lower prices, higher quality, faster delivery and better attitudes, some European peripheral equipment distributors are spurning U.S. equipment suppliers in favor of Japanese manufacturers.

For example, the OEM sales arm of one of Europe's biggest computer companies, ICL Plc., London, considered 26 terminal manufacturers—including all the major U.S. companies—before choosing Japanese manufacturer Kokusai Electric Co. Ltd., Tokyo. ICL's OEM sales executive, Edward Lucas-Smith, says Kokusai won for numerous reasons, including its willingness to modify products to meet ICL specifications, such as its 11 selectable national character sets. Kokusai also satisfied ICL that it was able to meet ICL's volume requirements as an exclusive European distributor. The deal with ICL gave the Japanese company access to more than 300 European ICL dealers. Lucas-Smith notes that the number of "dead-on-arrival" units among 13,000 Kokusai terminals shipped to ICL so far has been negligible. Nissei Sangyo America Ltd., Chicago, represents Kokusai in the United States.

More comprehensive in praising the Japanese than ICL and more damning of U.S. suppliers is Tom Risseeuw, managing director of one of Europe's biggest computer equipment distributors, Geveke Electronics B.V., Amsterdam, the Netherlands. "About 90 percent of the products we sell are from the United States, but we are not satisfied," he says. "We are now selling Japanese products in France, Belgium and the Netherlands. The



Kokusai's KDS 7362 monochrome display terminal, selected by ICL Plc., London, is just one example of a Japanese product that is supplanting its U.S. peripherals competitors in Europe. ICL also sells the Kokusai unit as part of its multiuser personal computer system.

Japanese are much more responsive on pricing, specifications and delivery." He names Oki Electric Industry Co. Ltd. and Mitsubishi Ltd. printer products as Geveke's initial Japanese lines. "The Japanese are more loyal to European distributors than the Americans," he explains. "The Japanese send people to Europe, and they stay here for five years. In contrast, U.S. companies have a rapid turnover of staff, so they have a new person managing international operations every year in some cases. [That person] usually wants to appoint new distributors, so you have to prove yourself all over again."

Risseeuw also complains that U.S. manufacturers tend to give low priority to European distributors when allocating stock for delivery, mainly because the U.S. market is larger than the European market. James McKenna, OEM product

manager for leading British peripheral distributor DRG Business Machines, Weston-super-Mare, England, shares that view. DRG's product line is almost entirely Japanese and includes printers from Citizen, Tokyo Electric Co. Ltd., Epson Corp. and Seikosha. McKenna thinks the Japanese are much more effective in getting and servicing distribution deals. "Americans do not pursue [our] business; the Japanese chase us."

McKenna is also satisfied with the floppy disk drives from Japan's Y-E Data that DRG sells. "Floppy disk drives are inherently unreliable," he says, "but we can actually ship Y-E Data units directly to our customers without having to test them." McKenna has worked for two U.S. disk drive manufacturers and does not think U.S. quality control is as good as Japan's. "Americans have a lot of good product ideas, but they

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cannot build products as well as the Japanese," he notes.

Low cost is the major attraction of Fujitsu daisy-wheel printers for Zygol Dynamics, Bicester, England. Although the company is one of two authorized British distributors of Diablo Systems Inc.'s daisy-wheel printers, company chairman Con Driscoll says, "The Fujitsu SP 320 runs at the same speed as the Diablo 630 API, but we can sell it for [almost half the price of] the Diablo printer." Driscoll expects sharp competition from the Fujitsu SP 830 daisy-wheel unit, which is priced no higher than the 630 API but runs much faster. Pointing to test results, he quotes a speed of 65 characters per second (cps) for the SP 830 compared with only 38 cps for the Diablo printer. "The Fujitsu units will enable us to penetrate new markets, such as low-cost word processors," Driscoll explains. He is convinced that Fujitsu will also get a high score on reliability. "We tested the SP 320 for three months, and nothing went wrong. But we are not dropping the Diablo products. We have a lot of very satisfied Diablo customers."

Diablo's British manager, Peter Benes, believes the motivation and devotion of the Japanese work force are the main reasons for the low cost of Japanese products. He believes Diablo will remain superior to Fujitsu in interfacing capability and breadth of product line.

Fujitsu's Winchester disk drives impress Nick Brackenbury, managing director of system integrator and distributor Darkcrest Ltd., London. He cites advanced design, low cost and impeccable quality as some of the reasons his company chose Fujitsu as its source of 14-inch Winchester drives for use with Digital Equipment Corp. VAX superminicomputers. Darkcrest in-

tended to order 14-inch Winchesters from Control Data Corp. but found Fujitsu drives with the same performance specifications to be lighter, to have fewer PC boards and to have simpler mechanics.

Brackenbury chose Fujitsu two years ago, and he still is convinced that its 14-inch Winchesters are better than U.S. drives. But he believes U.S. companies are still the only viable source of drives with removable media.

Terry Harris, former European vice president of Centronics Data Computer Corp., Hudson, N.H., has considerable experience in competing against the Japanese in Europe. Epson America Inc.'s high-quality, low-priced dot-matrix printers especially impacted Centronics' low-end printer line. Harris now heads Accent Computers,

London, which sells add-on products for European users of the IBM Personal Computer. He says Accent will concentrate on software and add-on PC boards, which are modified frequently so that the Japanese cannot copy them. Mechanical peripherals, such as printers, have long production runs, so they can be copied, he says.

Harris believes high-technology peripherals and products with a significant software content are fairly safe from Japanese competition. Geveke's Risseeuw concurs. Despite his unfavorable opinion of U.S. peripheral builders, Risseeuw is impressed with U.S. system manufacturers, and his company now sells the IBM PC-compatible personal computer from Eagle Computer Inc., Los Gatos, Calif.

Inmos to develop 32-bit chip for system integrators

Keith Jones, European Editor

By the end of this year, British semiconductor manufacturer Inmos Ltd., Bristol, England, plans to ship samples of its 32-bit microprocessor developed for concurrent computing on multiple processors. Called the Transputer, the chip is designed for system integrators. Inmos officials cite signal processing and database searching as promising applications.

Multiprocessor microcomputer systems are not new, but the Transputer takes a novel approach to inter-processor communication. Instead of a bus, it uses four point-to-point serial links to communicate with other Transputers.

Each link handles a 1.5M-bit-per-second (bps) data flow in each direction. An 8-bit bidirectional bus serves as the peripheral interface. In this way, multiple Transputers form a matrix, each directly connected to a maximum of four neighbors. Advantages Inmos lists include a simpler board layout and increased overall bandwidth because many links can operate concurrently.

The company acknowledges that the processes making up a concurrent program must be allocated to a specific Transputer and address space when compilations are made. This software-mapping method is called static allocation. In contrast,



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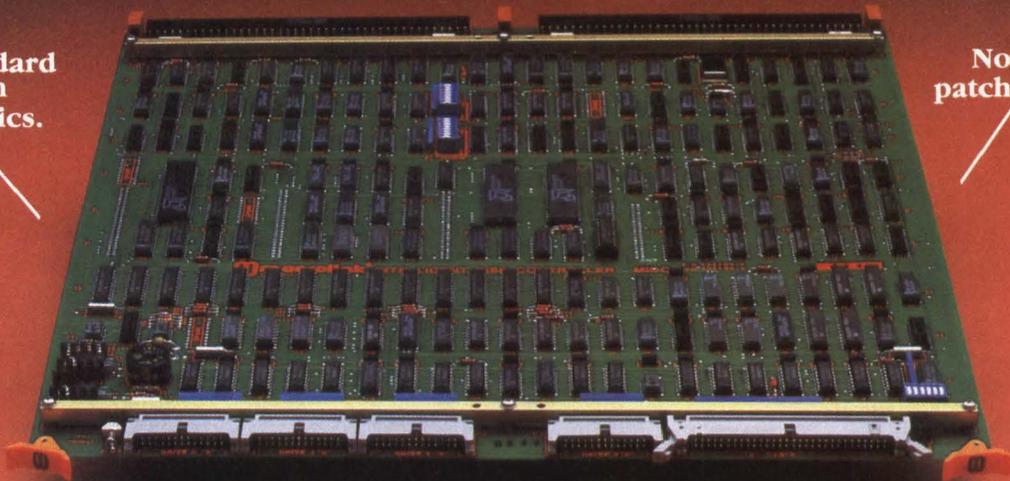
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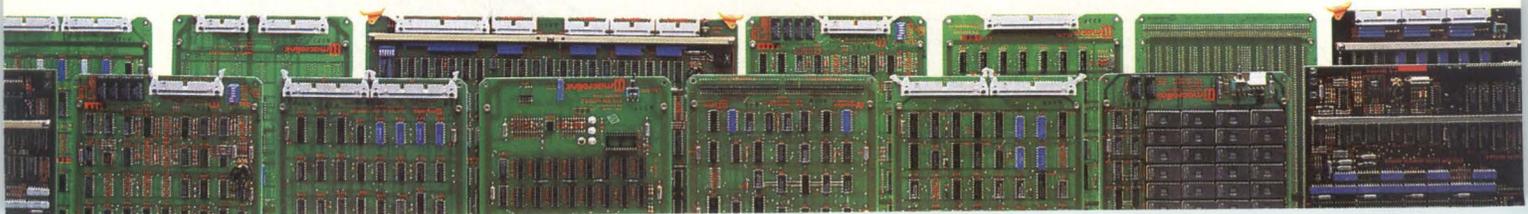
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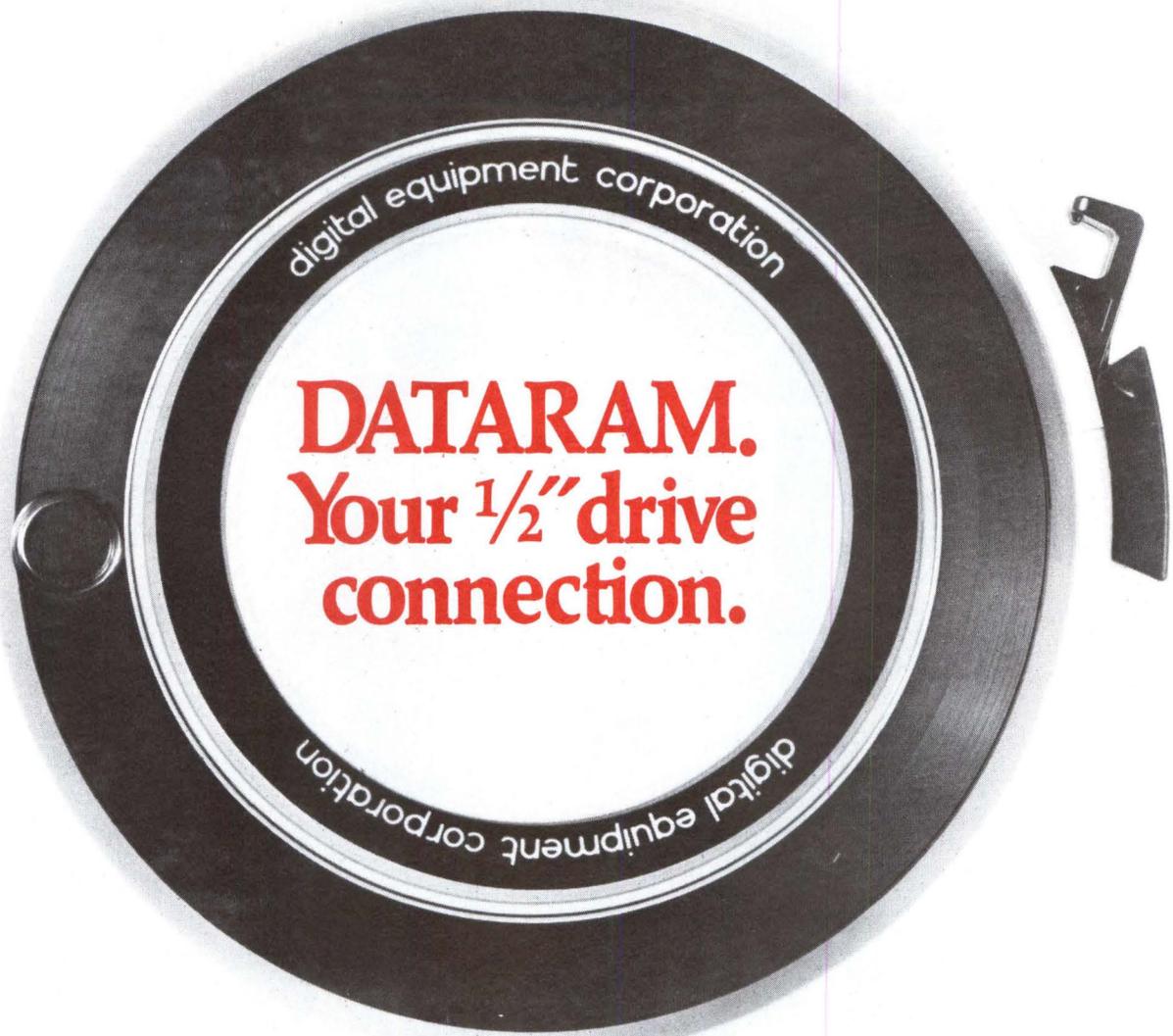
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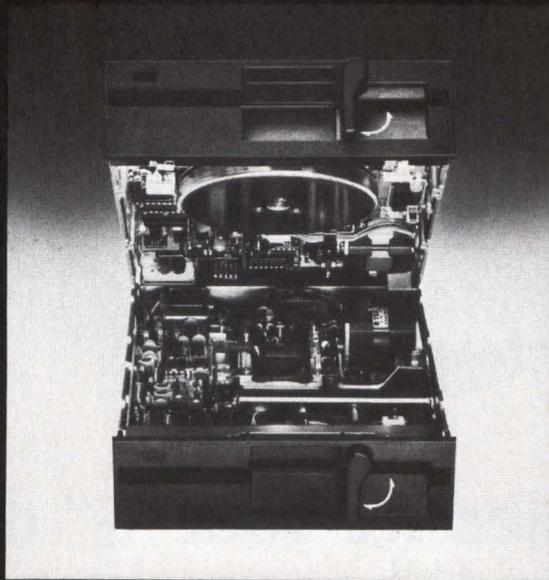
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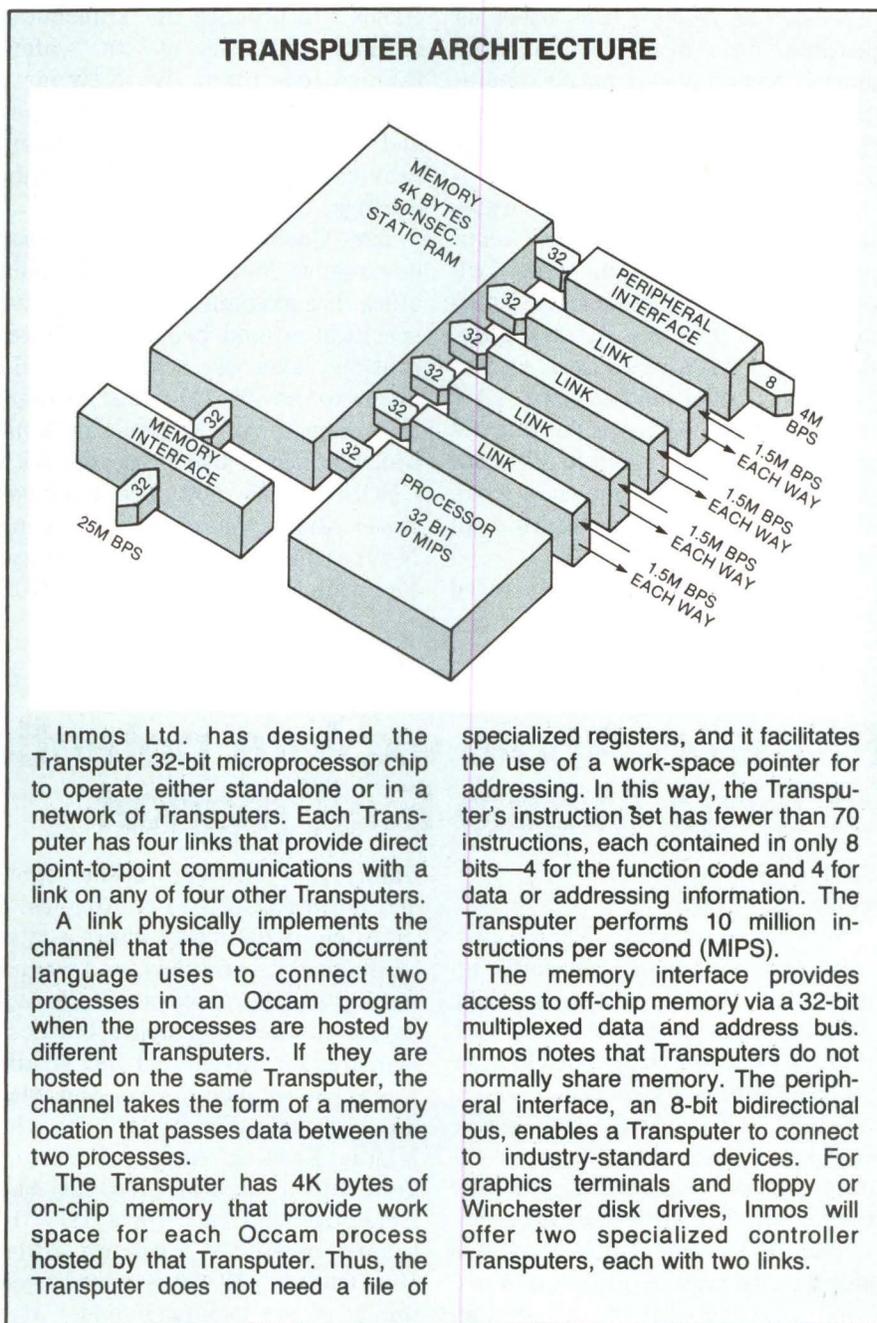
Intel Corp.'s Intel 432 multiprocessor chip set supports dynamic allocation, helped by a common memory shared by all processors and a bus structure for inter-processor communications. Richard Emmerson, product marketing manager with Intel 432 system house High Integrity Systems, Sawbridgeworth, England, explains, "The 432 hardware can allocate software to different processors at run time. The processors bid for work, and it does not matter how the program is partitioned." But Emmerson believes the Transputer could be "an excellent trade-off" between the flexibility of a machine like the 432 and the efficiency of a computer with rigidly-mapped software. He notes that the Transputer's multidimensional topology and link speed reduce its constraints.

The Transputer differs radically from the 432 in two other major respects: the simplicity of the Transputer's machine-level instruction set and the simplicity of Occam, the concurrent language for which the Transputer is optimized. Occam is the lowest-level programming language for the Transputer, and Inmos officials claim compiled Occam is as efficient as software written in an assembler code. High Integrity Systems may develop an Occam compiler for the 432. Occam's simplicity contrasts dramatically with the complexity of Ada, the language most closely associated with the Intel 432. Apart from simple assignment statements, Occam processes comprise little more than input and output statements. One fundamental similarity between the two languages is the communication-sequential-process concept, which is the basis of Ada's process-rendezvous feature as well as the foundation of Occam.

The Transputer's processor incorporates a hardware scheduler for sharing processor time between processes. It assigns priority to processes that perform interrupt-routine tasks. It also synchronizes the execution of pairs of connected

processes, so that communication via a channel occurs only when both processes—the input and output—are ready.

Because there is no explicit addressing in Occam, a process can be written and compiled in Occam



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without knowing whether its channels are connected to other processes on the same Transputer or on another Transputer. Moreover, two communicating processes need not be in adjacent Transputers. A user can write a process to pass on a message, as in database-searching applications. Compilation locates processes as near to each other as possible, and, in applications like image processing and matrix manipulation, processes need communicate only with others in adjacent Transputers.

Compilation takes place separately from a Transputer via an Occam programming system with two possible hosts—Victor Data Products' Victor 9000 or Digital Equipment Corp. VAX computers. Occam can be compiled only to DEC VAX or Intel 8086 machine code, but the system will be enhanced to generate the Transputer machine code when the Transputer is available in silicon.

Although Inmos has fabricated

prototype devices partially implementing Transputer features, it has not yet produced chips meeting the full specification. The 32-bit version of the Transputer will have 250,000 transistors on a single chip, and integration will be achieved using complementary - metal - oxide-semiconductor (CMOS) technology. Inmos will produce the Transputer in high volumes at its wafer-fabrication plant in Newport, Wales. Inmos is sending prototypes and samples from its U.S. wafer-fabrication facility in Colorado Springs, Colo.

Tim Coombs, a microprocessor engineer at Motorola Inc.'s London office, has examined the Transputer specification and believes the integration level is achievable. He points to the 300,000-transistor-per-chip density of Motorola's 32-bit 68020, which is also fabricated with CMOS. Inmos now manufactures static and dynamic RAMs using N-type MOS (NMOS) technology. The company intends to use CMOS

for 64K- and 256K-bit dynamic RAM devices functionally identical to CMOS chips planned by Intel.

Inmos also plans a 16-bit version of the Transputer. It will have the same instruction set as the 32-bit machine, thanks to the processor design in which data access is separate from data operation and all instructions are 1 byte long, regardless of word length.

Transputer lacks a conventional operating system. Inmos argues that Occam handles many operating-system functions, including process scheduling and communication. The company expects Transputer purchasers to add substantial value to Transputer-based products in the form of system and application software. Inmos plans to make Ada—as well as Pascal, FORTRAN and C—available on the Transputer, but it acknowledges that users will need to add many run-time support tools for Ada's wide repertoire of concurrency models.

Pioneer, Apple explore potential of large Middle East market

Edward S. Foster
Associate Editor

System suppliers generally ignore the Middle East market, despite experts' expectations that the area will purchase \$5 billion or more worth of computer products by 1987. As a result, the Arabic world has been plagued by out-of-date, overpriced systems generally operating in English or French.

Two U.S. companies that are seizing this market opportunity are Apple Computer Inc., Cupertino,

Calif., and Pioneer Technologies and Sciences Corp., Los Angeles.

"Apple is definitely interested in 'Arabizing' its products, and we are looking at several ways of doing it," says Ron Boring, Apple's business manager for Africa and the Middle East. The company is working with its regional distributors in the Middle East on Arabic character-generation capabilities for the Apple IIe and the Apple III. "In future products," Boring adds, "particularly MC68000-based systems, we are looking in-house at a

different kind of solution to offer true bilingual capabilities."

Pioneer is addressing that goal by developing bilingual English-Arabic hardware and software for micro-computer systems. "With many computer products today, you get French and German character sets for free," notes Dr. Othman Albadri Abdalla, who, along with fellow University of Southern California professor Dr. Wissan Ahmed, founded the privately-held Pioneer. "If [vendors] supply an Arabic character set, however, they charge

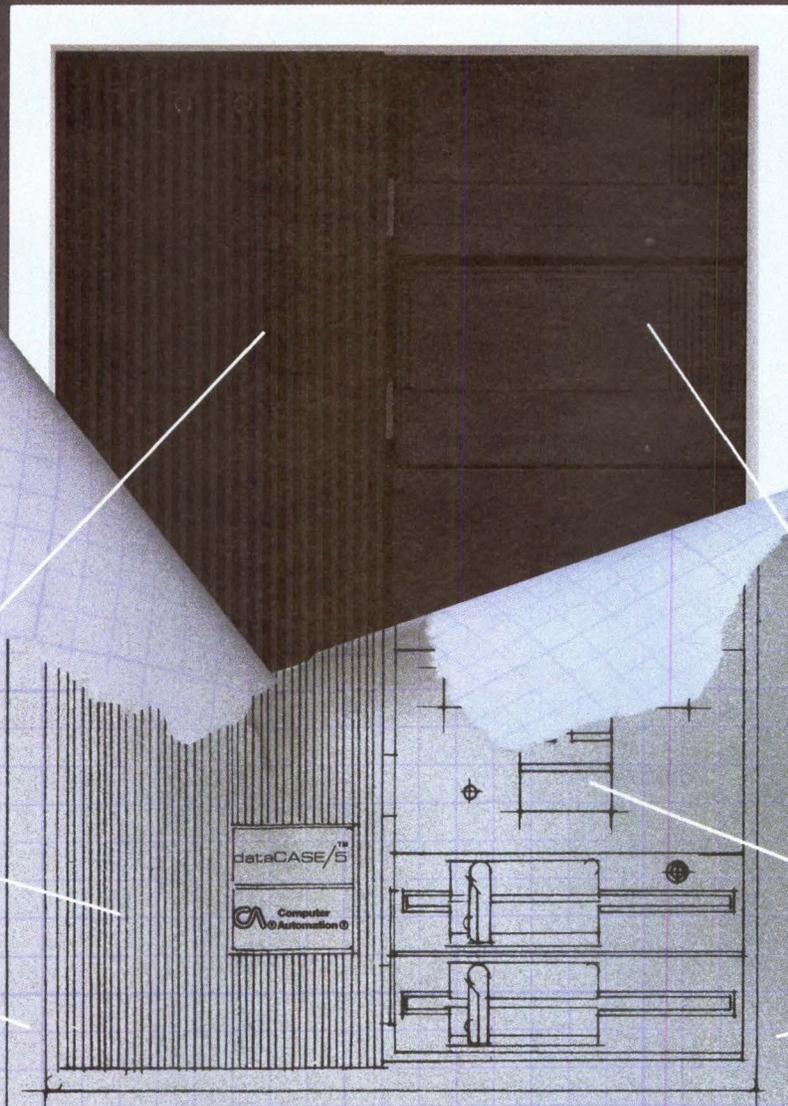
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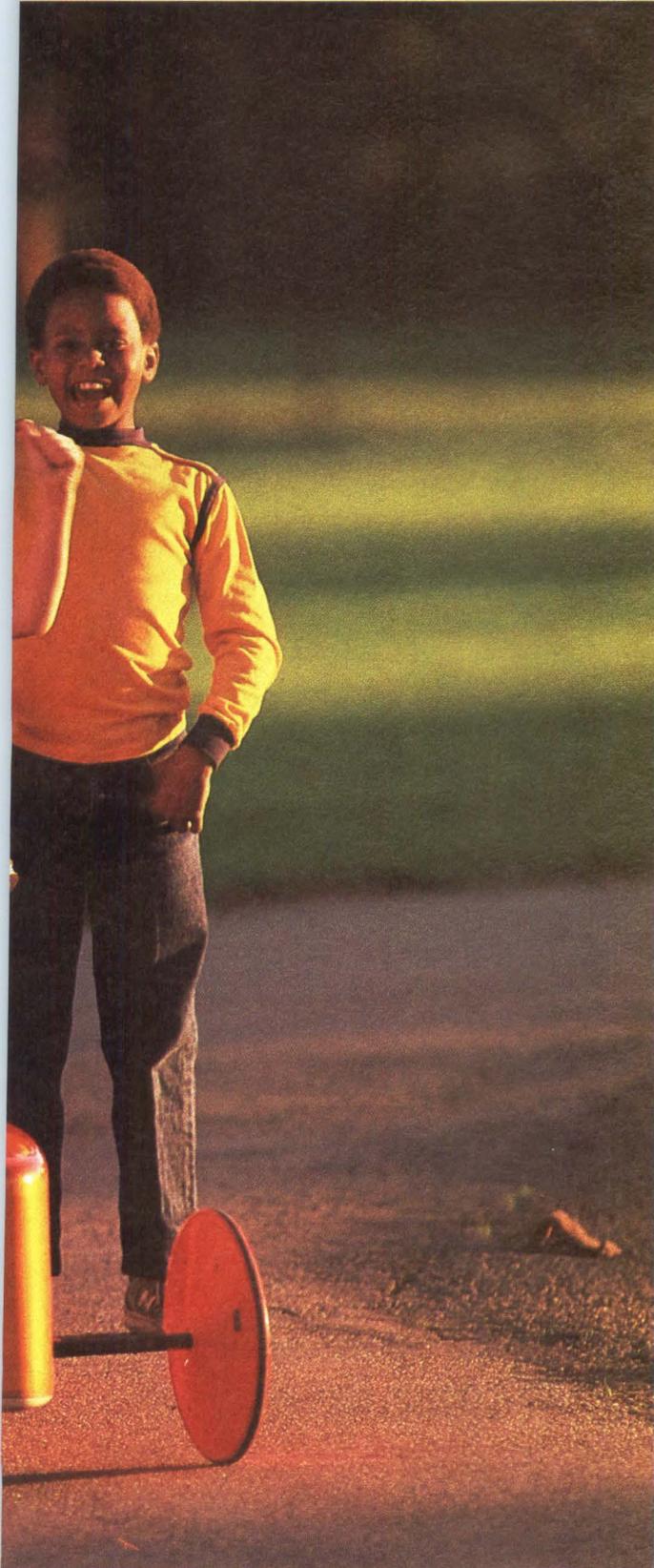
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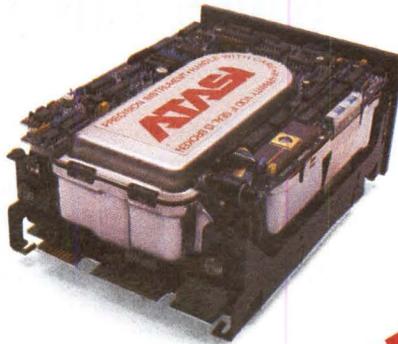
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MINI-MICRO SYSTEMS/February 1984

Mini-Micro World

INTERNATIONAL

ENGLISH-ARABIC OUTPUT

الطابعة العربية/الانجليزية QANTEX 7030

=====

ان هذه الطابعة المزدوجة اللغات تعمل على طباعة النصوص المكتوبة باللغتين العربية و الانجليزية في تمازج كامل . تعمل هذه الطابعة بسرعات مختلفة و بتحكم كامل من المستعمل لها .

السرعات الموجودة هي ١٨٠--١٥٠--٧٥--٣٧,٥ في الثانية الواحدة .

تستطيع ان تطبع بالعربي و IN ENGLISH ON THE SAME LINE

هذا النظام هو من تطوير شركة بايونير PIONEER TECHNOLOGIES

This printer is supplied by Pioneer Technologies with capability of printing English and Arabic text on separate lines or on the same line like what you see here on this line. *مثل ذلك هذا السطر*

You can make tables of arabic and english on the same line like

English-Arabic software operates on Pioneer Technologies' CP/M-based system with a Z80 processor.

two or three times what their costs dictate," he maintains.

Pioneer will offer a complete microcomputer system for less than \$3,000. The system will display, print and accept plain-language commands in Arabic or English. A basic configuration offers a Z80 or 8088 processor with 64K bytes of main memory, expandable to 512K bytes, two 320K-byte floppy disk drives, a bilingual monitor and a dot-matrix printer. Availability is scheduled for the first quarter of this year. The Pioneer system will include an integrated bilingual word-processing, database-management and inventory-control package. Application packages for accounting, school management, language training and other vertical markets are available.

The company has also developed a multiuser, UNIX-based configuration, an Arabic compiler and a PC board to support Arabic on the IBM PC. Pioneer is already marketing English-Arabic software packages to OEMs that wish to support Arabic, French or Urdu (Pakistani) on their systems.

Abdalla, who has several years of

experience as a marketing consultant in the Middle East, sees the Arabic market as mainframe-dominated and worth roughly \$1 billion. "Given bilingual systems at microcomputer prices, however, [the market] won't be less than \$5 billion by 1987," he predicts.

Computer users in the Middle East are almost exclusively large government and corporate organizations using English or French for data processing and often paying a premium for computer power. Abdalla cites a Middle Eastern airline that paid a West German system manufacturer \$160,000 for two stand-alone systems with only 8K bytes of main memory and two 256K-byte disk drives. He believes there is enough room in such a market for any supplier who can offer a system with Arabic capability and good price/performance.

Pioneer made its system bilingual rather than purely Arabic because, Abdalla explains, "the Arab businessman can't rely on any one language in the way one can rely on English in the United States. Many technical terms, for example, have no Arabic equivalents and appear in

English characters in the middle of a sentence. That is why we offer English and Arabic printing on the same line."

Abdalla knows of no other company offering an English-Arabic system, although a number of system and peripheral vendors support use of an Arabic character set. Not only do suppliers charge too much for that capability, claims Abdalla, but, quite frequently, they fail to offer readable Arabic characters. Arabic is written from right to left, and each of its 28 characters can be written three or four ways, depending on its position in a sentence.

Abdalla believes it is particularly important to offer Arabic on microcomputers to make the systems widely available for such applications as computer-aided training. Pioneer co-founder Ahmed is developing a speech-recognition module for Pioneer's system that will help teach people to read. "There is a significant shortage of trained teachers in the Arab world," Abdalla comments. "This technology can at least make those we do have more effective."

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The PA1000 provides low-cost IBM 3278/2 terminal emulation and coaxial connection to an IBM 3274/3276 cluster controller. Then, a single keystroke switches you back into the asynchronous world through an auxiliary RS-232-C port to access other computer systems, public information services or copy a screen to a printer.

Our microprocessor-based unit provides user-selectable rates up to 9600 baud, terminal keyboard configura-

tions, screen management and local or remote print functions. And, you can hook the PA1000 to a modem for remote dial-in access.

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VOICE TECHNOLOGY

WORKSHOP WORKSHOP WORKSHOP WORKSHOP WORKSHOP WORKSHOP
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VOICE APPLICATION

A WORKSHOP THAT BRIDGES THE GAP

Voice communication is viewed as the ultimate step toward simplifying the dialogue between man and machine. Although recent improvements in the cost and performance of voice technology make voice applications commercially feasible, the pace of implementation has been slow. Why? Achieving system integration was difficult and adequate development tools were lacking. As a result, voice seminars stressed theory, rather than practical application. Until now.

"IMPLEMENTING VOICE TECHNOLOGY"

LEARN BY DOING

Our "Implementing Voice Technology" workshop bridges the gap between theory and application. You'll not only hear about and see demonstrations of all the major voice technologies, you'll learn how to apply each of them.

The workshop is designed for OEMs and end users. Its results-oriented agenda enables system integrators, technical managers, and applications programmers to:

- Identify and plan applications for voice technology
- Evaluate and select voice I/O hardware
- Follow a carefully controlled, structured approach to voice I/O implementation
- Write voice I/O routines using a high level programming language designed specifically to ease application development
- Develop a voice application

DAY ONE: UNDERSTANDING VOICE TECHNOLOGIES, OPPORTUNITIES, AND TOOLS

Day one begins with an overview of voice and its benefits. All the major voice technologies will be demonstrated and discussed:

- Speaker Dependent Recognition
- Speaker Independent Recognition
- Speaker Verification
- Continuous Speech Recognition
- Voice Response
- Voice Store and Forward
- Vocoding

We will profile potential application areas, review voice hardware and software, and demonstrate typical applications. A workbook, users guide, 35 mm slides, and other learning aids reinforce all major concepts.

During this session you will learn Votan's Voice Application Development Language (VADL), a new, high level programming language optimized for controlling speech hardware. Supported by Votan's Voice Operating System, VADL provides an efficient vehicle for writing voice I/O software, without mastering the details of hardware and software handshaking.

DAY TWO: PLANNING AND IMPLEMENTING VOICE APPLICATIONS

We will step you through a tutorial using voice hardware, VADL, and the IBM Personal Computer. Participants will have all the tools needed to develop voice I/O software and, working at team workstations, will write and de-bug their own voice applications. Enrollment is limited so individualized instruction will be readily available.

This session also includes a structured planning process for implementing voice applications. This comprehensive planning program covers guidelines for developing applications and for selecting voice hardware.

ABOUT YOUR SPONSOR

"Implementing Voice Technology" is sponsored by Votan, a leading supplier of fully integrated, all-digital voice technology systems. Votan offers all the major voice technologies in multiple configurations on:

- Single channel, stand-alone voice terminals
- Multi-channel voice systems
- OEM and end-user voice boards

All Votan products are available with telephone interfacing capabilities and applications support. Since 1979 Votan has assisted customers in integrating voice software and hardware. Application engineers work closely with customers to help design, develop, and implement voice applications in a variety of vertical markets.

WORKSHOP DIRECTOR

Votan's Chief Scientist and Co-founder, Dr. Stephen Gill brings to the workshop more than 20 years of experience in scientific research and application. He developed the unique mathematical algorithm that is the heart of Votan's digital signal processing products. Dr. Gill holds patents in several areas and has authored numerous technical papers for professional journals.

Earlier, Dr. Gill worked at the Stanford Research Institute and received his Ph.D from Harvard University and BS degree from the Massachusetts Institute of Technology.

WORKSHOP INSTRUCTOR

Richard M. Melnicoff is Product Manager of Votan's full line of digital speech processing products. A knowledgeable and captivating speaker, he has led voice technology seminars at many industry conferences. Mr. Melnicoff's articles on both voice applications and technology have appeared in major trade publications.

Prior to Votan, Mr. Melnicoff was a consultant at Arthur D. Little, Inc., an international management and technology consulting firm. He earned his MBA degree at the University of Chicago and his BSEE at Cornell University.

COURSE OUTLINE

I. WHY USE DIGITAL SPEECH

A. Productivity Impact

1. busy eyes/busy hands
2. time critical data entry and retrieval
3. labor intensive data entry and retrieval
4. remote telephone processing

B. Economic

1. clerical cost reduction
2. improved service
3. data control and validity

C. Strategic

1. competitive differentiation
2. technology leadership
3. new products and markets

II. TECHNOLOGIES AND DEMONSTRATIONS

A. Voice Input

1. speaker dependent recognition
(discrete and continuous)
2. speaker independent recognition
3. speaker verification

B. Voice Output

1. compression versus synthesis
2. voice response
3. voice store and forward
4. vocoding

III. APPLICATIONS AND DEMONSTRATIONS

A. Generic Application Models

1. data entry and retrieval
2. remote transaction processing
3. messaging
4. equipment control
5. security

B. Finance And Banking

1. account activity and stock quotations
2. funds transfer
3. credit card verification

C. Manufacturing

1. factory floor data collection
2. shipping, receiving, inventory
3. CAD/CAM

D. Medical And Scientific

1. record management and forms processing
2. organ transplant exchange
3. instrument control

E. Retail And Merchandising

1. point of sale
2. catalogue sales
3. inventory control

F. Office

1. sales order entry
2. executive work station
3. voice mail

IV. USING VOICE HARDWARE

A. Voice Development System

B. Voice Terminals

C. Telephone Interface Facilities

D. Multi-channel Systems

E. Board Level Products

V. USING VOICE APPLICATION SOFTWARE

A. Overview Of Voice Operating System (VOS)

B. Voice Application Development Language (VADL)

1. VADL Compiler
2. Dialog Builder
3. Runtime Executive

VI. APPLICATION DEVELOPMENT WORKSHOP

A. Tutorial

B. Workshop

1. problem definition
2. write and debug VADL code on IBM Personal Computer and V5040 speech hardware
3. hands-on instruction and feedback

VII. VOICE IMPLEMENTATION PLANNING PROCESS

A. Define Objectives

B. Target Opportunity Areas

C. Define Application Requirements

1. profile users
2. profile tasks

D. Specify System Design Elements

1. single channel and multi-channel
2. technology mix
3. system host

E. Select Voice Hardware

1. performance
2. cost
3. ease of development
4. ease of use
5. product flexibility and completeness

F. Develop Software And Integrate Hardware

G. Implementation

H. Monitor Results

I. Select Migration Path

1984 SPRING SCHEDULE

ATLANTA, GA
April 17-18

CHICAGO, IL
April 11-12

DALLAS, TX
April 24-25

NEW YORK, NY
April 5-6

ORANGE COUNTY, CA
May 1-2

SAN JOSE, CA
March 20-21

You will be notified of the exact seminar location by mail.

WORKSHOP SPECIFICS

COST Cost per person for both days is \$600. Colleagues from your company may attend the same seminar for a fee of \$400 per person. The registration fee must accompany your registration form to assure confirmation.

CANCELLATION The registration fee is fully refundable up to five working days before the starting date of the seminar. To cover incurred expenses, a charge of 50% will be assessed for any cancellation or no-show after that date.

ACCOMMODATIONS Travel expenses, hotel charges, and meals, except lunch, are the responsibility of each participant. Lunch will be provided.

PREREQUISITES Although there are no specific prerequisites, participants familiar with computer programming concepts and terminology will gain the most from our workshop.

ON-SITE TRAINING For information about sponsoring this workshop for groups of 10 or more professionals within your organization, please contact the Workshop Registrar at (415) 490-7600.

YES, I WILL ATTEND on dates _____ in city _____

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() \$ _____ for _____ colleague(s) who will also attend

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Mini-Micro Interpreter

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

Digital PBXs enter the data-communications arena

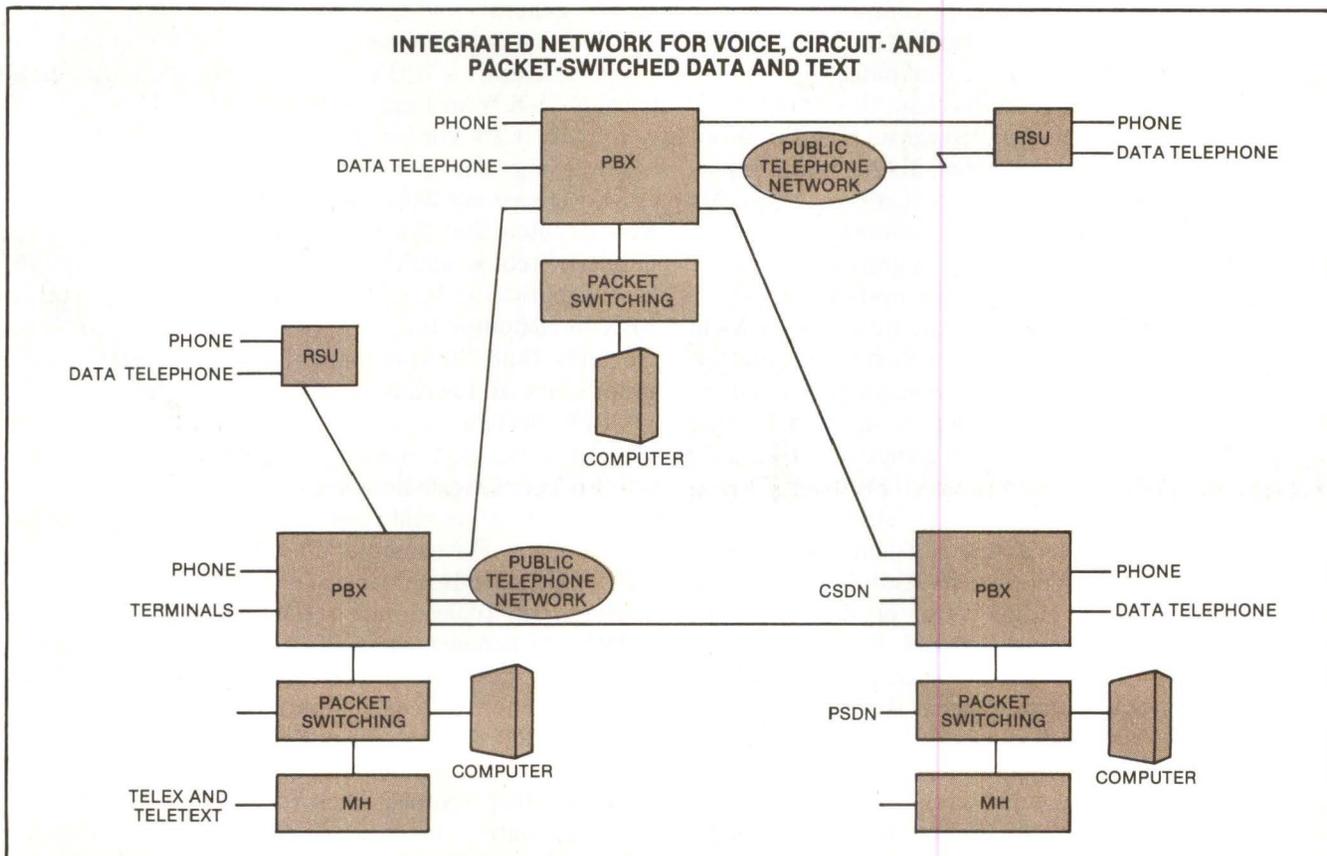
Keith Jones, European Editor

Faster than ever, the boundary between telecommunications and data communications is disappearing. Not only are both types of communication carried over the same media—from copper wire to radio waves bounced off satellites—but, increasingly, both use the same equipment for transmission and routing. One important piece of equipment in this category is the private automatic branch exchange (PABX or PBX), developed to switch telephone traffic within a building or a complex of buildings.

Formerly an analog device, the PBX has gone digital, anticipating the move to digital switching on public telephone networks. One of the advantages of digital

switching is that exchanges can be constructed entirely from integrated circuits, which are more compact and easier to maintain than the mechanical relays used in analog exchanges. Moreover, voice traffic transmitted in a bit stream and switched electronically sounds clearer because it is less vulnerable to interference than an analog waveform.

The technique for converting an analog signal to a digital signal, called pulse code modulation (PCM), involves sampling the analog waveform 8,000 times a second. To represent the waveform amplitude for each sample as a binary number, an 8-bit pulse is generated. Thus, the analog channel is converted to a 64K-bit-per-second (bps) digital channel. Lots of these 64K-bps channels can be squeezed onto the same physical circuit



In this network that integrates voice and data, several remote PBX systems are linked over leased digital telephone lines. Such a network might connect a company's buildings within one city, for example. RSU stands for an extension of the main PBX, called a remote-switching unit, PSDN is (public) packet-switched data network, CSDN is circuit-switched data network, and MH is a message handler for telex or teletext. (Source: Ericsson Information Systems A.B.)

The Interpreter

by time-division-multiplexing the 8-bit samples.

A bonus for computer users is that it is just as easy to transmit data as digitized voice traffic over the 64K-bps channels. In fact, it's easier because PCM is unnecessary. Computer users find themselves the beneficiaries, almost coincidentally, of a technology aimed primarily at telecommunications. The ability to handle data is such an attraction that most PBX vendors promote it as heavily as the voice features of their products.

Interfacing computers and PBXs is such an important issue that several leading PBX vendors and computer manufacturers have joined to support the computer-to-PBX interface (CPI) formulated by computer manufacturer Digital Equipment Corp. and PBX builder Northern Telecom Inc. CPI is primarily aimed at local communications. For long-distance data communications, PBX vendors point to their products' ability to handle the X.25 packet-switching protocol, a standard adopted by international telecommunications standards body International Consultative Committee of Telephone and Telegraph (CCITT in French). In another attempt to interface with computers, several PBX vendors offer interface cards that fit into the chassis of IBM Corp.'s Personal Computer.

Almost all PBX manufacturers claim they are looking at connections with local-area networks (LANs). Most manufacturers say that PBXs and LANs will complement each other rather than compete—with LANs handling very high-speed local connections—and that companies with several branches might use wide-area networks based on interlinked PBX systems.

Another event that will affect the future of PBXs is CCITT's October 1984 session, at which the committee is expected to adopt a worldwide transmission standard for voice and terminal attachments to digital switched networks. It will be one of a group of standards intended to define the Integrated Services Digital Network (ISDN), which will be offered by most common carriers in North America and Europe. The attachments standard will specify two 64K-bps channels for transmitting either voice or data and one 16K-bps channel for signaling and for transmitting low-speed data. The standard will facilitate the use of attachments such as data telephones that transmit both voice and data.

CCITT officials say they hope builders of telephone and data terminals worldwide will offer many products supporting the standard once it is official. At the same time, they acknowledge that standards for public-switched networks will continue to vary. The North American standard, established by AT&T and usually referred to as T1 Carrier, multiplexes 24 channels onto

one circuit. It also uses 8K bps of the 64K bps on each channel for signaling information, leaving only 56K bps for data or voice. In contrast, the European standard adopted by the Conference Européenne des Postes et Telegraphes (CEPT), the organization of common carriers, specifies 32 channels per circuit. Two are dedicated to signaling functions, and each of the remaining 30 provides a full 64K bps for voice or data.

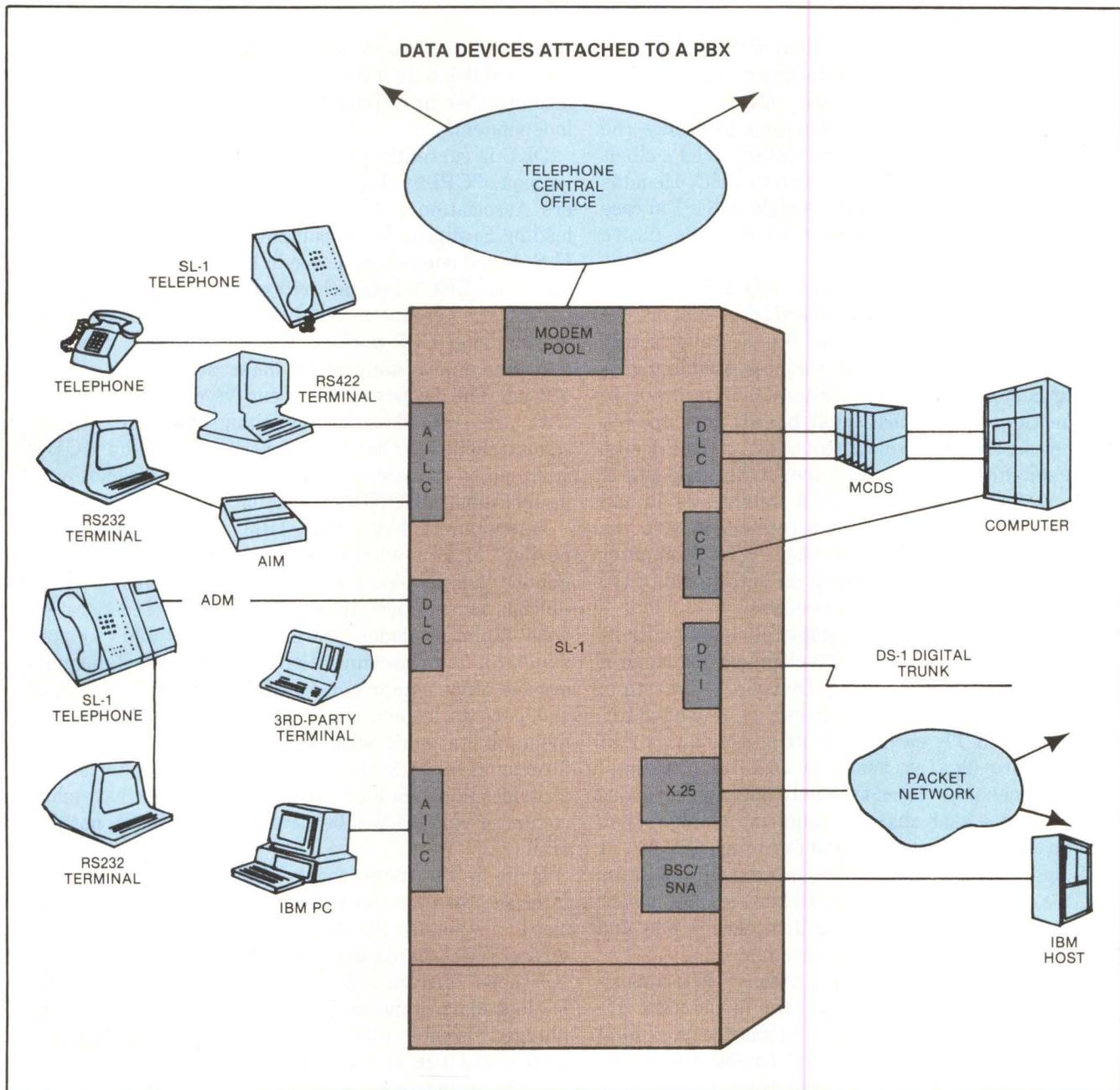
DEC claims its interface is a de facto standard

The CPI formulated by DEC and Northern Telecom is "well on the way to becoming an industry standard," say DEC officials. DEC claims that more than 30 companies have obtained licenses to build products supporting CPI since it was announced in July 1983. PBX builders that have declared their intention to support it include Rolm Corp., Mitel Corp. and Intecom Inc.; computer manufacturers include Hewlett-Packard Co. and Data General Corp. DEC's PBX program manager, Peter Janca, regards this cooperation between companies from two different industries as "a big breakthrough," a sentiment echoed by Bob Kelsch, acting general manager of the Northern Telecom division that sells the company's SL-1 PBX system.

While using a PBX to cut the costs of data transmission from local or remote terminals to a host computer, CPI conforms with the T1 standard by multiplexing 24 channels onto one 1.54M-bps circuit (1.54M bps equals 24-by-64K bps). Northern Telecom's Kelsch notes that T1 was selected because it is the public-switching standard in North America and this [the adoption of the T1 standard] facilitates remote PBX-to-computer links wherever they are necessary. He adds that T1 also found favor because it is not proprietary and because it provides a high bit rate.

CPI replaces as many as 24 one-for-one links between the PBX and host computer with a single standard twisted-pair telephone connection. However, one link per attachment is still needed on the terminal side of the interface. For example, if an SL-1 interfaces with a DEC VAX, each terminal still needs a separate line and a Northern Telecom unit, the add-on data module (ADM), to convert the RS232 signal to the protocol handled by the SL-1. But on the computer side of the interface, only one connection is needed instead of as many as 24 ADMs, formerly housed in Northern Telecom's multichannel data system (MCDS) that converts SL-1 protocol back to RS232. The interface also eliminates the data line card (DLC) devices otherwise needed to connect the SL-1 switching matrix to the MCDS.

The interface takes the form of a T1 line card that multiplexes as many as 24 channels onto one circuit and



Northern Telecom Inc.'s SL-1 PBX can interconnect a variety of data-communications and telecommunications devices, ranging from telephones to host computers. AILC stands for asynchronous interface line circuit, AIM is asynchronous interface module, DLC is data line card, ADM is add-on data module, MCDS is multichannel data system, CPI is computer-to-PBX interface, DTI is digital trunk interface (DS-1 is the North American digital transmission standard), X.25 is the international standard for packet switching, BSC is IBM's bisynchronous protocol, and SNA is IBM's System Network Architecture, which contains its network protocols.

generates T1 protocols. The computer manufacturer must provide cards for the host that can interpret the T1 protocol and de-multiplex the 24 channels into individual terminal links again. DEC has managed to incorporate these functions on two cards that replace multiple DMF 32 interface boards. DEC's Janca estimates that the cost of the PBX and host equipment

needed to connect 24 terminals can be reduced on the PBX-to-host side of the interface "by at least 50 percent" by using CPI. The normal cost is more than \$30,000.

Janca notes that DEC is prepared to license CPI to any manufacturer. The license will give perpetual permission to design, build and sell CPI-based products

The Interpreter

at no charge. The one major condition of the agreement is that the licensee must sign a document agreeing not to disclose information about the interface to third parties. Janca claims the condition aims to reduce the danger that CPI might be misinterpreted, albeit innocently, by a third party unknown to DEC. He adds that DEC also wants to protect its right to CPI in case it decides to patent the information in some future product.

Janca stresses that licensees get only the specification for CPI and not for the two boards that support the interface on DEC VAX systems. But he reveals that some semiconductor companies are interested in manufacturing custom integrated circuits that incorporate those functions of the DEC-built boards that are not host dependent. This development would reduce design and manufacturing costs for other CPI supporters. Janca now looks forward to cost reductions in the connections between terminal attachments and the PBX. "We have gotten rid of the PBX-to-computer black boxes. We are now working on getting rid of the terminal-to-PBX boxes," Janca declares.

Not all CPI supporters are completely happy with it. Wim Roelandts, research and development manager of HP's Information Networks Division, Cupertino, Calif., says that the interface wastes a lot of bandwidth. To conform with T1, each of the 24 channels in a CPI connection provides as much as 56K bps for data. However, Roelandts notes that only one asynchronous terminal can use each channel, requiring no more than 19.2K bps. Moreover, the signaling employed by T1 takes 1 bps from each 8-bps pulse, leaving only 7 bps for data. This means that each byte (8-bits) of data is split into two 4-bit sections, wasting 3 of each 7 bits and reducing the data-transmission speed.

DEC's Janca acknowledges this criticism is technically correct but claims it is irrelevant in practice. He points out that CPI is used primarily for local communications, so the waste of bandwidth is not costly. Janca reveals that DEC and Northern Telecom rejected the connection of more than one terminal per channel as a CPI feature because of the cost to PBX builders. To avoid "making trouble" for PBX manufacturers, the possibility of using all 8 bits by transferring signaling to a dedicated channel was also put to one side. DEC's European PBX program manager, Hervé Peterschmitt, explains that these problems apply only to character-oriented protocols and that synchronous transmission can make use of all 56K bps of the bandwidth. But he notes that the connection of synchronous devices using CPI is now only being "tested." Janca reveals that DEC and Northern

Telecom wanted to avoid time-consuming complications and establish a de facto standard quickly to keep many incompatible proprietary links from being developed independently.

DEC is currently pushing acceptance of a European version of CPI by the European Computer Manufacturers Association (ECMA). ECMA's members are the leading European-based computer companies and many U.S.-based companies active in Europe, including DEC and IBM. DEC's Peterschmitt claims that two-thirds of the ECMA general assembly supports the activities of an unofficial CPI working group. However, it would take unanimous support to make acceptance of CPI official. The proposed European version will conform with the CEPT public-switching standard. Peterschmitt believes that the adoption of CPI by ECMA will lead to its acceptance by CEPT and ultimately to its inclusion in CCITT's collection of ISDN standards.

Peterschmitt hints that IBM is "not a principal pusher" of CPI within ECMA, even though it has a minority shareholding in Rolm, a CPI supporter. IBM officials say no more than, "Part of IBM's cooperation with Rolm includes work to define and support standards for communications among central computers and office equipment, like PBXs, phones, terminals and personal computers." Rolm itself refuses to comment on its work with IBM, although Fred Oliver, director of business development in Rolm's international telecommunications division, remarks that many computer vendors will be strong in the market, not just IBM.

Rolm is far more eager to draw attention to its interface card for the IBM PC that fits into an empty slot in a standard PC chassis. Two other PBX vendors offering such cards are Mitel and Northern Telecom. Northern Telecom supplies a card that makes an IBM PC look like a standard RS422 terminal so that it can be plugged directly into an asynchronous interface line card (AILC) in an SL-1 system. Northern Telecom's Kelsch points to another interface that will be available early in 1984, which enables an IBM PC or any other personal computer to emulate an IBM 3270 terminal supporting either IBM's bisynchronous protocol or Systems Network Architecture (SNA).

Packet-switching capabilities

Several PBX vendors now offer devices that can packetize data for transmission over a packet-switched network employing the X.25 protocol for public data networks. They include Northern Telecom, Rolm, Ericsson Information Systems A.B. and NEC Corp. The Rolm product supports as many as 63 asynchro-

IF X.25 SOFTWARE IS THROWING YOU A CURVE,

CUT IT OUT.

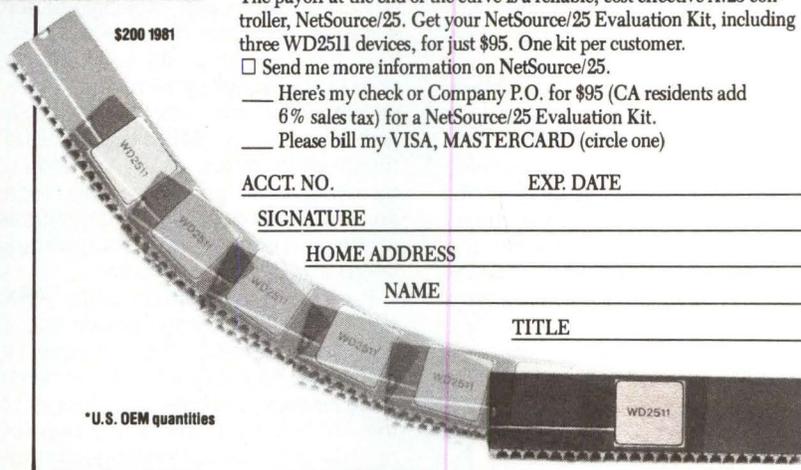
Designing an X.25 network interface has never been easier, or more cost effective. Western Digital's NetSource/25 Packet Switching Controller packs the CCITT X.25 LAPB protocol into a single VLSI device, the WD2511. So you can save years of software development and hardware integration.

Our aggressive new pricing means you save on component cost, too. As we've travelled along the experience curve, we've driven the price down to just \$35 each in large quantities. At that price, it just doesn't make sense to tackle X.25 yourself.

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nous serial terminals and provides access for four X.25 ports, one providing as many as 56K bps and the others 9.6K bps each. Each port can be linked to a local host computer operating in X.25 mode, to a public packet-switching data network such as Tymnet or Telenet or to a remote Rolm PBX via an X.25 link. The common description of the Rolm device is that it behaves like a packet assembler/disassembler (PAD).

But a PBX can do more than simply act as a PAD feeding an X.25 link. It can also operate as a packet-switching node when connected to PBXs at other remote sites. Rolf Mörlinger, product planning manager for Ericsson Information Systems, Tyreso, Sweden, sees users of his company's MD-110 PBX system establishing private, wide-area networks using leased digital telephone lines. (see diagram, Page 101). The physical medium for transmission could be standard two-pair telephone wires, a microwave link or a fiber-optic cable. Mörlinger explains that some of the 64K-bps channels in each digital line carry voice, while

others carry packet-switched data. The MD-110's data-communications processor (DCP) carries out the PAD function and then uses one of the reserved data channels to transmit to another MD-110 in the network. Mörlinger notes that packet switching significantly reduces the number of channels needed for high-speed data traffic between computers in the network. He believes that low-speed terminals can share a 64K-bps channel using simple multiplexer devices rather than packet switching. Such a device could be housed in a remote switching unit (RSU), which acts as a satellite PBX to an MD-110. In addition to running a private, packet-switched network, the DCP in an MD-110 can also provide message-handling functions, including mailbox facilities.

Plessey Office Systems Ltd., Nottingham, England, is promoting the concept of networks based on the integrated services PBX (ISPBX). It is a private version of the public services conforming to CCITT's ISDN standards. Alec Kingsmill, data product manag-

PBXs AND LOCAL-AREA NETWORKS

Most private automatic branch exchange (PABX or PBX) builders are delaying the introduction of gateways to local-area networks (LAN)s until LANs become more widely adopted. Another reason for the delay is uncertainty about which kind of LAN will predominate—the token-passing ring, in which a device's turn to communicate is determined by a "token" that passes around the network, or the Ethernet design, in which devices contend equally for a turn to communicate.

But at least one PBX builder has already decided which kind of LAN is most suitable for close integration with its product. Ztel Corp., North Andover, Mass., offers compatibility with the token-passing ring technology backed by IBM Corp. More observers expect the Institute of Electrical and Electronic Engineers (IEEE) to adopt the IBM specification as its standard for token-passing rings. If there are any differences, Ztel will follow IBM specifications rather than the IEEE's, says William Karavatos, Ztel vice president of marketing and sales.

Karavatos explains that Ztel favors connection with the token-passing LAN because its technology is more

"deterministic" than Ethernet's contention-bus approach, making it better suited to carry real-time voice traffic. IBM maintains that its LAN allows priority access for synchronous transmission requiring guaranteed bandwidth, such as 64K-bit-per-second (bps) voice traffic. A synchronous-bandwidth manager temporarily stops asynchronous operation and instructs stations transmitting synchronous information to communicate.

Karavatos notes that Ztel's PBX system, the PNX, can operate like a node in a token-passing ring network, as well as provide more conventional PBX functions. It takes advantage of the 4M-bps data rate of the ring for applications like transmitting information from "lots of terminals," Karavatos maintains.

CXC Corp., Irvine, Calif., claims that compatibility with IBM's token-passing ring is an important feature of its new product, the Rose. The Rose combines LAN and PBX technology, claims CXC. CXC's vice president of marketing and strategic planning, Bob Hawk, explains that units making up the Rose include the Teleterminal, a device that can transmit 64K bps of packet-switched data plus 128K bps

of mixed voice and circuit-switched data. As many as 92 Teleterminals can plug into any of the 64 nodes in a complex LAN that forms the main transmission medium of the Rose. This portion of the Rose consists of two LANs. One is a broadband ring LAN and the other is an Ethernet contention LAN, forming a physical ring but a logical bus.

The Ethernet handles packet data, while the ring carries mixed voice and data. The 50M-bps bandwidth of the broadband ring is controlled by an RF modem. The bandwidth includes a 16M-bps portion that carries four 4M-bps channels, each with the same capacity as the IBM token-passing ring.

Each Teleterminal can support one or two attached devices, such as personal computers. Each node incorporates a chip-based device designed to assign bandwidth dynamically, preventing relatively low-speed data transmissions from wasting capacity. The bandwidth can be divided into chunks as small as 8K bps. Hawk says that the Rose is currently being beta-tested and that volume shipment will start in June 1984.

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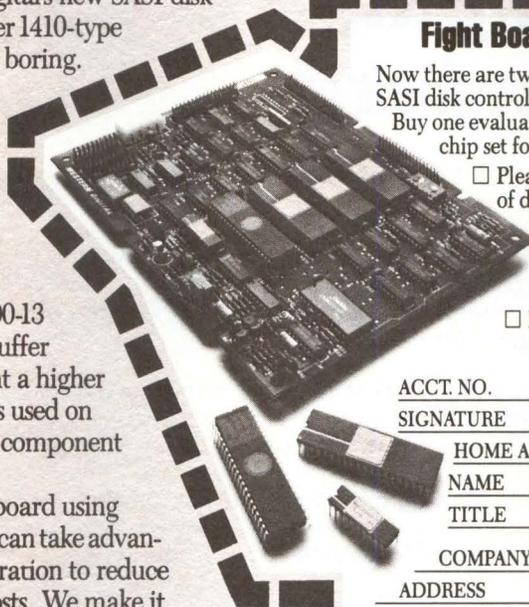
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er for Plessey, explains that ISPBX employs the digital private networking signaling system (DPNSS), which has many protocol elements similar to CCITT signaling system Number 7, a key feature of the CEPT version of ISDN. But DPNSS is enhanced to give "full cross-network functionality that private networks cannot offer," Kingsmill remarks. He notes that these added features include services that cannot be invoked on the public network because of unresolved tariffs.

In the voice areas, these services include "ring back when free," which enables the party being called to pay for the call. In the data environment, it means that resources can be positioned anywhere in the network, without users having to worry about the costs of services. He explains that DPNSS is designed to gain maximum use of inter-PBX channels by holding a connection for the shortest possible time. A message is passed from a PBX to the adjacent PBX, which either acts on that message or passes it to the next PBX.

Kingsmill notes that the overall goal is to achieve open systems interconnection (OSI), in which devices and components of applications can interconnect regardless of the underlying telecommunications characteristics. Pointing to the development of the seven-layer OSI model developed by the International Standards Organization (ISO), Kingsmill sees ISPBX fitting alongside ISDN in the hierarchy.

Plessey builds an all-digital PBX called the iDX, which is being tailored for the U.S. market by Stromberg Carlson, Lake Mary, Fla. The iDX is already a major product in Britain, says Kingsmill. He adds that customers there are starting to implement DPNSS networks using leased lines. He states that British telecommunications common carrier British Telecom is "encouraging" the adoption of DPNSS and that there are plans to present it as a proposed standard to CEPT. □

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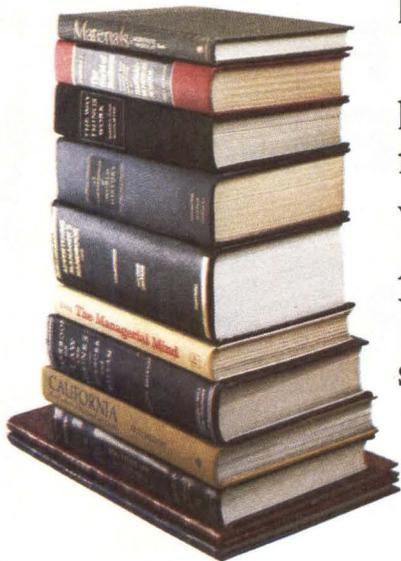
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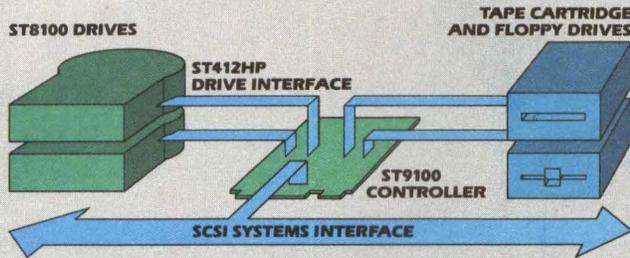
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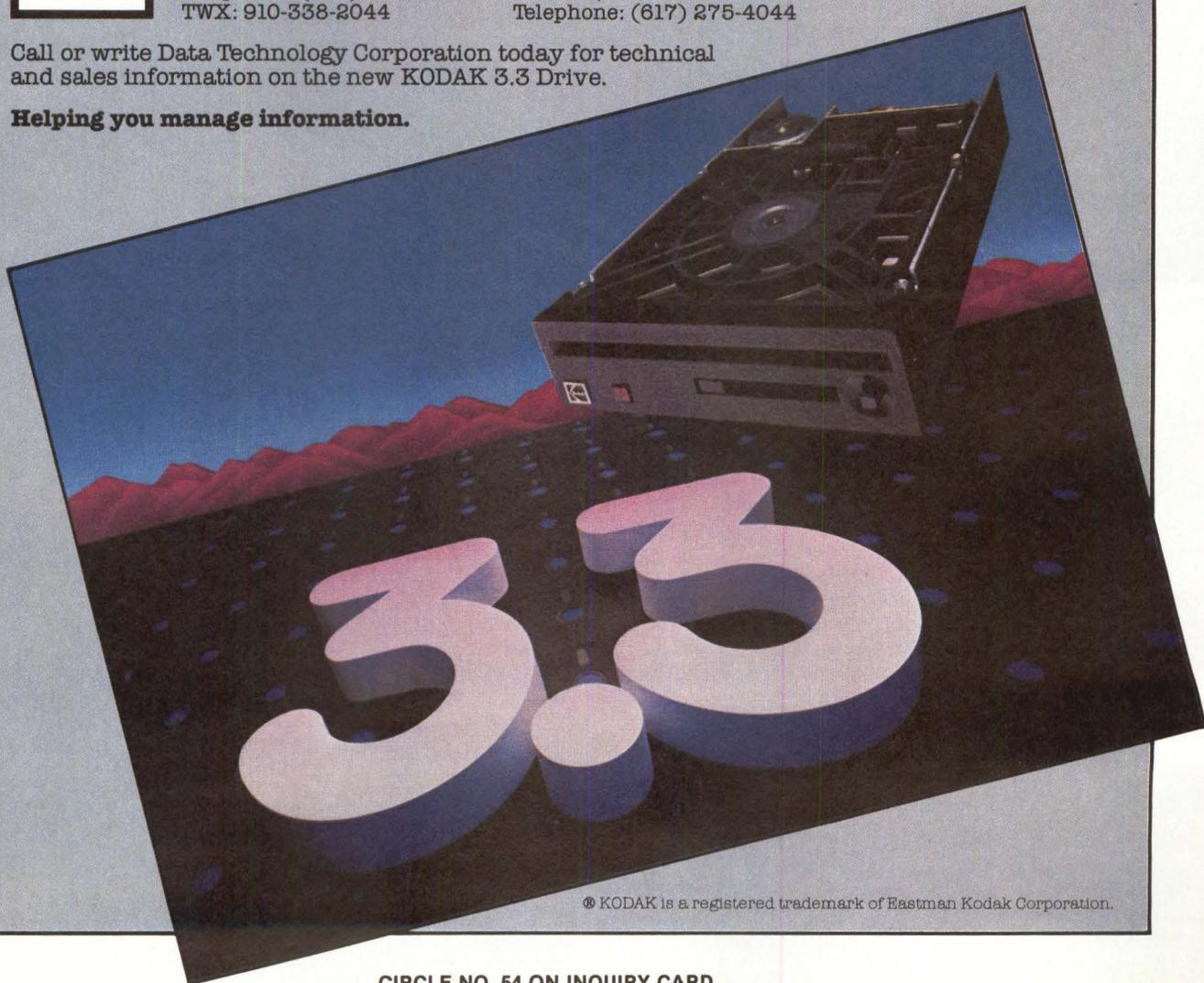
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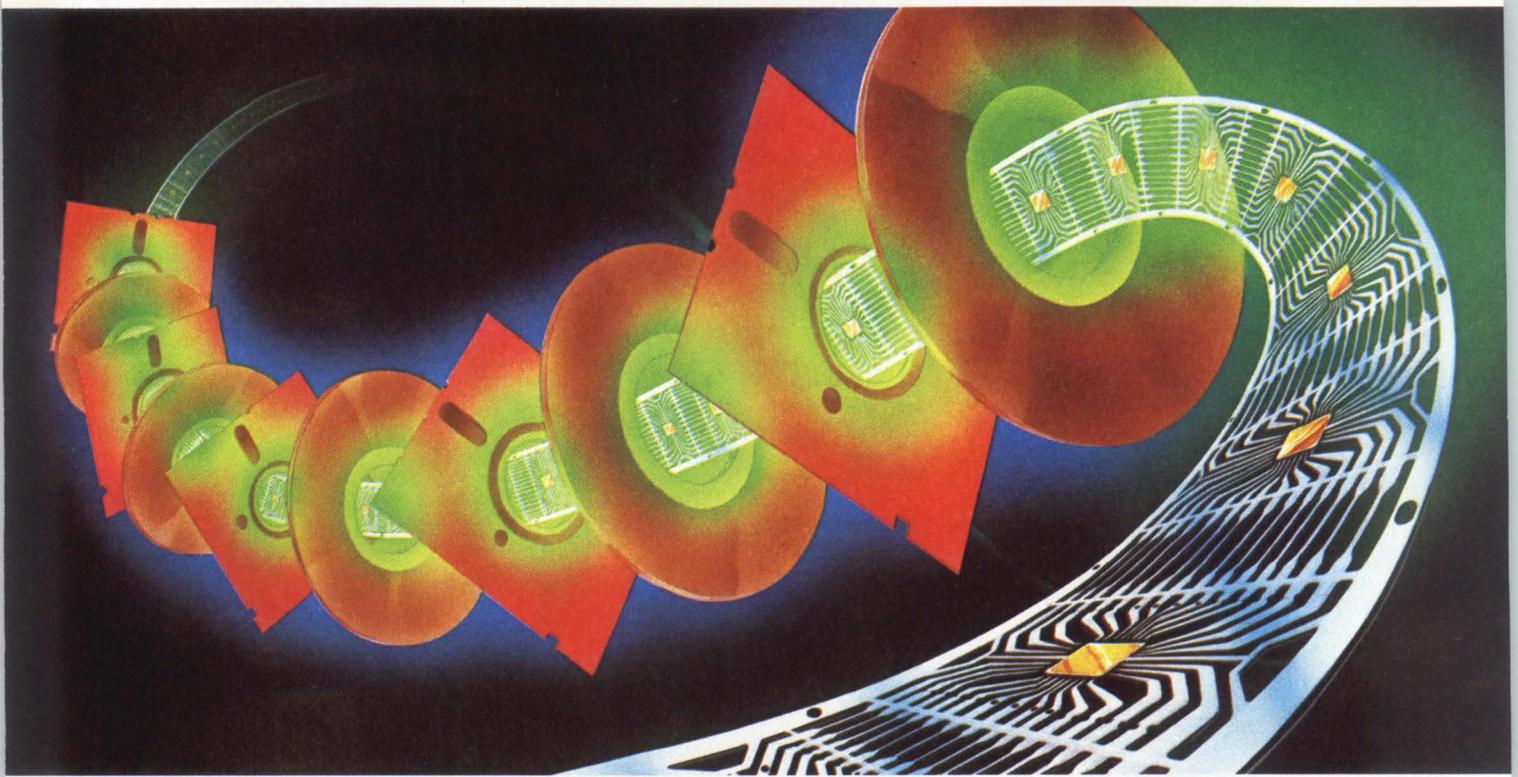
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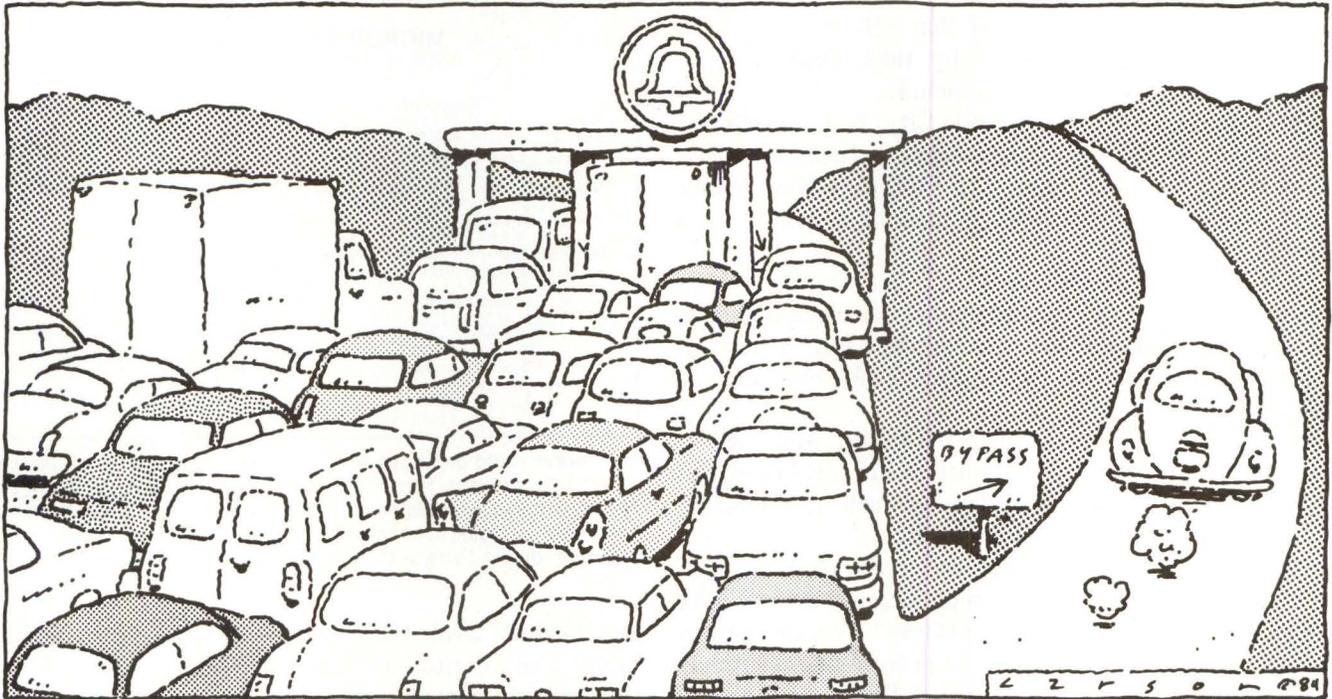


Illustration by Jim Carson

Bypassing local telephone lines— a growing option for data communications

Stephen J. Shaw, Washington Editor

For highway travelers, the word "bypass" indicates a time-saving shortcut around congested routes. For those using the newly deregulated U.S. telephone network, bypassing provides a money-saving way around the local telephone company. In the wake of American Telephone & Telegraph Co.'s Jan. 1 divestiture of local telephone companies and accompanying increases in local phone charges, more communications common carriers and large telephone users are looking for—and finding—new routes for their voice and data traffic.

The court-ordered breakup of AT&T's telephone monopoly is the most vivid recent example of a growing trend toward alternative, often private, communications networks. The Federal Communications Commission (FCC) provided much of the impetus for this change. The commission has spent nearly a decade deregulating the telecommunications industry in the belief that competitive market forces can provide better, less expensive communications services than can government regulation. The development of a potpourri of new communications technologies that

could revamp the institutional relationships in the telecommunications and computer industries abetted the FCC's activities. Digital microwave radio, communications satellites, cable television, optical fiber, teleports, cellular telephone and other mobile radio systems have emerged in powerful combinations to challenge the venerable twisted-pair copper telephone wire for local and long-distance telecommunications.

"In its most general sense, 'bypass' has meant the use of communications facilities or services (video, voice or data) which go around the local telephone exchanges of the public switched network," states a 1983 report prepared by the FCC's Common Carrier Bureau as part of an extensive investigation into the market structure of telephone services. The New York Telephone Co. defines "bypass" as "any arrangement a customer uses to avoid or reduce Bell Operating Co.-provided access services."

The potential movement of revenue to the various bypass services from local telephone companies' copper-wire facilities is huge. Jerome Lucas, president of telecommunications consulting company Telestrategies

The Interpreter

Inc., McLean, Va., estimates that \$10 billion will be diverted to bypass networks by 1992. Organizations engaged in bypass operations include:

- Intelplex Corp., an Atlantic City, N.J., reseller of toll services that uses a microwave network to serve approximately 1,000 users. The FCC says New Jersey Bell projected losses of \$7 million to \$10 million to Intelplex last year.

- MCI Communications Corp., Washington, which uses a microwave network to bypass Southern Bell local facilities in Miami and interconnect MCI inter-exchange switches. Revenue loss by Southern Bell is estimated at \$42,000 per year.

- Martin Marietta Corp., Bethesda, Md., which interconnects two company locations in Florida through a private fiber-optic link. The network is displacing \$500,000 annually from Southern Bell.

- Federal Telephone System, a government-wide telephone network that is employing digital satellite circuits supplied by RCA American Communications Corp., Princeton, N.J., for a private-line switched network between Seattle and San Francisco. Loss of revenue for Pacific Northwest Bell is estimated at \$1.5 million per year.

- Tektronix Inc., Beaverton, Wash., which uses a private microwave system to link company plants in Oregon and Washington for voice and data communications. Pacific Northwest Bell stands to lose \$800,000 annually.

Prime candidates for bypass networks, states Louis Feldner, a public utilities specialist with the FCC's Common Carrier Bureau and author of the commission's bypass study, are industries requiring high-speed data communications, including Fortune 500 financial organizations, manufacturers and distributors; aerospace companies; state and federal government organizations; and large academic institutions. Although revenues from data-communications services are small compared with revenues from voice communications—\$55 billion for voice compared with \$4.5 billion for data in 1981, according to a Bell Laboratories estimate—the data-communications market is expected to grow at an annual rate of 20 percent to 30 percent through 1990. The rapid introduction of minicomputer and microcomputer systems for business and personal use is spurring this growth. International Data Corp., a Framingham, Mass., market research organization, predicts the number of installed computer terminals will reach 19.1 million in 1986, up from 6.9 million in 1981.

The vulnerability of local telephone operations to bypass technologies stems in part from the technical

MICROWAVE GROWTH

(Millions of constant 1980 dollars)

Segment	1980	1982	1985	1990
Bell System (including Western Electric Production)	12.5	21	29	85
Independent telephone companies	35.0	42	55	85
Private and industrial	8.0	12	20	35
Satellite common carriers and specialized common carriers	5.0	26*	47*	30*
Total: United States	60.5	101	151	235
Total: Canada	18.0	29	40	65
Total: U.S. and Canada	78.5	130	191	300

*Including 10 GHz

Source: International Resource Development

Microwave radio technology is the leading contender in the market to provide services that will bypass local telephone exchanges. Recent events that strengthen the position of microwave offerings are advances in digital technology and new allocations of frequency spectrum by the Federal Communications Commission.

inability of local telephone wire plants to handle high-speed, digital data transmissions. Conventional twisted-pair copper wire is prevalent throughout the local telephone network. Designed primarily for analog voice transmission, it has a 4,000-Hz frequency bandwidth. For data communications, the bandwidth can accommodate 4,800 bits per second (bps). As many as 9,600 bps can be transmitted with slight degradation and bypass of the telephone switch at the local exchange. Through improved electronics and installation of wiring with increased bandwidth, local telephone companies are becoming better equipped to carry data at 56K and even 1.544M bps. But such services are expensive, and installing facilities for customized networks can take as long as a year.

"Less than 10 percent of local operating companies' revenues come from data," comments Wendell Bailey, vice president for science and technology with the National Cable Television Association (NCTA). "They have to optimize [their plants] for voice."

The FCC regulates, and Congress legislates

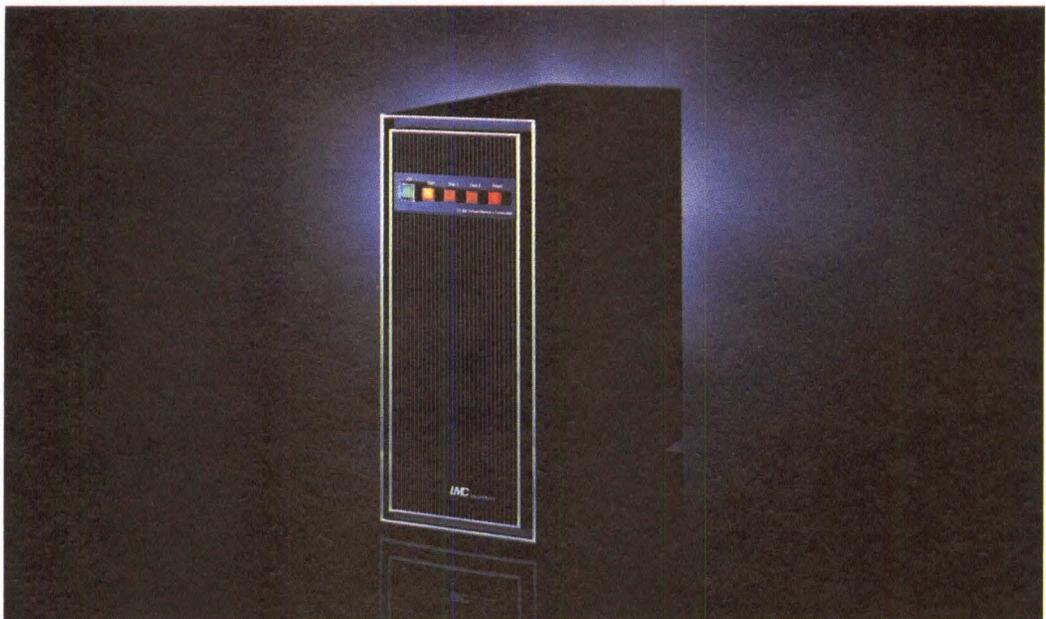
Prompted by concerns about the integrity of local telephone service in the face of bypass threats, the FCC and the U.S. House of Representatives Subcommittee on Telecommunications, Consumer Protection and Finance continue to squabble over how local service will be subsidized in the post-divestiture telephone environment. The FCC plans to replace the massive subsidies from long-distance charges that underwrite local service with flat charges levied on consumers and businesses, ranging from \$2 to \$6 monthly per line. The fee was scheduled to take effect on Jan. 1 but was

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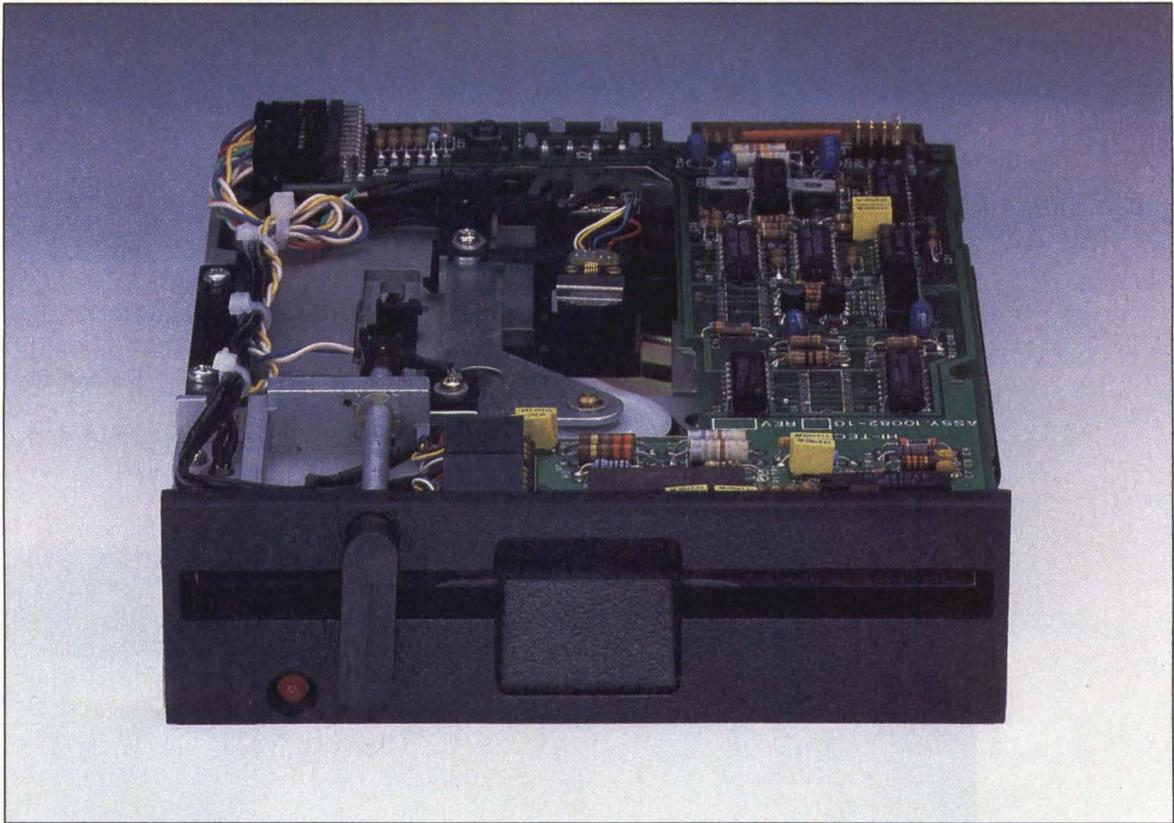
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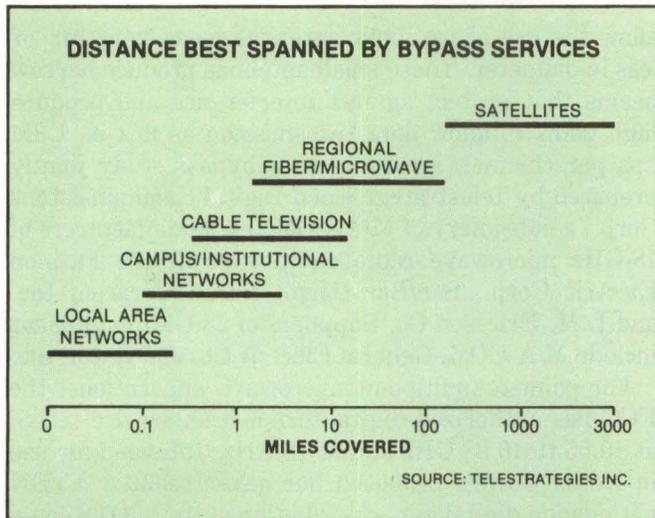
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The efficiency of different types of bypass services varies with the distance spanned by a communication network. At one extreme, local area networks aren't able to span more than a few miles; at the other, satellite-based networks become efficient only when a network covers at least 700 miles, say most experts.

delayed until April 3 to allow the commission more time to study the more than 200,000 pages of proposed tariff changes submitted by AT&T and local telephone companies. The access charge would be imposed for access to inter-exchange long-distance services and would be paid whether or not long-distance services were used.

The FCC developed the access fee to pressure the telephone companies to start basing tariffs on cost, when justified. Traditionally, charges for exchange facilities have been based on levels of usage, despite the fact that costs of most exchange components are not sensitive to the levels of traffic that pass through them.

"The growing tendency of large users of interstate services to bypass exchange facilities to avoid traditional usage-based charges for use of these facilities is threatening the efficiency and continued viability of the public network," testified FCC chairman Mark Fowler at hearings before the House Committee on Government Operations. Fowler also sees a difference between "uneconomic" and "economic" bypass services. In uneconomic bypass, a supplier can provide selected customers access to inter-exchange facilities at a lower price than the local operating company can, even though the supplier's costs are higher. Regulation pushes the operating company's access charges higher than its cost. In contrast, economic bypass costs less than an operating company's cost.

Therefore, Fowler notes, some bypass systems were constructed even though their costs exceeded those of the local telephone company. He testified that it makes

little sense to maintain rate-making policies that create artificial incentives for bypass when bypass is not the least expensive way to transmit information.

Large users represent a significant percentage of revenues under the usage-based tariff system of local telephone companies. Telestrategies' Lucas says 1 percent of business customers account for 40 percent of operating companies' business revenues; 10 percent account for 75 percent.

"The net result [of large users moving to bypass facilities] will be that remaining subscribers, including residential and small business subscribers, will be forced to make up the difference and be stuck with higher costs per line for exchange plant," FCC chairman Fowler predicts.

When it comes to telephone access charges, the outlook of the U.S. Senate and House differs markedly from the FCC's. Two pieces of politically-motivated legislation—S.R.1660 in the Senate and H.R.4102 in the House—would significantly modify the FCC's access charge order. Government-mandated increases in local telephone charges, expected to rise dramatically following divestiture, will be unpopular with any segment of the telephone-user population.

The Senate bill delays imposition of access charges for two years. The House version eliminates access charges for residential subscribers of telephone exchange services. Business customers who use local telephone company facilities to access long-distance services would pay an access fee of \$6 monthly per line. However, if they employ one or more of the various bypass technologies, they would pay \$25 monthly per line to compensate the local telephone company for the lost revenue. If bypass is employed and access to local telephone facilities is maintained as backup, subscribers would be charged \$2.50 per line per month, or 10 percent of the revenues diverted to the bypass lines. Both bills call for imposition of a \$100,000 fine if a business using bypass technology is caught not paying the access surcharge. The FCC would enforce the provision.

"We want to encourage the development of new technologies; at the same time, we don't want to create incentives to bypass the local operating companies," comments a staff aide for the House Telecommunications Subcommittee, which is chaired by Rep. Timothy Wirth (D-Colo.), the chief House architect of the plan.

Not surprisingly, the FCC has vehemently argued against both proposals, calling them "unworkable, unenforceable and possibly illegal." Of particular concern is the surcharge to be imposed on bypassers as outlined in the House bill. Since telephone service

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represents a contractual relationship between users and service providers, legal questions are raised regarding the imposition of access fees on those who have not contracted for service. Even if such a surcharge is legal, says the FCC, "such a fee will raise mammoth problems concerning legal authority, identification and implementation."

The 'bypass express' won't be derailed

Regardless of the outcome of the spat between Capitol Hill and the FCC, development and refinement of bypass technologies will continue unabated. The various communications technologies and systems will increasingly affect, either singly or in combination, the planning and economics of both voice and data communications. The "bypass express," comments one communications industry observer, will not easily be derailed.

Topping all lists as the leading technology contender for alternate communications systems is microwave transmission. The relative maturity of the technology, advances in digital-communications equipment and additional allocation by the FCC of frequency spectrum for transmission have made microwave systems readily available for use in private communications networks.

"Private microwave is the number one threat to local operating companies and the number one source of bypass today," comments John Borden, a telecommunications analyst with the market research company The Yankee Group, Boston.

Borden estimates that 650 microwave systems will be shipped this year for use in private short-haul networks, compared with 500 units last year. The networks operate at 18 or 23 GHz. Additional portions of the spectrum are available for microwave transmission at 2, 4, 6 and 11 GHz, but these frequencies are congested with users, primarily long-distance communications carriers such as AT&T and Western Union Telegraph Co. Microwave systems can also use the 12-GHz band, but the FCC may soon allocate this portion of the spectrum to direct-broadcast satellite systems.

International Resource and Development (IRD) Inc., Norwalk, Conn., a market research and consulting organization, estimates that the market for microwave equipment in the United States will total \$151 million in 1985. Independent telephone companies—those never affiliated with the Bell System—will account for \$55 million, followed by satellite and specialized carriers, which will account for \$47 million, according to IRD.

Most of the growth is likely to occur for systems operating at 18 and 23 GHz because these frequencies

allow the use of parabolic antennas measuring 1m. or less in diameter. These small antennas produce narrow beams that protect against interference and produce high gains to allow data transmission as fast as 1.8M bps per channel, according to a bypass study jointly prepared by Telestrategies and Digital Communications Corp., a subsidiary of M/A-COM Inc. Manufacturers of 18-GHz microwave radio equipment include Farinon Electric Corp., San/Bar Corp., Local Terracom Inc. and L.M. Ericsson Co. Suppliers of 23-GHz equipment include M/A-COM, General Electric Co. and Racon Inc.

For point-to-multipoint microwave applications, the FCC has authorized digital-termination service (DTS) at 10.55 to 10.88 GHz and at 18 GHz. Intended for use in Xerox Corp.'s proposed but never realized XTEN nationwide digital data-distribution system, DTS could be an effective alternative to in-ground distribution systems. The FCC has authorized a variety of DTS systems including those planned by ISA Communications Services Inc., Contemporary Communications Corp. and Satellite Business Systems for local communications distribution using digital broadcast microwave radios on rooftops in urban areas.

MCI has received authorization to construct DTS systems in 41 cities and has completed installations in Chicago, Dallas and Washington. MCI's planned communications network includes cellular-radio telephone systems, long-haul microwave and fiber-optic links, local-switch fiber-optic links, local switch facilities and a 24-transponder satellite capacity acquired on the Hughes Communications Inc. Galaxy system. With this network, MCI will be well-positioned to compete on an end-to-end basis with any combination of current or former Bell System companies. "We'll have the flexibility to address new markets as they appear," predicts Brian Thompson, MCI senior vice president for corporate development.

CATV proves to be a sleeper

In the long run, facilities for community-access television (CATV), the formal name for cable TV, could well prove the most significant threat to local telephone companies, predicts the FCC's Feldner. Franchise agreements between local jurisdictions and CATV companies often specify two-way capabilities and a second cable network to interconnect businesses, educational institutions and government agencies. The large bandwidth available on a coaxial cable—as large as 600 MHz—provides a big advantage over twisted-pair wire for high-speed data communications.

Nine cable systems offer operational or experimental data-transmission services, and others plan similar

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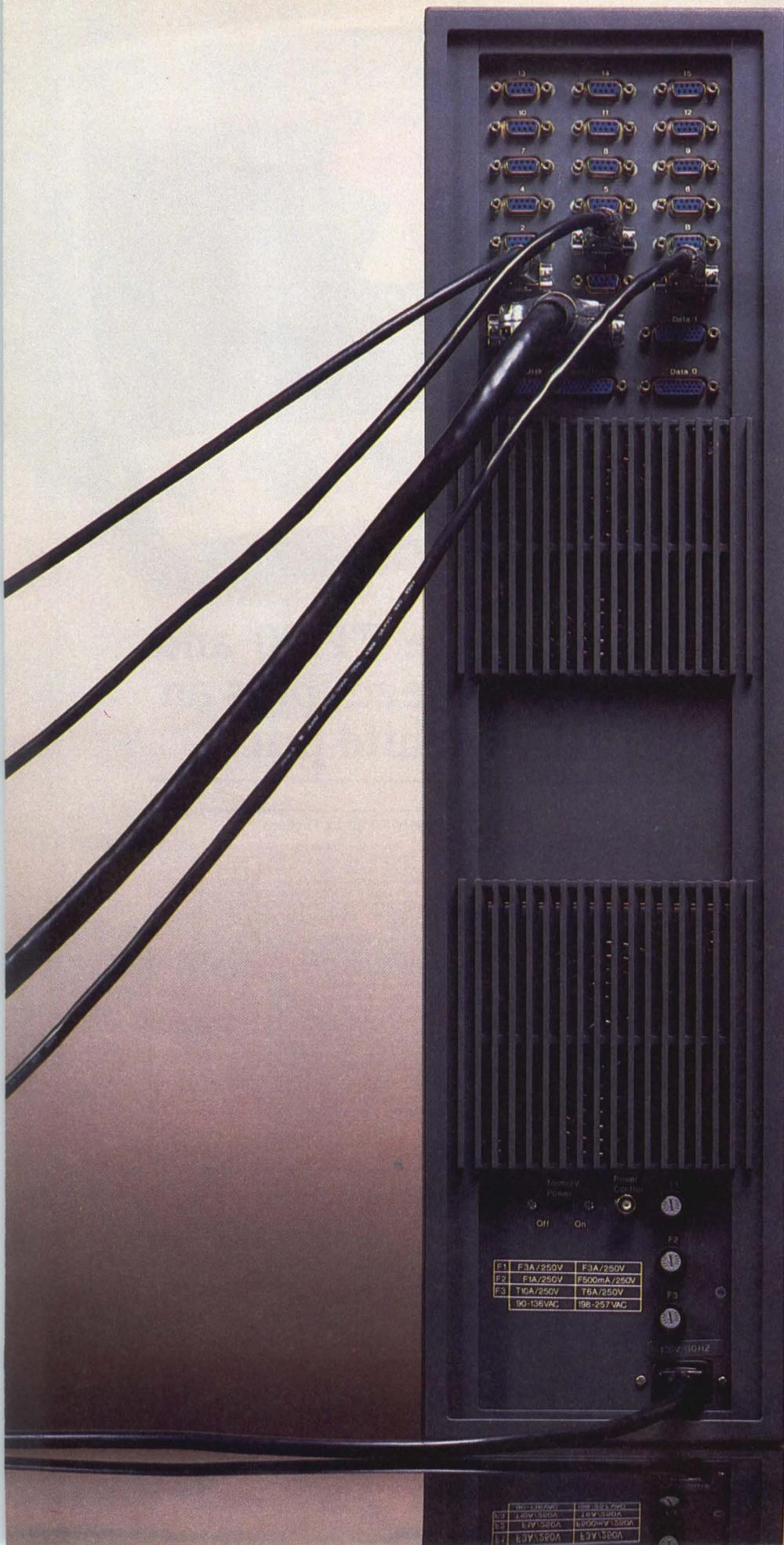
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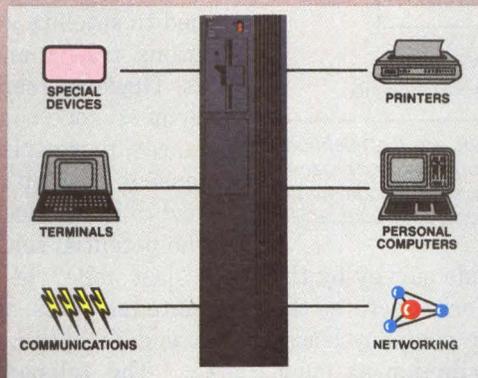
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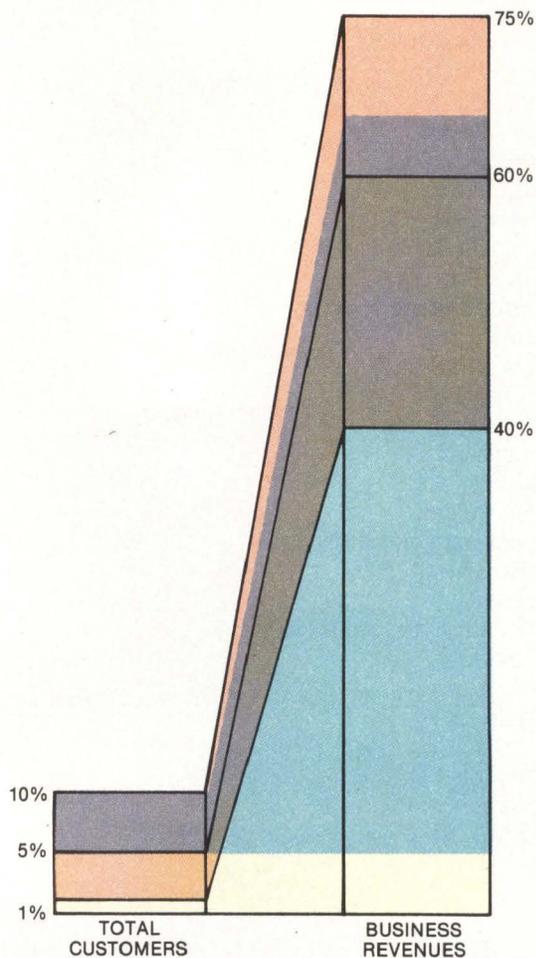
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A FEW CUSTOMERS OF LOCAL OPERATING COMPANIES SUPPLY MOST REVENUES



The prime candidates to use bypass services are the telephone company's biggest corporate customers. Although these companies make up a small percentage of total customers, they account for the greatest amount of revenues to local telephone operating companies.

offerings, according to an industry-wide survey by the NCTA. Manhattan Cable Co., New York, operates the most sophisticated data network. The company leases circuits to users for local data distribution at much lower rates—\$160 per month for a 9.6K-bps circuit—than the \$526 per month charged by New York Telephone for its digital data service (DDS). For 56K-bps service, Manhattan Cable's charge is \$490 a month; the telephone company's is \$1,300.

"There's lots of spectrum available and a lot of nooks and crannies to place data on cable even where it's saturated with video signal," says the NCTA's Bailey. Although Bailey believes CATV's ability to tailor data networks for customers will siphon data traffic from the

digital service offerings of local telephone companies, he maintains that the overall amount of data transmission will remain small for several reasons. First, CATV transmission equipment is best for sending video signals, which can tolerate levels of impulse noise that would render data traffic unintelligible. Second, most CATV system operators lack data-communications experience. Until the market for video entertainment is saturated, system operators are not going to devote much effort to local data distribution, Bailey says. Finally, he points out that approximately 55 percent of the nation's 5,000 cable systems are limited to 21 channels, all of which are occupied with video entertainment programming.

Satellite networks spawn the teleport concept

Two companies dominate the market for end-to-end satellite networks that transmit voice, video and data among widely scattered customer locations. One is Satellite Business Systems (SBS), McLean, Va., a joint venture of Comsat General Corp., Aetna Life Assurance Co. and IBM Corp., and the other is American Satellite Corp., Rockville, Md., owned by Continental Telecom Inc. and Fairchild Industries Inc. SBS has approximately 140 earth stations installed that carry digital transmissions at 2.4K to 6.3M bps. American Satellite also has approximately 140 earth stations serving government and commercial customers.

Their customers and those of a variety of smaller specialized carriers such as Equatorial Communications Inc. and Cylix Communications Network Inc. turned to satellite networks to integrate their communications traffic and cut escalating communications costs. However, satellites are useful only in networks that must cover more than 700 miles; for shorter distances, terrestrially based networks are usually less expensive. In addition, satellite users face the question of how to handle local information distribution.

One potential solution to the problem of distributing the "last mile" of satellite transmissions is to use satellite teleports, an aggregation of satellite transmission and reception facilities near large metropolitan areas. The teleports have private local-distribution links into a city to connect satellite earth stations with end users.

The FCC's Feldner says as many as 16 teleports have been proposed in cities nationwide. The most developed teleport concept has been advanced by a consortium comprising the Port Authority of New York and New Jersey, investment brokerage company Merrill Lynch Pierce Fenner and Smith Inc. and Western Union Telegraph Co. Plans call for as many as 32 earth stations to be installed on Staten Island, N. Y., linked to

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customers in Manhattan by a fiber-optic cable by 1987.

Additional teleports are planned in Chicago, Boston, New York, Portland, Ore., and Columbus, Ohio. Real estate developers and communications organizations are interested in investing in teleports, says Feldner, because they represent an opportunity to develop land near large cities. "Teleports will be an important force for bypass applications because they bring together users on a large scale and create an important critical mass of know-how that individual users don't have," he says.

In addition to playing a key role in combination with other communications technologies for bypass, fiber-optic technology itself is emerging as a challenge to twisted-pair wires for local and trunked distribution of integrated voice, video and data communications. The FCC has recently approved five non-AT&T applications to use fiber optics in interstate communications for private and public uses. Like coaxial cable, fiber-optic cable offers large bandwidth and high data speeds.

The FCC authorized MCI to construct a 225-mile fiber-optic link between New York and Washington for use in MCI's backbone trunk network. The commission also gave the go-ahead to a joint venture between railroad company CSX Corp., Richmond, Va., and Southern New England Telephone Co. to install 24 pairs of fiber-optic cable between Miami and Jacksonville, Fla. GTE Sprint Communication Corp., McLean, Va., has begun installing a 29-mile fiber-optic link between Anaheim, Calif., and Los Angeles. Microtel Corp. has obtained FCC approval for a fiber-optic link for a voice- and data-communications network that will use the Florida East Coast Railway rights-of-way along the Southern Florida coast.

Start-up Institutional Communications Co. (ICC), Washington, expects to begin service with a five-trunk fiber-optic network early next year. ICC plans to install the links to connect Washington, Baltimore and Maryland suburban municipalities, where potential customers maintain corporate offices. "We've targeted bypass as our business. Our main thrust will be to provide a direct connection, via fiber, from our customers' premises to inter-exchange switches," says ICC president Arthur Barber.

Mobile radio services offer another alternative

Less significant bypass technologies are those used for mobile radio, including services provided by radio common carriers for one-way alphanumeric services, specialized mobile radio (SMR) services and nationwide satellite-interconnection paging offerings. The most promising mobile service is cellular telephone that

offers greatly expanded over-the-air channel capacity through the reuse of frequencies in geographically separate "cells."

The FCC has allocated 40 MHz for cellular services, with 20-MHz allotments going to wire-line companies and 20 MHz going to non-wire-line companies in each market. AT&T subsidiary the Advanced Mobile Phone Service (AMPS) Co. has had a demonstration cellular system in place in Chicago for two years, and other cellular systems are expected to begin service this year.

Cellular phone service will relieve a pent-up demand for mobile telephone services, says Telestrategies' Lucas. Only 2.5 MHz of bandwidth is now available for SMR services, he says, which meets the requirements for a miniscule 0.1 percent of the 160 million automobiles on the road. Bypass opportunities will come, Lucas predicts, when mass-production economies push prices for rental and a reasonable amount of measured service below \$100 per month to compete with residential and business wire-line charges.

Telephone companies play catch-up

Telephone operating companies are not likely to sit idly by as competing bypass suppliers strip them of their most lucrative business bases. The operating companies are busily exploring the same technology options as their bypass competitors. Local facilities are being upgraded, fiber-optic links will slowly find their way into local telephone plants, and more broadband coaxial cable to handle faster data transmission will appear, Lucas says. He predicts that the local operating companies will capture 70 percent of the estimated \$10 billion in revenues to be spent for bypass technologies by 1992. "The local operating companies will petition the court to be allowed back into the market for inter-exchange services within their regions as well," Lucas maintains.

The biggest potential bypasser of them all, AT&T Communications, plans to connect its inter-exchange switching facilities directly to customer premises. The long-distance service provider has filed tariffs for customer-premise earth stations using the AT&T Comstar and Telstar satellite systems. And AT&T is fine-tuning its tariffs to lease satellite transponders directly to customers and to offer end-to-end digital-communications services at 1.544M bps.

The single communications highway that was the hallmark of the Bell System has splintered into a maze of overlapping avenues, expressways and, sometimes, dead ends. For the hardy traveler with a sure sense of his destination, bypass could offer the shortest, most economical route for communications traffic. □

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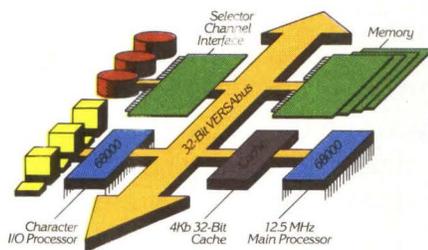


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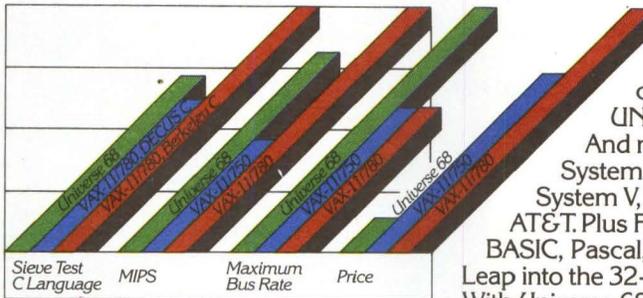
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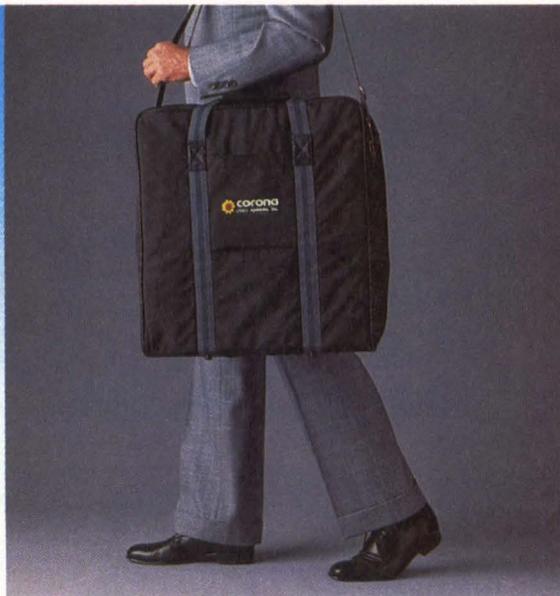
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Micro software industry faces clogged distribution channels

Jeffrey Tarter, Contributing Correspondent

Three or four years ago, microcomputer software publishing was a cottage industry that served a market composed chiefly of hobbyists. From this ragtag beginning, though, software publishing has expanded with almost explosive force. Total sales of microcomputer software in 1983 reached \$1 billion, and most market researchers predict a growth rate of at least 50 percent a year to \$5 billion by 1987.

In fact, a 50 percent annual growth rate may turn out to be conservative: the home and corporate markets may grow faster, as prices of hardware drop and—more importantly—as enhanced machine capabilities open important new applications for small computers.

Yet the huge and growing demand for software still has to pull products through distribution channels that are inadequate for users and publishers alike. “The pipeline is only so big, and it’s full,” warns Jim Pelkey, president of Sorcim Corp., San Jose, Calif., publisher of a popular spreadsheet program.

For software developers, the problem of distribution continues to escalate the cost of reaching the market. Fred Gibbons, president of Software Publishing Corp., Mountain View, Calif., points out that he launched his company’s first product—a file-management program—with about \$30,000. Today, he spends “in excess of \$4 million” to stay visible in retail outlets and devotes 13 percent of sales revenues to advertising. Similarly, Lotus Development Corp., Cambridge, Mass., spent more than \$2 million in 1983 just to launch a single product, an integrated spreadsheet and graphics package called 1-2-3.

Software buyers confront an equally frustrating problem in dealing with the industry’s distribution system. Even though software continues to grow richer and more useful, the job of tracking down the program that is the best solution to an individual problem has become more difficult. Says Stewart Alsop, editor of *InfoWorld* magazine, a weekly that reviews microcomputer software: “Even we can’t keep track of what’s out there in the marketplace, and we’ve got editors and reviewers who evaluate software constantly.”

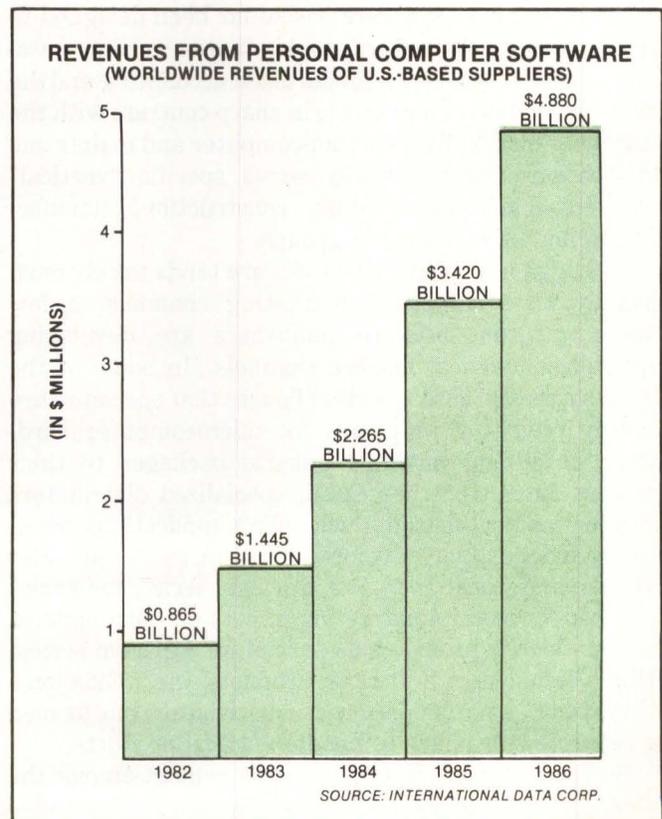
Software publishing remains a highly fragmented business. Most companies are developers of as few as one or two programs. Each of these companies must develop its own marketing channels, and end users are

left with the baffling problem of locating all the potential sources for each application they want to buy.

There are currently at least 10 distribution channels through which software passes from the developer to the ultimate purchaser. These channels often overlap—that is, a program may be available from several sources (though at different prices and with different support). Some, such as traditional retail outlets, tend to be more significant at the moment than others, such as electronic distribution.

“This industry is changing so fast that it’s foolish to plan very far ahead on the basis of what’s happening right now,” says Alsop. “All we can say with any confidence is that the software market in a couple of years will be a lot bigger and a lot different from what it is now.”

Revenues from personal computer software will approach \$5 billion in 1986, predicts Janice Antonellis, a software analyst for research organization International Data Corp. Products represented here include both business and home computers, except for those that are exclusively game-related.



The Interpreter

Much software sells bundled with hardware

IBM Corp. is often said to have launched the software industry when it "unbundled" software from its hardware sales in 1969. Nevertheless, hardware and software combinations are still a widespread distribution channel for much software, and one market research company, Strategic Inc., estimates that half of all current microcomputer manufactureres offer bundling arrangements.

The largest bundling volume occurs with microcomputer operating system software: both the CP/M operating system and the MS-DOS operating systems used on the most popular microcomputers are provided by independent software companies under licensing agreements with hardware manufacturers. In addition, popular application and productivity software is often sold with microcomputers as a way of adding value or building in what amounts to a discount on the total system. Still other microcomputer software, such as word-processing and spreadsheet programs, finds its way into turnkey hardware and software packages that are sold by independent sales organizations (system houses, system integrators, OEMs and computer graphics peripherals manufacturers).

Vertical-market products have a strong future

Microcomputer software has so far been designed to accommodate very general applications—word processing, spreadsheet work, standardized accounting and the like. This generic emphasis is in sharp contrast with the narrower market focus of minicomputer and mainframe applications, which usually serve specific "vertical" markets—banking, retailing, construction, manufacturing and other industry groups.

Although microcomputer software tends to rely most heavily on broad-based marketing channels, a few microcomputer software publishers are developing specialized vertical market channels. In some of the most successful cases, system houses that specialize are simply rewriting programs for microcomputer hardware or adding modified generic packages to their product lines. In other cases, specialized distributors serving vertical markets will solicit applications created by independent developers or end users. Modular Turnkey Systems Inc., Hot Springs, Ariz., for example, has focused its marketing efforts on farm applications, which it promotes as part of its Agricom series. High Technology Software Products Inc., Oklahoma City, Okla., a national software distributor, has formed a separate subsidiary to handle vertical products.

So far, vertical market channels remain among the most primitive in the microcomputer software world—

but they are also likely to evolve dramatically as buyers discover the growing sophistication of microcomputer software packages. "Vertical markets are unquestionably the wave of the future," says Dick Newbert, small business marketing manager at Digital Equipment Corp.'s Small Systems Group.

Computer retail stores remain a major channel

The most visible channel for software distribution is still the traditional all-purpose computer store that sells microcomputer software alongside hardware, peripherals and supplies. There are probably at least 2,000 such outlets (depending on how narrowly "computer store" is defined) and, for the moment, they collectively handle the largest volume of sales of any channel.

Computer stores, however, show some of the worst symptoms of stress due to the software industry's growth. Even though the profit margins on software sales are generally higher than those on hardware sales, even a small inventory of software titles—say 75 to 100 programs—ties up a lot of cash; \$10,000 is usually the minimum outlay, and it can quickly rise if a dealer has to stock versions of the same program for several different machines.

Retailers confront the same problem as do their customers: evaluating the flood of new—and even old—products. Computer store salesmen must be able to respond with reasonable authority to questions from a wide variety of customers, to demonstrate features of programs the store offers and to answer the inevitable support questions posed by end users.

Not surprisingly, very few retailers can afford the investment in sales training and product evaluation that software demands, especially high-priced business programs. They cut corners, trimming inventory to titles that are heavily advertised or have the greatest established base. A few software publishers pay bonuses to retail salespeople who learn and demonstrate new programs. Almost as much effort now goes into creating demonstration diskettes and sales support materials as once went into writing the programs themselves.

The battle for shelf space in computer retail outlets is a growing source of frustration for software developers, who find themselves frozen out of the market if they can't afford hefty advertising budgets and can't achieve high sales volumes. "Companies spend millions of dollars developing products and then place their fate in the hands of individual dealers who may or may not market the product effectively," says Larry Matte, president of Marketing Solutions Inc., a company that helps publishers handle distribution obstacles.

Dealers have begun to discover that concentrating on

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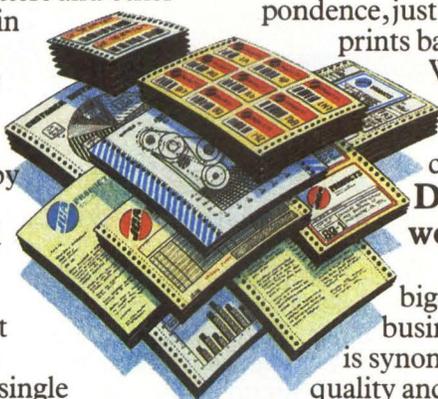
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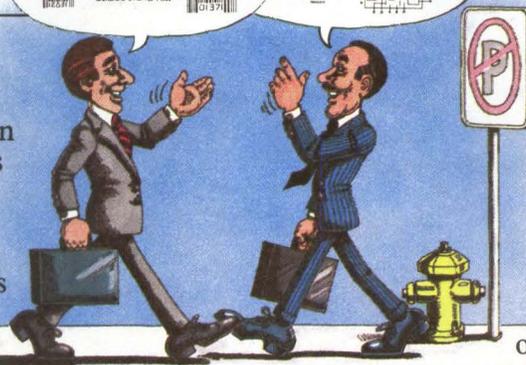
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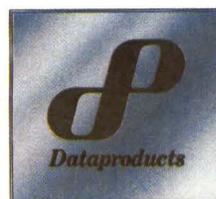
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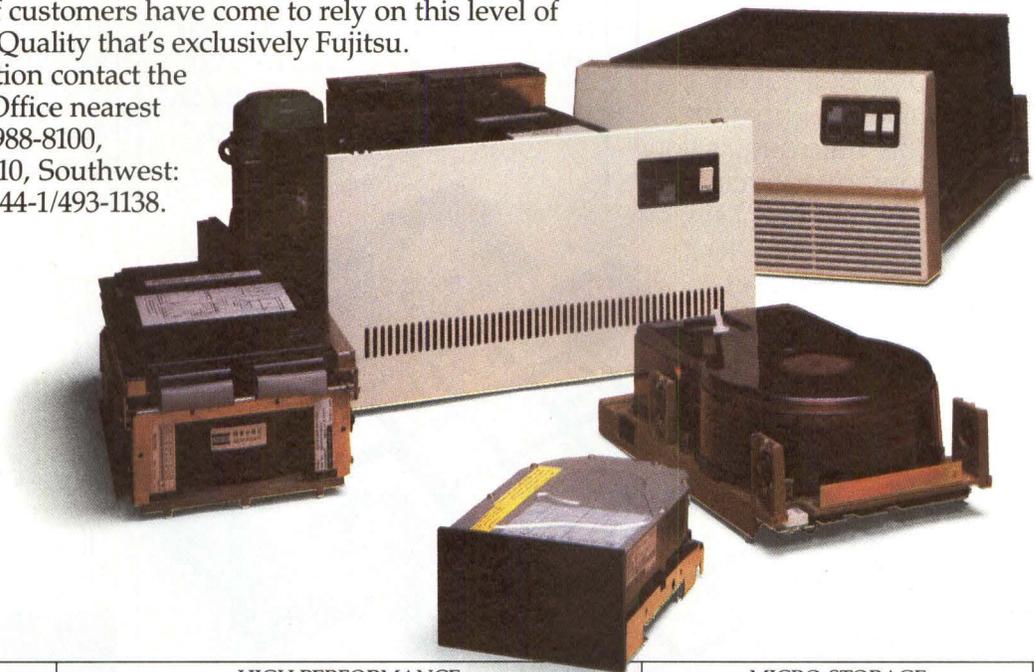
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The Interpreter

best-selling titles can be self-defeating. Software that is most heavily advertised tends to attract the attention of discounters, both in mail-order and conventional retail channels. To stay competitive, conventional retailers cut prices and profit margins—yet remain obliged to provide service and support the discounters don't offer.

Some computer retailers cope with the demands of inventory selection and support by joining chains, which centralize buying and training. Chain operations have grown rapidly—the largest, ComputerLand, now has more than 500 stores, and its 1983 sales were almost \$1 billion, up from \$458 million in 1982. One market research company, Future Computing, Richardson, Texas, recently reported that only about 25 percent all computer specialty outlets are independently owned.

A trend toward software-only stores grows

Traditional computer stores are likely to become specialized sources for hardware, not software. What may in part replace the all-purpose computer store as a marketing channel is the software-only outlet, a type of store that carries a much greater depth of inventory and can devote greater attention to evaluating and supporting software products.

At the moment, software retail outlets are relatively scarce. Future Computing says it has identified only about 175 such dealers, 50 of which belong to one chain, Software Centres International. (More than half of all software dealerships are independently managed.) As a marketing channel, software retailers appear poised for

extremely rapid growth. One market researcher predicts that there will be nearly 5,000 software-only stores in 1987—more than twice the current number of traditional computer retail outlets.

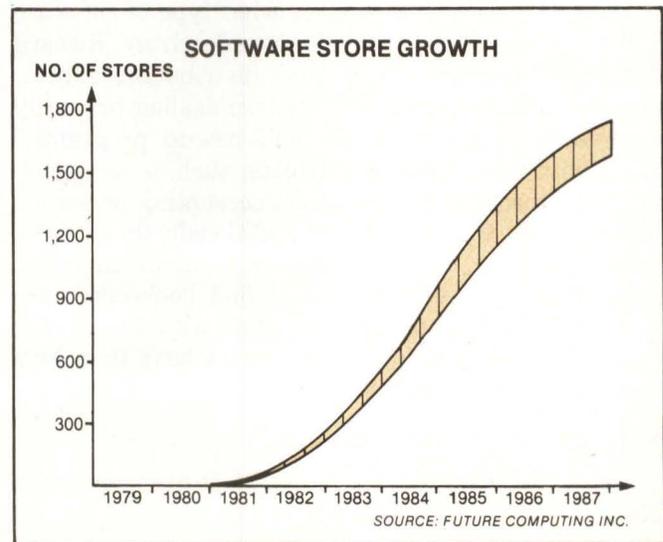
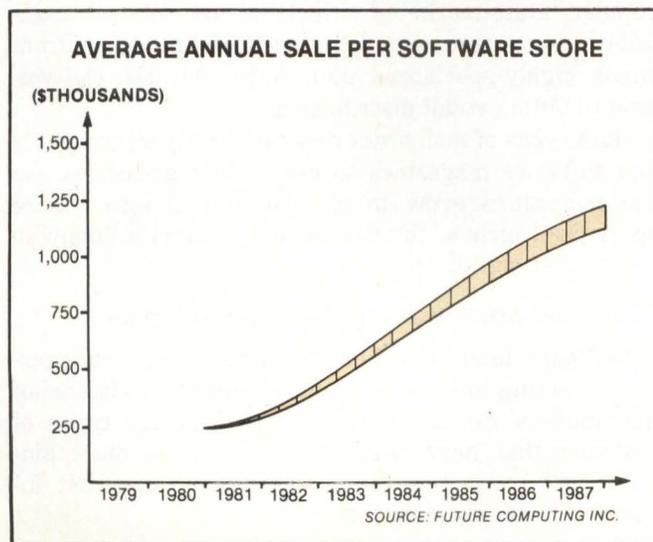
Despite the start-up costs of a company-owned chain, there are clear advantages to a hardware company in controlling its own distribution channels and in being able to evaluate and support a far greater range of software products than conventional retailers can.

Company-owned stores begin to compete

An alternative response to the problems that traditional computer retailers face is the gradual appearance of retail outlets that are wholly-owned by hardware manufacturers. IBM and DEC are assembling chains of stores that will provide support and inventory for their products. Both start far behind the Radio Shack chain owned by Tandy Corp. Its 6,000 stores represent the country's largest electronics merchandising operation.

Despite the start-up costs, a company-owned chain offers clear advantages to a major hardware company. The company controls its own distribution channels and is able to evaluate and support a far greater range of software products. For users, there is the advantage of

Although software-only stores are still relatively scarce, they should undergo rapid growth in the next few years, estimates market research organization Future Computing Inc. Their advantage: they specialize in evaluating and supporting software products.



The Interpreter

being able to deal with a single source for troubleshooting.

Still, it's unlikely that company-owned stores will turn into a software marketing channel of major proportions. DEC and IBM have limited retailing competence and enthusiasm and won't risk the anger of traditional dealers by competing against them too aggressively. (DEC split its microcomputer line between its own stores and its independent dealers to minimize competition between channels.)

Major software publishers tend to guard their brand identities jealously. Radio Shack, for example, insisted on repackaging all software it carried, although it ultimately found that this policy discouraged third-party developers and publishers from writing programs for its machines.

Bookstores offer a limited outlet

Probably the least important retail channel for software, bookstores have the potential to become a major outlet for at least some types of programs. Two of the leading book chains, B. Dalton and Waldenbooks, began testing software displays in 1982. Book publisher Simon & Schuster has begun negotiating distribution deals with a number of leading software developers. And other book publishers are likely to follow with titles designed specifically for book outlets. (Book publishers are already a significant distribution channel for educational software.) Says John Brockman, an agent who has negotiated many of the most visible distribution contracts with book publishers, "All roads lead to New York and its major book-publishing houses."

Although there is general agreement that bookstores represent a natural and, so far, untapped distribution channel, the crucial question is what type of software will end up using this channel most effectively. Richard Loftin, a software agent and distribution expert, predicts that bookstores will end up dealing primarily with lower-priced "self-help and how-to programs," along with fairly generic products, such as unspecialized word processors and simple accounting packages. He points out that bookstores traditionally do not offer sales support or demonstrations of their merchandise. As a result, he predicts, "We'll find booksellers are going to be very timid about dealing with any kind of complex software product, where they have to make a judgment about the value of what they're selling."

Publishers try direct sales

Just as the major hardware manufacturers have been attracted by the idea of setting up their own stores, so

the larger software publishers have dabbled with so-called "national accounts" programs—direct sales to large end users, bypassing retail outlets and distributors. "For the independents, a strong presence with national accounts—the major banks, the U.S. government, Fortune 500 and so on—is more a necessity than an option," claims Robert Glidden, chairman of Perfect Software Inc.

Direct selling to end users poses many of the same risks that hardware companies face with their company-owned stores. Setting up a sales force that can sell directly to large accounts is expensive, and publishers must handle sensitive issues of pricing and territory without damaging the goodwill of traditional retailers.

One form of direct selling that has always existed in the software industry is the consumer and trade show. Small publishers initially used shows as a forum to demonstrate programs to interested consumers who couldn't be reached through retail outlets. Though attendance lately seems to be dropping, the consumer shows still draw large crowds eager to see the latest Apple-, CP/M- or IBM-compatible products.

Several specialized software-only trade shows appear on the calendar. The biggest of these, Softcon in New Orleans, Feb. 21-23, has been described by its promoters as the "largest convention ever held in New Orleans." Promoters estimated before the show that it could draw as many as 40,000 buyers—many of whom will represent large "national accounts" eager to deal through a direct sales channel.

Mail order gains importance

Mail-order sales, another established software-distribution channel, has gradually evolved into a way of marketing two distinctly different types of software: popular, mass-marketed titles that are sold by main-order discounters and fairly esoteric products from small, highly-specialized publishers who lack the volume to obtain retail distribution.

Both types of mail order depend heavily on computer and software magazines to reach their audiences. As the magazines grow in circulation and enter more specialized niches, the mail-order channel is likely to grow more significant.

Electronic down-loading is still up in the air

Software lends itself easily to electronic transmission, creating interest in a purely electronic channel of distribution. So far, however, the primary types of software that have been down-loaded are entertainment and game programs—short programs that involve minimal documentation.

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SUPER. MICRO.

The Interpreter

Will software other than games ever use electronic distribution? Ted Leonsis, publisher of software catalog *LIST* magazine, says business software may be demonstrated through electronic down-loading, "but we'll probably see the actual programs delivered by Federal Express."

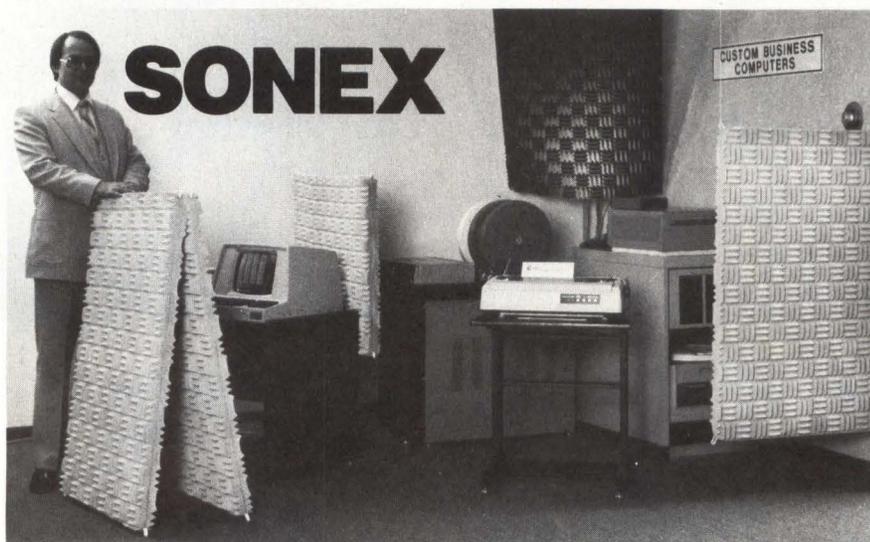
One reason for taking electronic down-loading seriously is the presence in the computer market of a newly-deregulated American Telephone & Telegraph Co. Electronic distribution of software through AT&T's telecommunications network is an obvious direction for the company to take, and AT&T has announced a vaguely-defined plan for marketing on-line video games in association with Coleco.

Software catalogs proliferate

The proliferation of software titles almost inevitably inspired publishers to create software directories—there are at least a dozen major ones, with more planned—and the directories, in turn, have sometimes served as a springboard for software-distribution services. Two of the largest directories, *LIST* and the

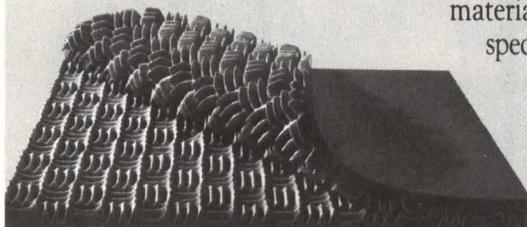
PC Clearinghouse, both maintain large staffs of researchers who do nothing but collect data on available software titles. *LIST*'s Leonsis says he has 5,800 titles by 1,400 publishers and developers in his database. He estimates that there may be 7,500 microcomputer programs on the market and predicts that *LIST* will eventually track down most of them. Leonsis' magazine now only describes programs, leaving readers the job of contacting publishers. Like *PC Clearinghouse*, Leonsis plans to offer an on-line computer service that will fill end-user orders. Leonsis points out that software catalogs are especially valuable for acquainting publishers of narrow-niche packages with buyers who need specialized solutions. "When we're on-line," he adds, "I think you'll see us become a major force for publishers that otherwise could barely survive in the marketplace." □

Jeffrey Tarter is publisher of *Soft-letter*, a biweekly newsletter that reports on trends and business strategies in software publishing.

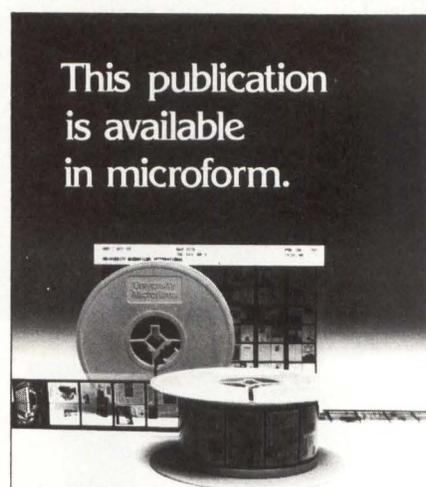


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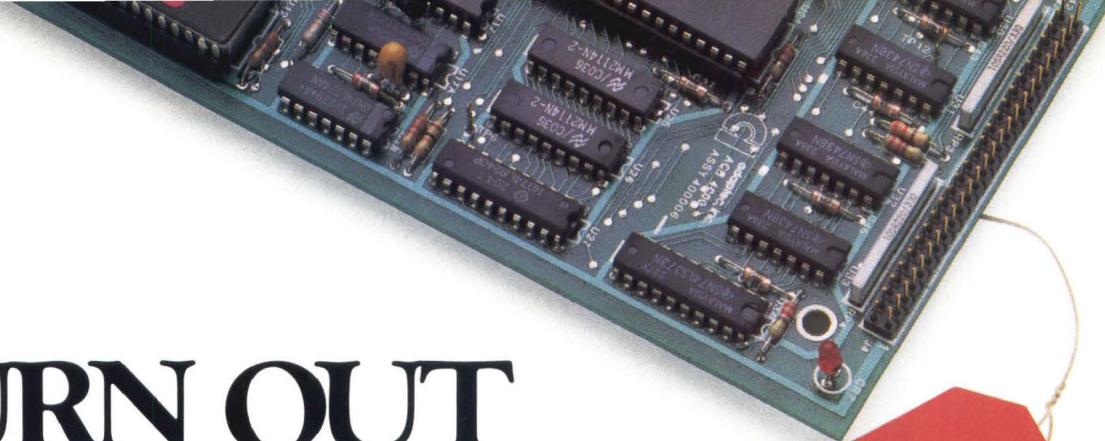
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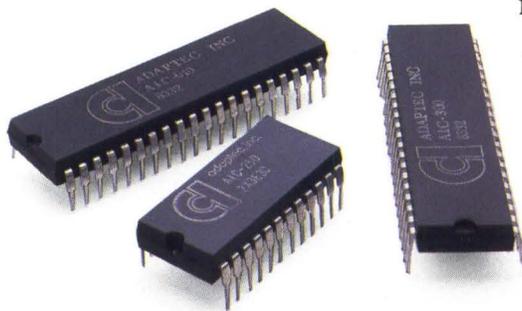


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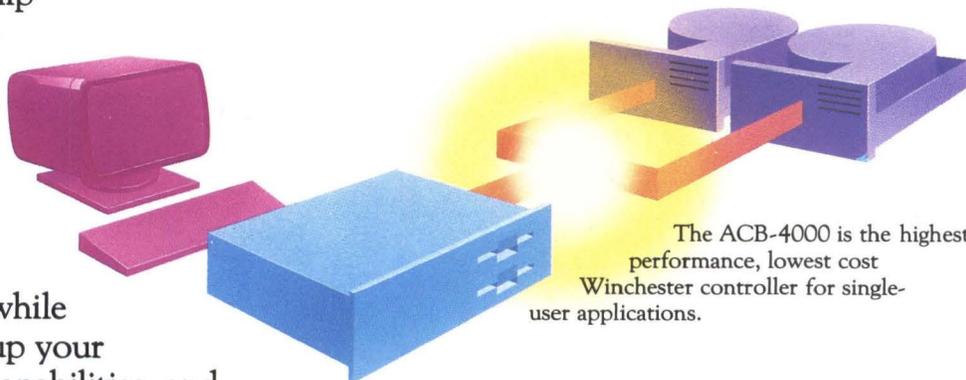
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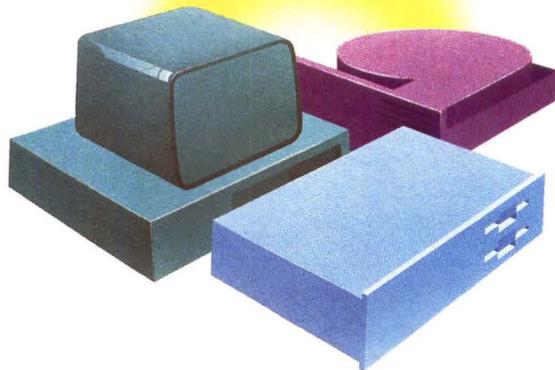
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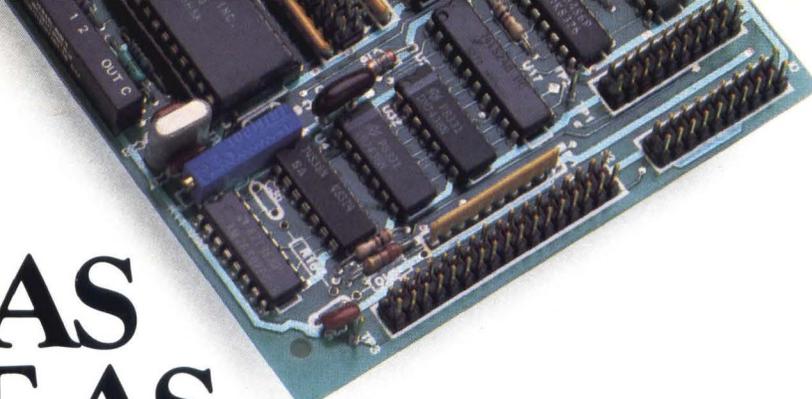
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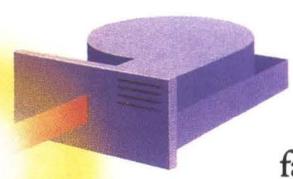
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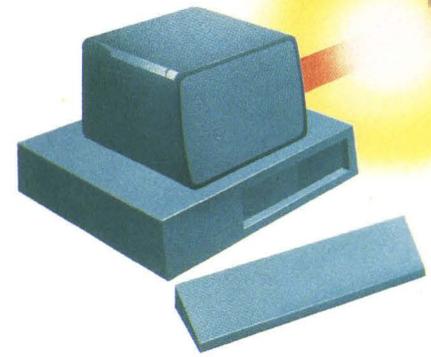
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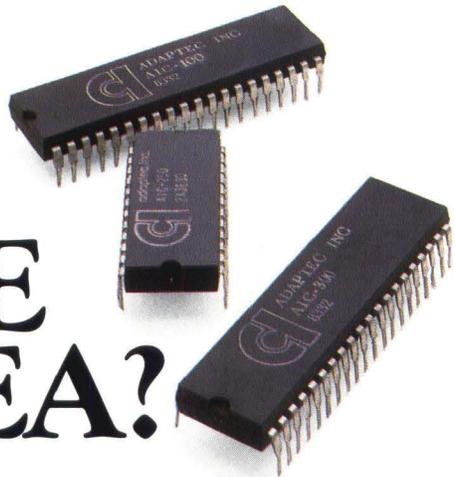
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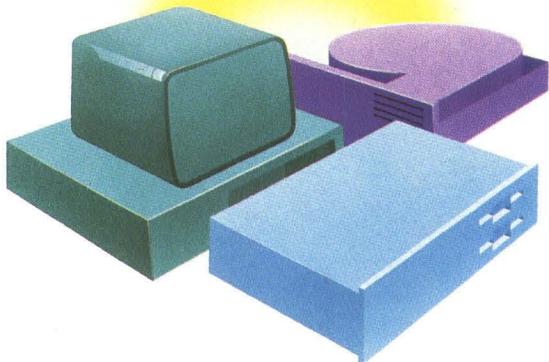
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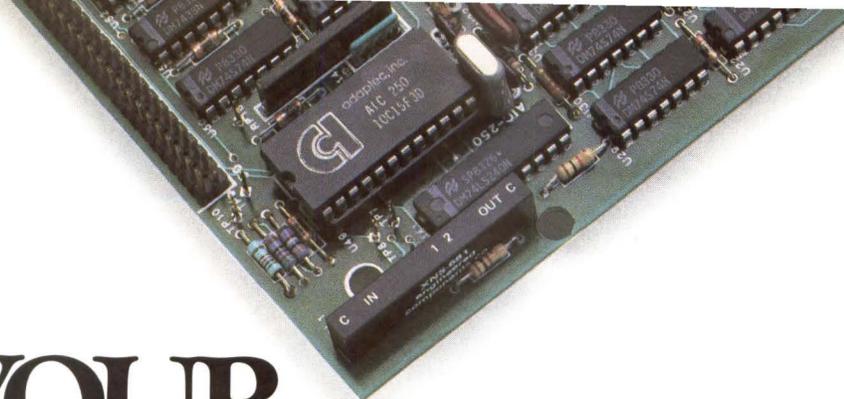
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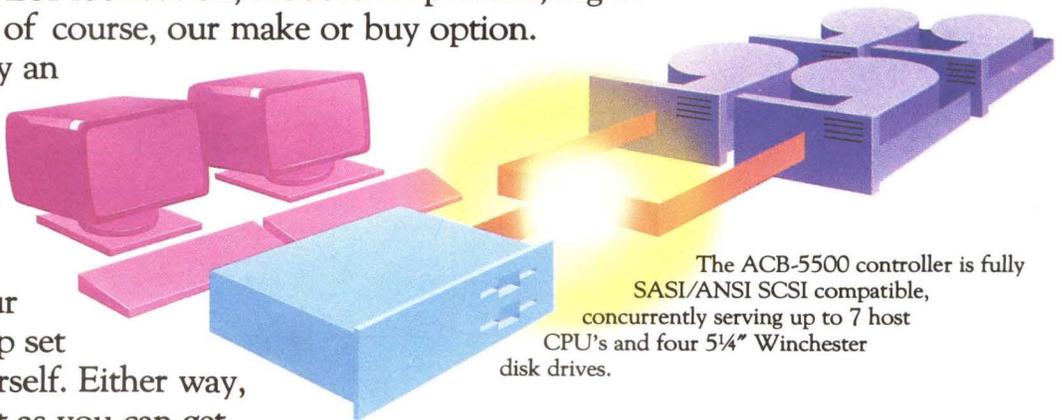
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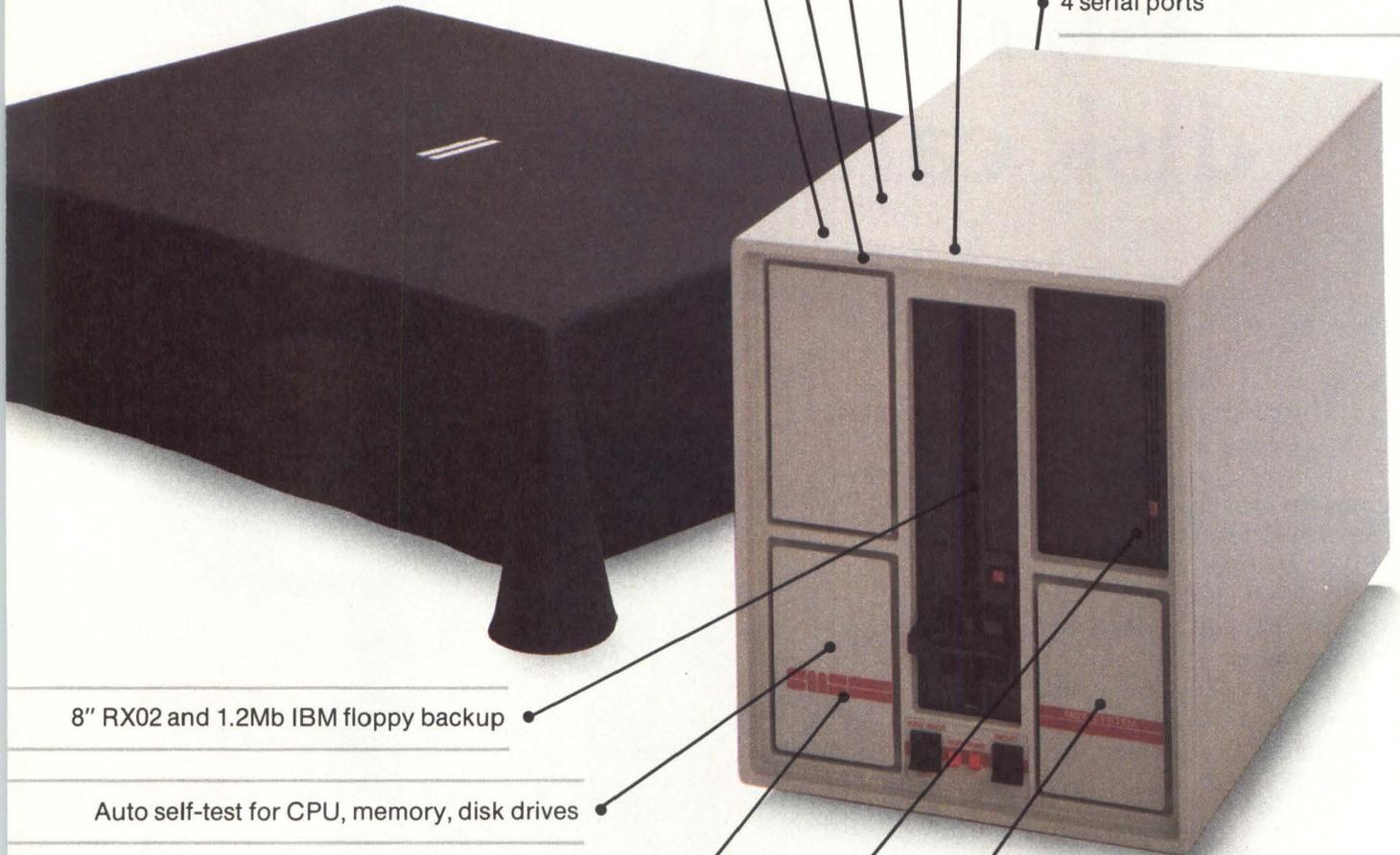
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The Integrator

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Ada begins use in commercial systems

The Pentagon's new computer language is branching out; new commercial applications include mail sorting and dialysis-machine control

Gary Legg, Associate Editor

Ada, the fledgling computer language, is finally trying its wings. After spending a decade in the nest of the U.S. Department of Defense (DOD) and becoming an officially recognized language just last year, it's now finding use not only in DOD projects but also in commercial systems. And, despite some critics' claims that the language would never fly, system developers who use Ada are impressed with its capabilities.

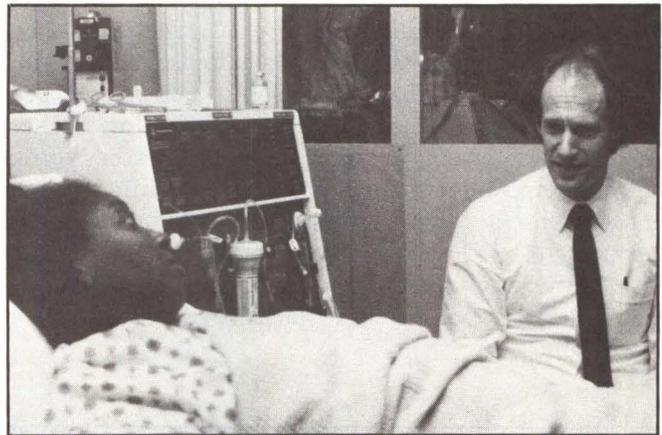
The good reviews are appearing despite a shortage of high-quality compilers. Very few compilers implement the complete Ada specification, and most haven't yet achieved the performance levels to which software developers are accustomed. In addition, some compilers run only on hardware, which has limited capabilities or isn't in widespread use.

Developers using Ada say this situation will soon change. They expect several compilers to pass the DOD's validation tests (and thus become officially complete Ada implementations) before year-end. They're also confident that production-quality compilers will be available by the time their projects need them (see "Improved Ada compilers overcome performance limitations," Page 163).

Current compilers do the job

Even current Ada compilers are adequate for developing application software. Since committing to Ada in 1981, Intellimac Inc., Rockville, Md., has applied the language to payroll and parts-control systems and to semantic processing for translating English to other languages. Although the semantic work has been an internal research project, Canada's Department of National Defence is negotiating with Intellimac for a system that would translate English-language technical documents into French.

Intellimac also sells turnkey 68000-based Ada development systems, some of which are finding use as components in larger, application-oriented systems.



Ada-controlled dialysis machines will soon be operating at St. Luke's-Roosevelt Hospital Center in New York. Dr. Jonathan Lorch, shown here with a kidney patient, says Ada programs will eventually administer individual dialysis prescriptions.

One such system, using Ada compilers developed by TeleSoft and Irvine Computer Sciences Corp., is being installed in the nephrology department at St. Luke's-Roosevelt Hospital Center in New York. Physicians there plan to use the system for collecting and processing data gathered from dialysis machines connected to kidney patients. Eventually, the system will monitor and control the machines, providing an individual dialysis prescription for each patient.

Dr. Jonathan Lorch of St. Luke's-Roosevelt explains that a computer can play an important part in dialysis because of the huge amounts of data involved. "Our patients generate about 15M bytes of lab data a year," he says, "and some of them are with us for 10 years on dialysis." Lorch says that Ada's interfacing capabilities make it ideal for dialysis applications because his department needs a multiple-computer system that acquires data and creates a database. In the system being implemented, a laboratory computer will gather data from dialysis machines, and another computer will automatically retrieve and store the data each night.

The Integrator

Real-time features aid patient monitoring

Real-time capabilities were also a factor in Ada's selection for the hospital system. Lorch explains that controlling a dialysis prescription involves on-line monitoring of parameters such as a patient's blood pressure and the dialytic's conductivity and sodium concentration. Currently available dialysis systems can monitor these parameters, Lorch says, but they require assembly-language programming—an unappealing task.

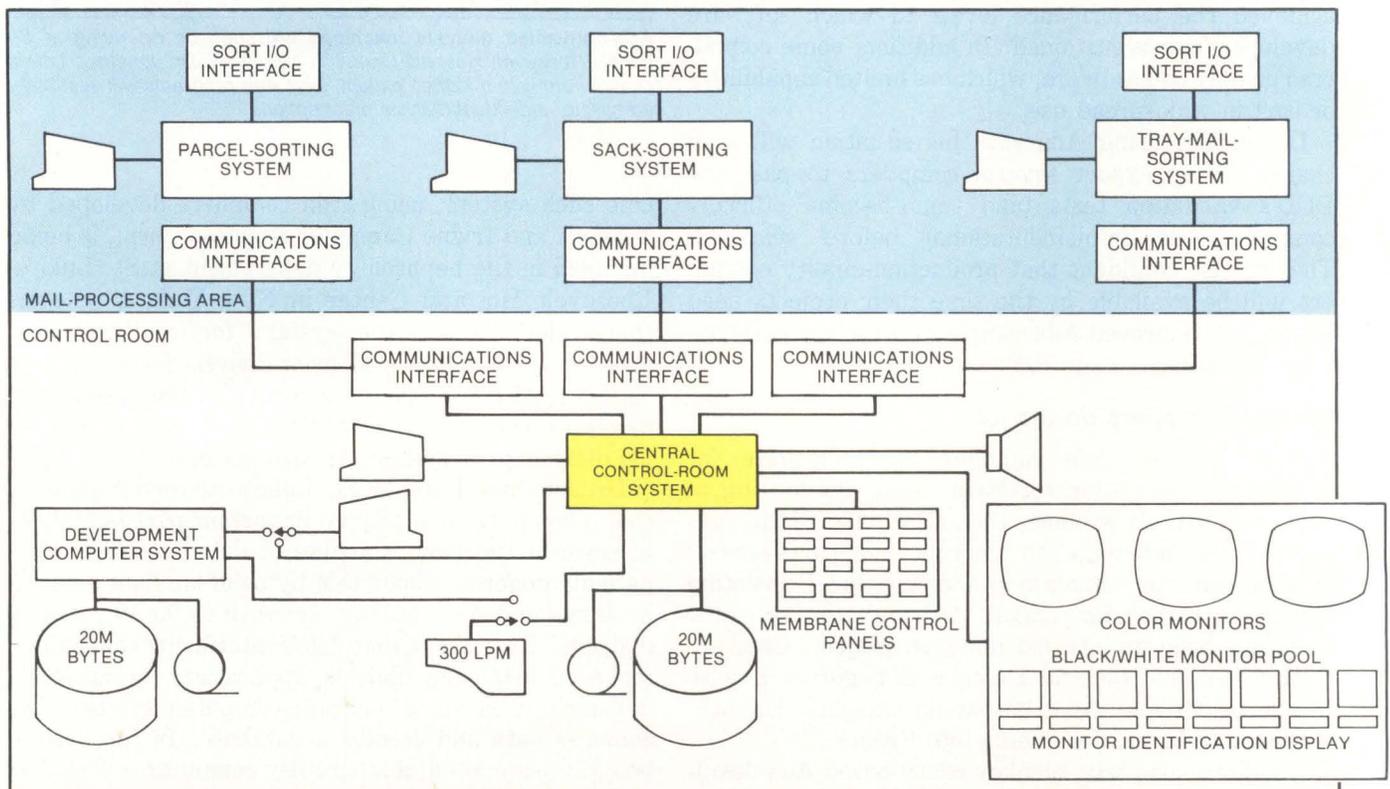
Ada's strong typing—a feature that prevents an operation applicable to one type of data structure from being applied to a different type of structure—is an additional benefit of the St. Luke's-Roosevelt system. "Medicine is a field that lends itself to a strongly typed language," Lorch observes, because of the importance of correct processing of the results of laboratory tests. "The serum sodium, which is one test, is different and distinct abstractly from the serum potassium, which is another test," Lorch explains, even though floating-point numbers represent the results of both. Ada allows use of derived types so that "you can't add a sodium to a potassium."

Being an Ada pioneer might have its drawbacks, however. For example, Lorch notes, neither of the Ada compilers available from Intellimac yet provides a complete Ada implementation. He believes this is a minor problem, though, and one that is offset by Ada's advantages, especially easier program maintenance.

Portability benefits postal service

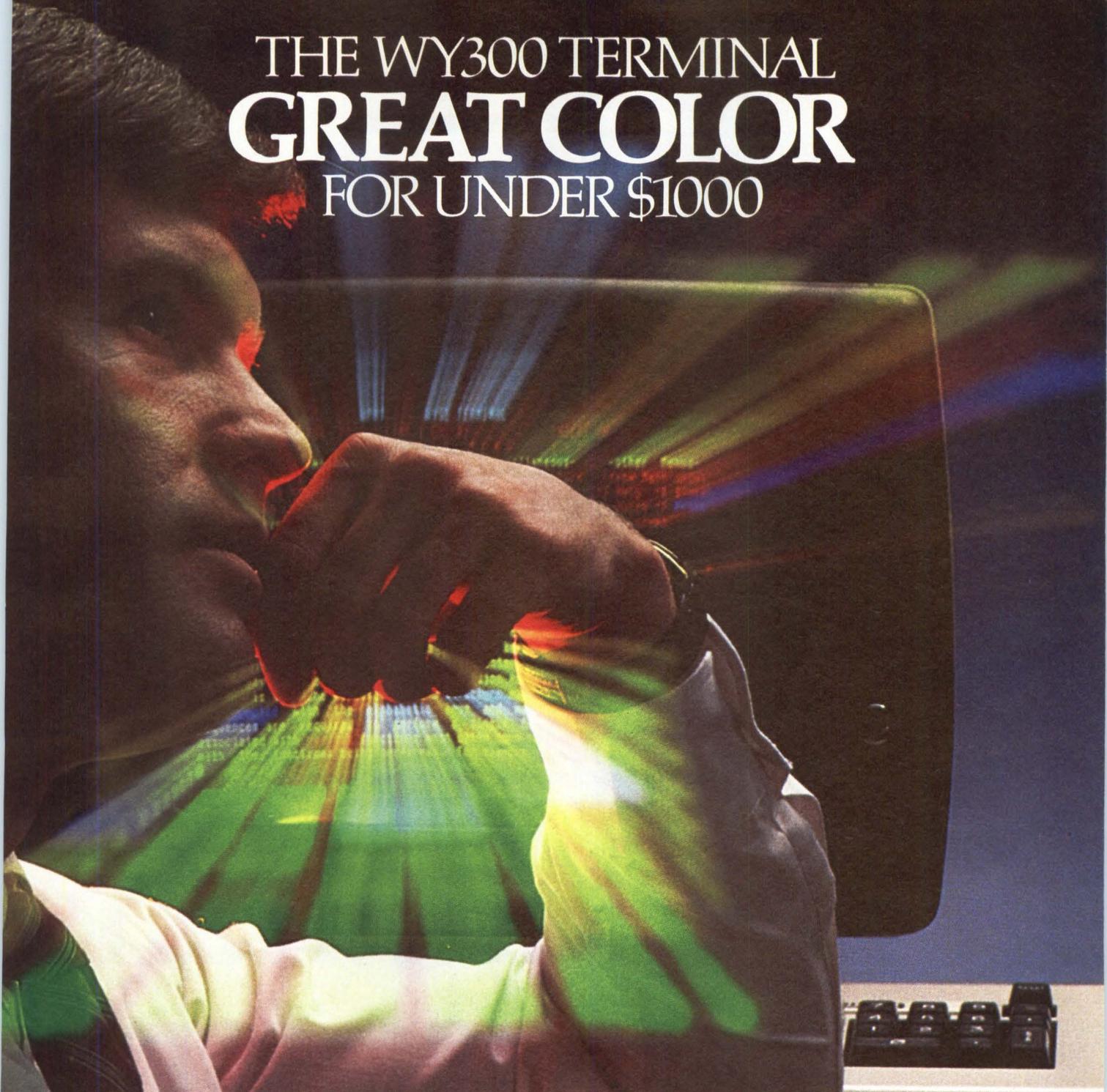
Another advantage, portability, was a major reason for Ada's selection as the language for implementing a new mail-sorting and -handling system for the U.S. Postal Service. Because Ada is a standard language that ultimately will operate identically on many different computer types, its use allows hardware to be upgraded as new technology becomes available. This is important for the Postal Service with its 21 bulk-mail facilities nationwide.

Currently in the design stage, the Ada-based mail system will be installed about a year from now at a facility under construction in Phoenix, Ariz. IG Associates, an Alexandria, Va., company that specializes in mechanization, engineering and architectural consulting, wrote the specification for the system. Plans call for three Intellimac 68000-based computers on the



Ada-based mail-handling system will include three computers for sorting sacks, parcels and trays of mail. A fourth computer will control the overall operation.

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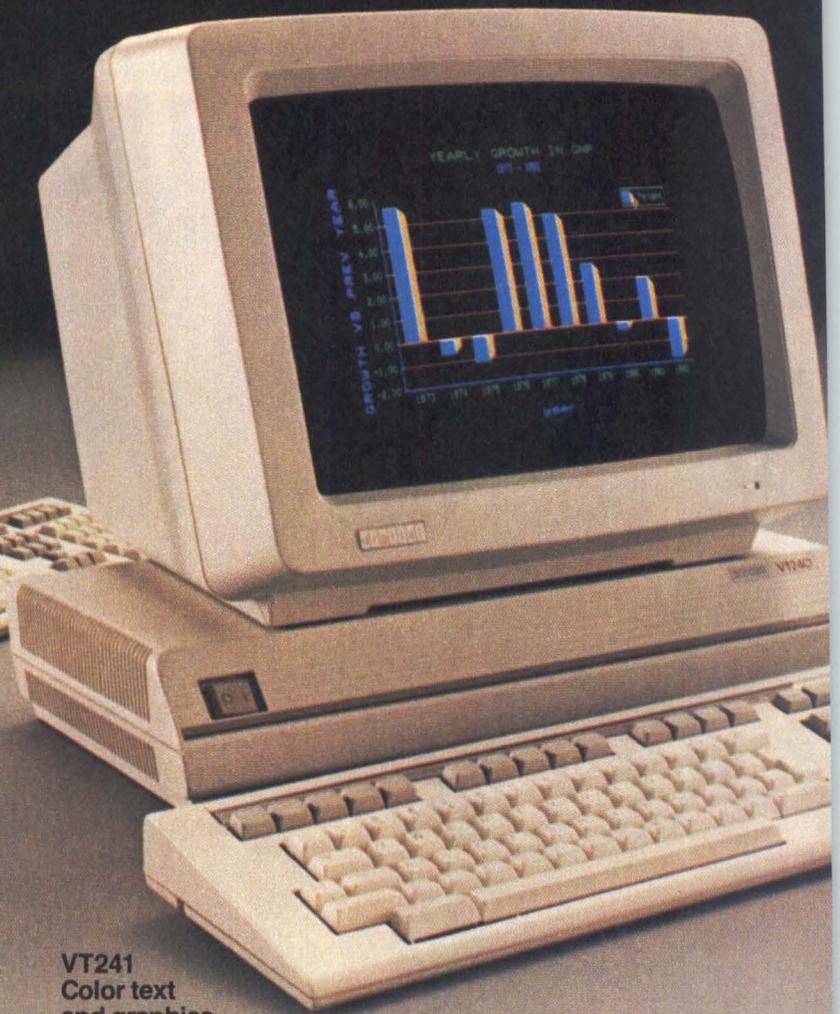
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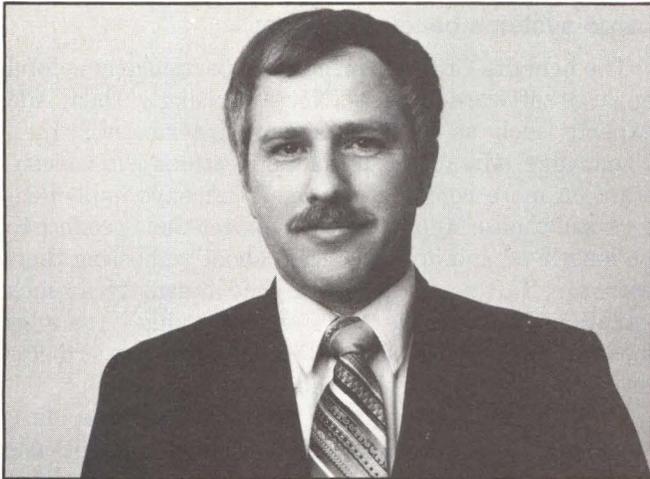
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The Integrator



Ralph Crafts, Intellimac vice president for operations and marketing, says requirements for software maintenance and support decreased by more than 95 percent after his company began programming in Ada.

mail-processing floor and another in a control room. All will be programmed in Ada and will communicate via an Ethernet network.

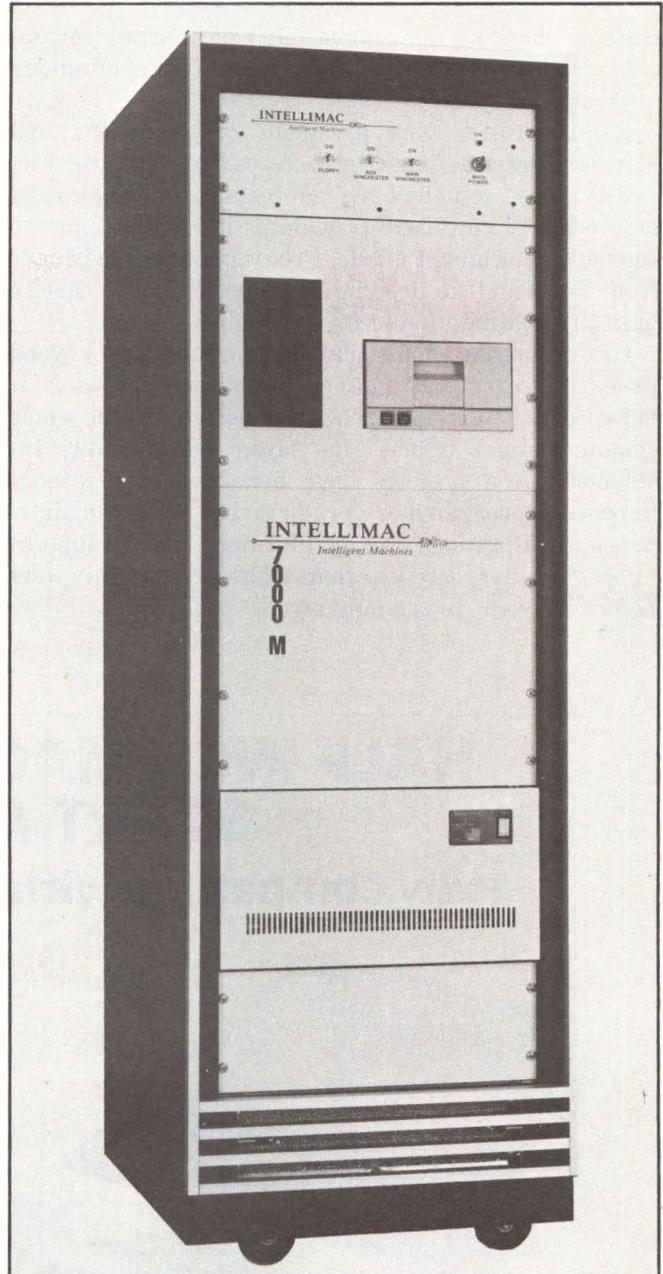
IG Associates consultant Ron Buren notes that the Postal Service's situation explains its concern with software portability. The agency's bulk-mail centers now use equipment that's about 10 years old, he says, and software on that equipment can't easily move to an updated system. Buren says the ease of moving Ada to different equipment will make the production of software for postal applications more efficient.

Real-time military applications begin

Military use of Ada—in the experimental stage until lately—is starting to involve actual applications. Singer Co.'s Librascope Division, Glendale, Calif., is using TeleSoft's Ada compiler and program-support environment to develop communications software for the U.S. Army. At least one of the applications, designed for 68000-based systems, is already operating.

Customers of Rolm Corp., Santa Clara, Calif., marketer of the first commercial validated Ada compiler, are also applying the new language to military projects. Bruce Noel, Rolm's Ada marketing manager, says applications include aircraft navigation, command-and-control systems and others involving complex software problems. Noel says companies are also buying the Rolm Ada software for in-house programmer training, typically on Data General Corp.'s MV/10000 systems with 15 to 25 user terminals.

In another application, software engineers at the Naval Surface Weapons Center (NSWC), Dahlgren,



Intellimac computers such as this one will run Ada programs that control mail sorting at a new U.S. Postal Service facility in Phoenix, Ariz.

Va., are treating Ada as a program-design language (PDL). Using Intellimac hardware and Telesoft's compiler, they write compilable and executable code and treat the executing design as a prototype of a final software system. NSWC software engineer Michael Masters explains that using program "stubs" keeps the prototype design from expanding into a completely implemented software system. Thus, designers concen-

The Integrator

trate on checking the compatibility of program components and on verifying proper flow of control among program sections.

Ralph Crafts, vice president of operations and marketing at Intellimac, elaborates: "We can use Ada as a PDL and actually have non-technical managers and non-technical end users provide an intelligent input to the design document itself." Programmers then benefit from following the design, he notes, "because they're basically writing in structured English again."

Crafts further claims that Ada's benefits go beyond its existence as just another computer language. "It enhances the top-down structured design and the whole communications effort," he says. As a result, Intellimac's Ada projects have benefited from greatly improved programmer productivity. "The maintenance, the upgrades, the modifications and the support effort," he says, "are less than a 20th of what they were before we went to the language."

Large systems benefit the most

The benefits Crafts mentions are particularly helpful on large software projects. Not surprisingly, then, Ada experts such as Tucker Taft of Intermetrics Inc., Cambridge, Mass., say initial applications will concentrate on more complex systems. Taft says implementors will choose Ada when they expect their product to be long-lived and are concerned about re-hosting their software. Taft notes that C is a good alternative in such situations, but it lacks Ada's strong typing. "It's a lot looser than Ada," he says. "People with large projects prefer a tighter control at the language level."

Despite Ada's advantages and some early applications, many software developers are postponing its use until suitable compilers are available for the equipment they want to use. Observers such as Taft think the wait won't be long, though—perhaps only a few months. "Everyone is waiting to see what compilers are coming," he says. □

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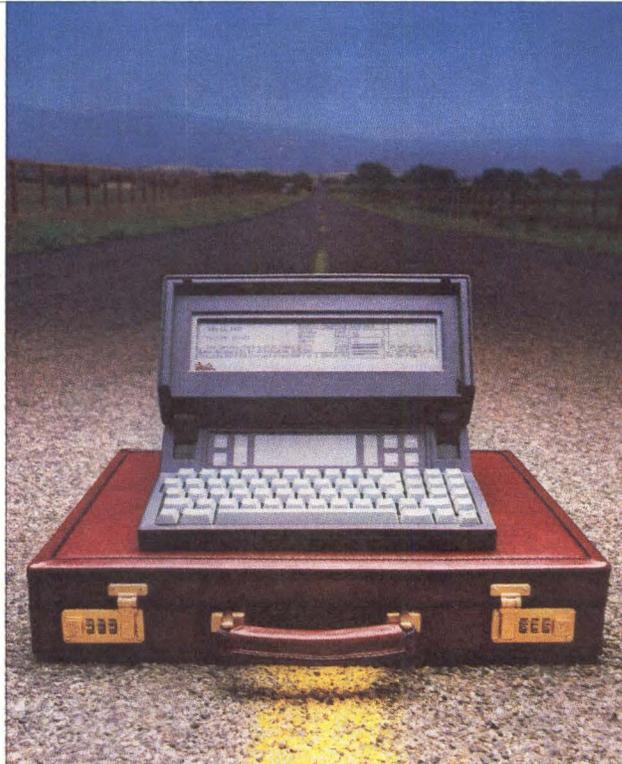
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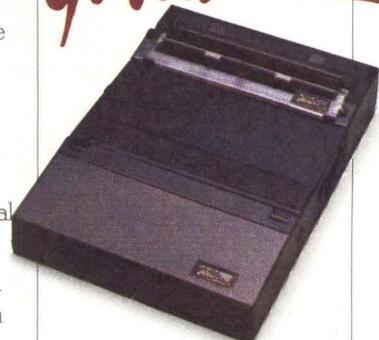
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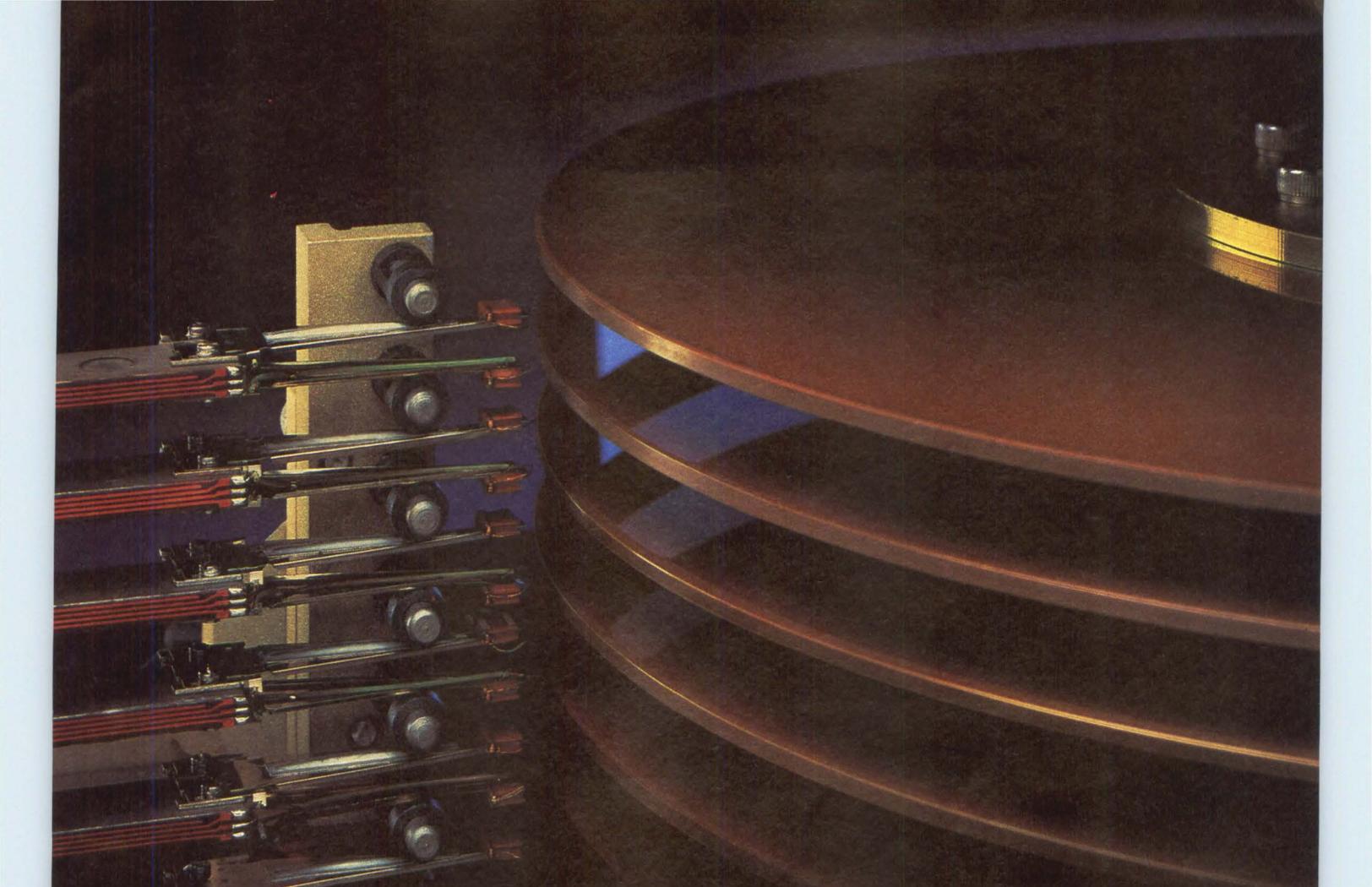
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The Integrator

Improved Ada compilers overcome performance limitations

Quality and utility now receive as much attention as the Department of Defense's validation tests

Gary Legg, Associate Editor

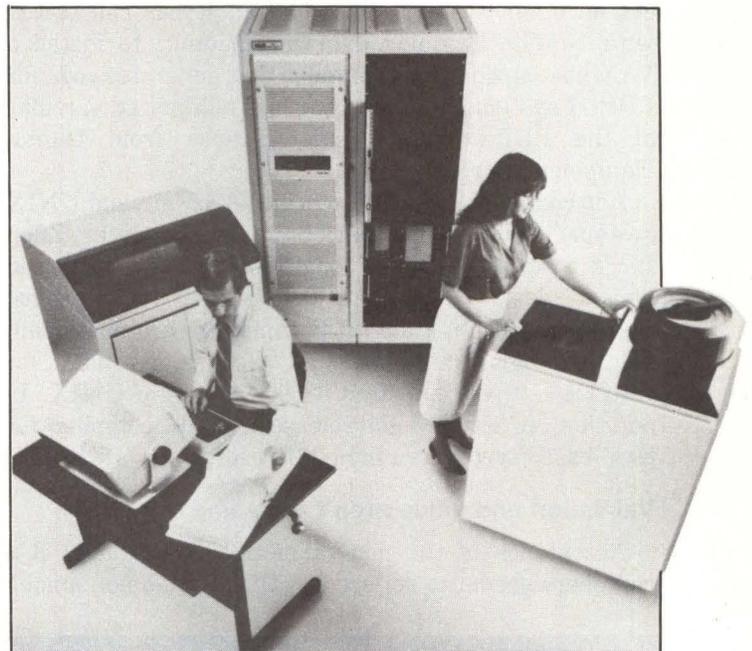
A year after Ada's introduction as a standard computer language, compilers for it are getting better and more plentiful. New versions compile faster, produce more efficient object code and implement more of Ada's features. By year-end, say many Ada observers, production-quality compilers—officially validated by the U.S. Department of Defense (DOD)—will be available on a variety of popular computers.

Emphasis shifts to performance and systems

Until recently, validation—the process of demonstrating to the DOD that a compiler correctly implements the entire Ada standard—received most of the attention directed toward Ada. Now that some compilers have passed the stiff validation tests, however, emphasis is shifting toward compiler performance and toward making Ada available on some widely used computer systems. Validation is still an important issue, however; the DOD ultimately will permit the name "Ada" to appear only on compilers that have passed formal validation testing. In addition, future DOD contracts will prohibit use of compilers that haven't been validated.

Because validated compilers haven't been available on most popular computers, though, some companies starting to use Ada have found through experimentation that almost-complete compilers serve their needs reasonably well. Besides, software developers reason, if an appropriate validated compiler isn't now available, one soon will be. What's equally important in the meantime, they say, is the availability of a reasonably complete compiler that performs well on their systems.

By press time, two commercial Ada compilers had passed the more than 1,500 compiler tests that the DOD calls the "validation test suite." The first compiler to pass, from Rolm Corp., San Jose, Calif., received DOD certification last spring; it runs on Data General Corp.'s MV series of 32-bit computers and on Rolm's 32-bit Ada



The 32-bit Ada Work Center from Rolm Corp. runs the first commercial Ada compiler to be validated by the U.S. Department of Defense.

Work Centers. It generates code for these systems and for Rolm's MSE/14 and 1666 16-bit systems.

The other validated compiler, developed by Western Digital Corp., passed validation tests last August and has since been sold to Western Digital spin-off Gensoft Corp., Pittsburgh. Developed for Western Digital's 16-bit WD1600 computer system, the compiler is being rewritten for other machines.

Some non-validated compilers have succeeded commercially. For example, TeleSoft, San Diego, claims to have installed more than 350 of its Ada compilers, and Irvine Computer Sciences Corp. (ICS), Irvine, Calif., sells non-validated compilers directly and through several computer manufacturers. Both companies are likely to have validated compilers available this year,

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however; TeleSoft, in fact, might have one before this issue appears.

One reason for the success of TeleSoft and ICS is the fact that their compilers—unlike the two that first passed validation testing—run on a variety of popular computer systems. TeleSoft, for example, has versions of its compiler for VAX (VMS and UNIX) systems, the IBM Personal Computer, 68000-based UNIX systems and the IBM 370. It has also recently negotiated with several computer manufacturers—including Harris Corp., Perkin-Elmer Corp., Burroughs Corp. and Convergent Technologies Inc.—to install Ada compilers on other systems. In addition, it has contracted with Norden Systems, Norwalk, Conn., to install a VAX-hosted Ada cross compiler that generates code for PDP-11 systems. Norden produces militarized versions of the PDP systems under license from Digital Equipment Corp.

Ada compilers from ICS run on VAX VMS and UNIX systems, Gould SEL's Concept 32 minicomputer, Zilog Inc.'s System 8000 and the 68000- and UNIX-based Unistar desktop system from Callan Data Systems, Westlake Village, Calif. ICS compilers are also available through UniSoft Corp., Berkeley, Calif., for UniPlus+, that company's 68000 version of UNIX. In addition, ICS will soon release an Ada compiler for 8086-based systems running Microsoft Corp.'s XENIX.

Validation and value aren't the same

Acceptance of the non-validated TeleSoft and ICS compilers seems to reflect an attitude common among

many software developers: a validated Ada compiler isn't necessarily useful, and a non-validated compiler isn't necessarily bad. Indeed, passing the validation tests guarantees only that a compiler correctly implements the Ada language; it doesn't guarantee compilation speed, efficiency of the resulting object code or helpful compiler-generated error messages. In addition, some Ada experts say it's possible to circumvent the intent of validation deliberately and market a certified compiler that contains bugs.

Critics of Ada compilers usually emphasize other concerns, however. For instance, critics of the validated Gensoft compiler say that the 16-bit Western Digital system for which it was designed severely limits its use. Gensoft president David Fisher acknowledges that a 16-bit machine isn't the best host for an Ada compiler. "It really is not the right hardware for the majority of the community," he says, "even though the compiler is a fine piece of software." Consequently, Gensoft is rehosting its compiler on larger computers such as the VAX. The company also plans to work with mainframe manufacturers, putting the compiler on their machines for sales through the manufacturers' distribution networks.

Gensoft is also improving the performance of its compiler in a joint venture with Tartan Laboratories, which originated at Carnegie-Mellon University. "Tartan's business is not Ada; it's optimizing compilers," Fisher says. "Ours is Ada, but not necessarily optimizing, so it was a good marriage."

Optimizing its already-validated compiler is an ongoing activity for Rolm, too, says Rolm's Ada marketing manager, Bruce Noel. "We fully anticipate that the performance will be increased, both in the compile rate and the efficiency of the targeted code, as we do future releases," he says. The Rolm compiler's performance is already quite acceptable, though, Noel says. "It probably compiles today at about half the rate you would expect from a good FORTRAN compiler on an equivalent machine," he observes, "and that's pretty good because Ada's a fairly complex language—much more complex than FORTRAN." Similarly, says Noel, Ada's greater complexity results in less compact object code. "It's doing more context checking; it's checking a lot of things a FORTRAN compiler doesn't check," he says.

Second-generation compilers appear

Rolm and Gensoft face similar situations: having scurried to be first to supply validated Ada compilers, they're now improving their products and—in the case of Gensoft—implementing them on different hardware.



Providing use of an Ada compiler from Irvine Computer Sciences Corp. is Gould's Concept 32/67 32-bit computer.



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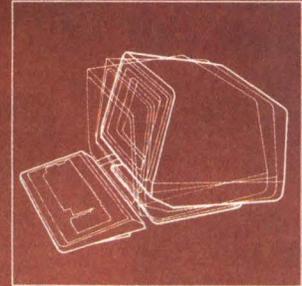
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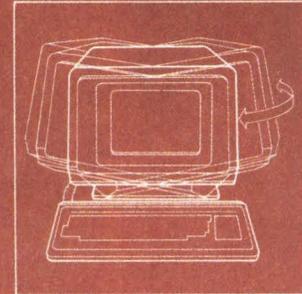
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Even TeleSoft, which wasn't in the rush to validation, is rewriting its compiler in Ada (the original version is in Pascal) and improving it. The result of this activity, which probably will become evident within the next several months, will be a supply of "second-generation" compilers.

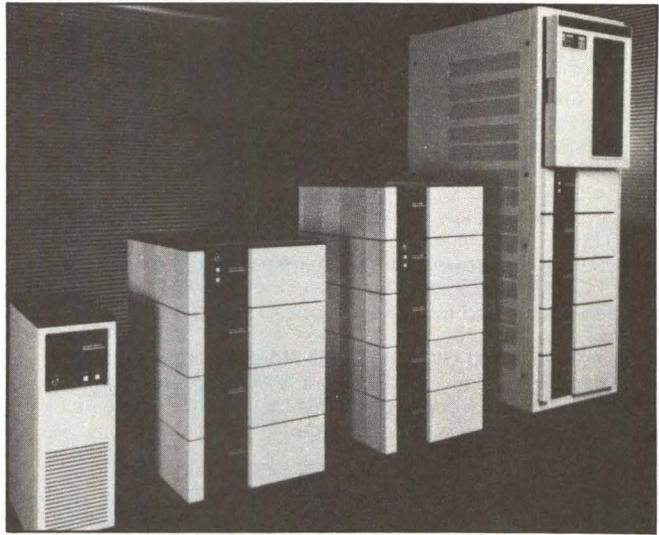
Tom Dent, acting president of TeleSoft, says being first with a second-generation product will be an advantage. "Most of the other compilers," he claims, "will have to go through another rewrite to meet requirements of performance and efficiency." Dent says TeleSoft is well into the rewrite stage, though, because the company placed its priority on marketing instead of early validation and thus gained valuable experience from its customers. TeleSoft's approach with its compiler was to "get it out in the street, find out what it needs to make it run well and design those things in," Dent says.

Likewise, ICS hasn't rushed toward validation with its compiler. Greg Moulton, a member of the ICS

'You can do all sorts of things to get through the validation suite without actually producing a good bulletproof compiler.'

compiler implementation team, says a more careful approach is necessary to protect the compiler's users. "We have a lot of people using the compiler," he says. "We're pretty much forced to work on producing a set of features that are reliable and not just try to make our way through the validation suite." The danger in overemphasizing validation, Moulton notes, is in the temptation to push a poorly performing or even bug-laden compiler through the validation tests. "Validation isn't as comprehensive as you might be led to believe," he observes. "You can do all sorts of things to get through the validation suite without actually producing a good, bulletproof compiler." Moulton says this situation is improving, however, because the validation suite undergoes revision as its shortcomings become known.

The ICS Ada compiler is still evolving, says Moulton. Each release includes new useful features, and validation of a complete compiler for VAX VMS systems is scheduled for the third quarter of this year. But Moulton claims the ICS compiler already performs well. "It's been pretty much unanimously decided that we have the fastest compiler available," he says, "and I'm



Supermicrocomputers that run the ICS Ada compiler include models 11, 21 and 31 of Zilog's System 8000. One of the model 31s shown includes an optional nine-track tape drive.

pretty sure that it's the most efficient, too." Moulton bases his claim on informal benchmark tests by AdaTec, a technical committee on Ada within the Association for Computing Machinery (ACM). He says the ICS compiler also enjoys the advantages of running on some fairly inexpensive machines and of requiring less memory than other Ada compilers.

More validated compilers coming

ICS will have plenty of competition in the coming months; several other companies are also working on Ada compilers. And, although not all of the companies will produce validated compilers this year, some undoubtedly will.

TeleSoft might well be one of the first. By November, the company was preparing at least one Ada implementation for in-house certification, a procedure usually conducted just before formal validation. The company wasn't saying which system the certified compiler would run on, however; that decision would result from an in-house competition among several compiler teams.

Another competitor is Alsys Microsoftware Inc., Waltham, Mass., a U.S. subsidiary of a French company founded by Jean Ichbiah, Ada's chief architect. The company's first products, VAX-hosted Ada cross compilers for 68000- and 8086-based systems, are scheduled for release late this year; native compilers are scheduled to appear soon thereafter.

Originally, Alsys had planned to develop an Ada compiler for the IBM PC but now is re-evaluating that decision. Benjamin Brosgol, Alsys vice president and

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technical director, says the company will complete a compiler for an 8086-based machine, but whether that machine is the PC is still in question. He says next-generation PCs from IBM Corp.—including the XT 370 and the 3270—are more sophisticated and thus better candidates.

Among other Ada companies, SofTech Inc., Waltham, Mass., and Intermetrics Inc., Cambridge, Mass., are developing compilers under DOD contracts. Both the Army-supported SofTech version for the VAX-11/780 and the Air Force-sponsored Intermetrics version for the IBM 370 must meet certain performance specifications in addition to passing validation tests. Both projects are behind their original schedules, however, perhaps because of the additional requirements or perhaps simply because Ada is so complex. Most commercial Ada projects have consistently lagged behind their schedules, too.

Good performance is essential

As these and other companies develop Ada compilers, one fact becomes increasingly clear: with so many compilers soon to be available, customers will be able to pick and choose. As a result, compiler developers must not only supply validated compilers, but also optimize their products for best performance. "If you don't do a fair amount of optimization, Ada can generate a lot of code, basically because there's the concept of checking," says Tucker Taft, a compiler specialist with Intermetrics. "Almost every time you do anything, it checks to make sure that the range of the result is within the legal range of the variable you're trying to assign it to."

Ada suppliers thus concentrate heavily on optimization. In contrast to a year ago—when companies primarily emphasized their knowledge of Ada itself—most now stress their credentials as compiler-optimization specialists. Several have recently hired compiler experts—some with expertise in fast compilation and others with experience in object-code optimization.

How well will the expected crop of validated Ada compilers perform? Only time will tell. If the effort going into them is any indication, though, they will perform quite nicely. In the short term, they might not realize all their goals, but demand for them will probably ensure their use anyway. As Gensoft's Fisher says, "The world is still waiting for a full Ada compiler—a validated Ada compiler—on the more popular machines." □

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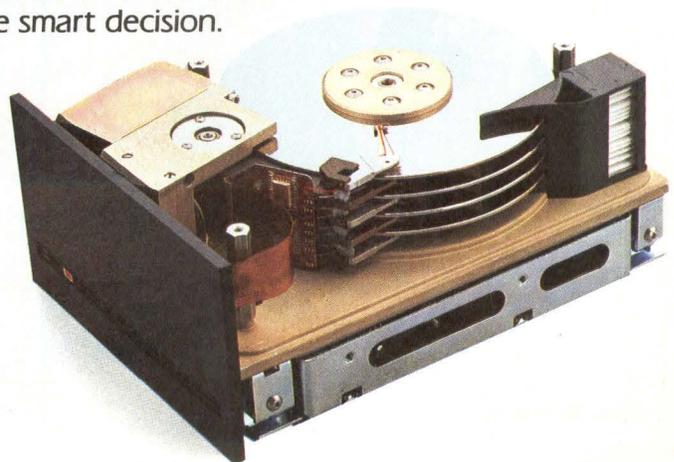
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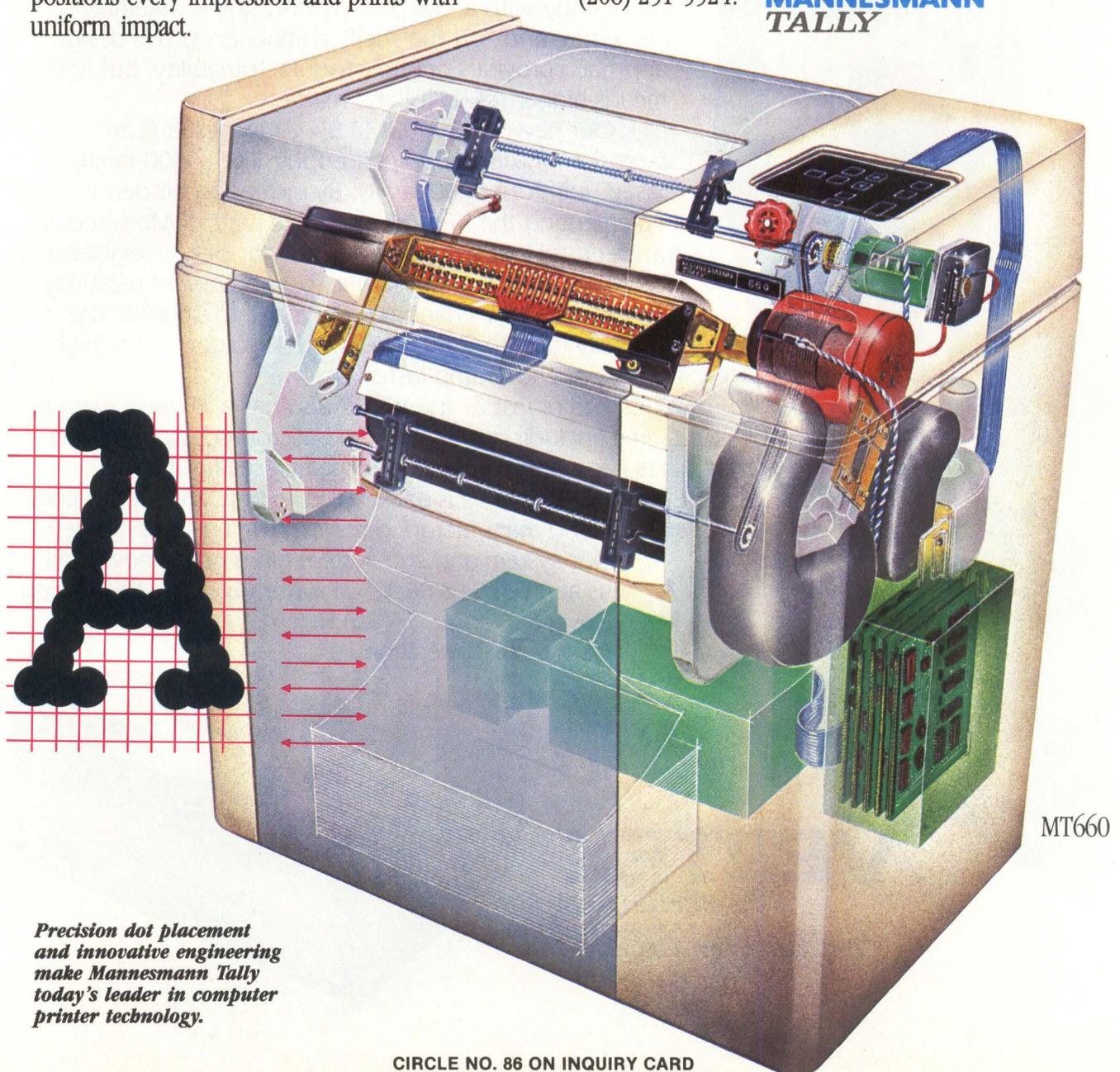
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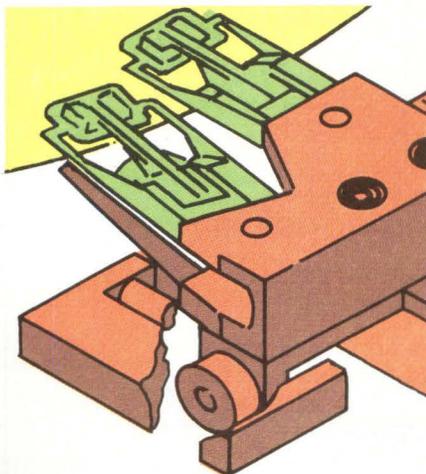
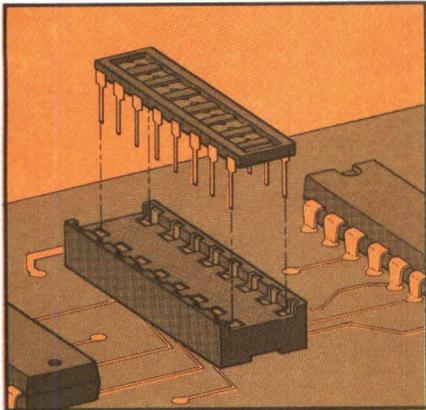
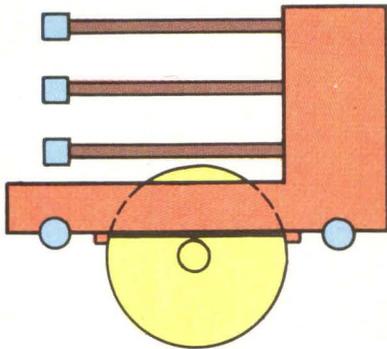
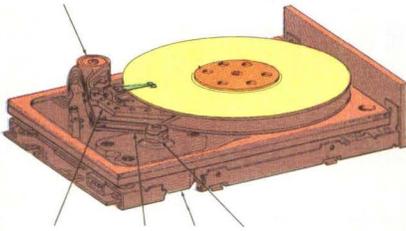
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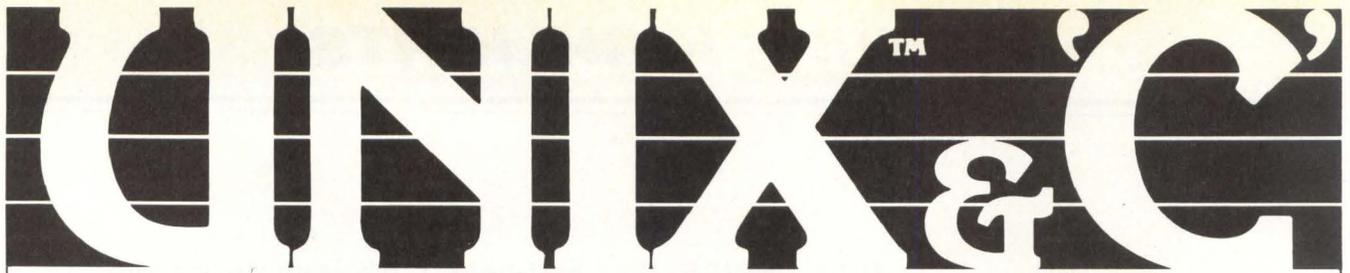


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MEDIA: The magnetic media market has evolved into a multi-billion-dollar industry and is expected to reach more than \$5 billion by 1987. Turn to p. 217 and discover how new recording technologies, such as vertical and optical recording, and new media materials like chromium dioxide and "spin-coated disks," present new marketing as well as technological challenges for media manufacturers.

TAPE DRIVES: Sales of streaming tape drives are surging due to demand for low-cost backup for Winchester disk drives. MMS presents a survey of cassette/cartridge streamers starting on p. 225

SOFTWARE: The industry that supplies minicomputer word-processing software is quite competitive. Beginning on p. 277, MMS details a directory of more than 35 independent software houses and their products.



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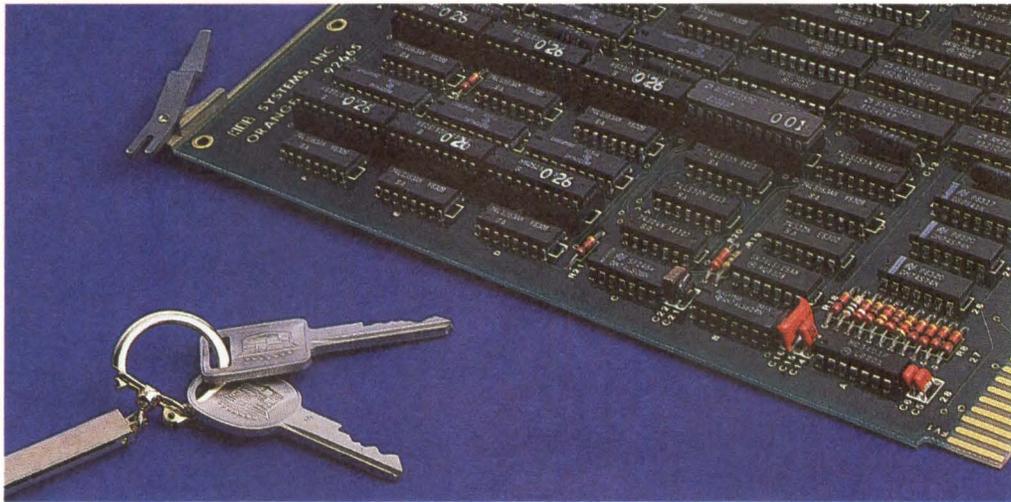
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Product profile: Half-height, 5¼-inch disk drives will dominate low-end storage market

Technological innovations slash sizes, increase performance in anticipation of market boom

David R. Simpson, Associate Editor

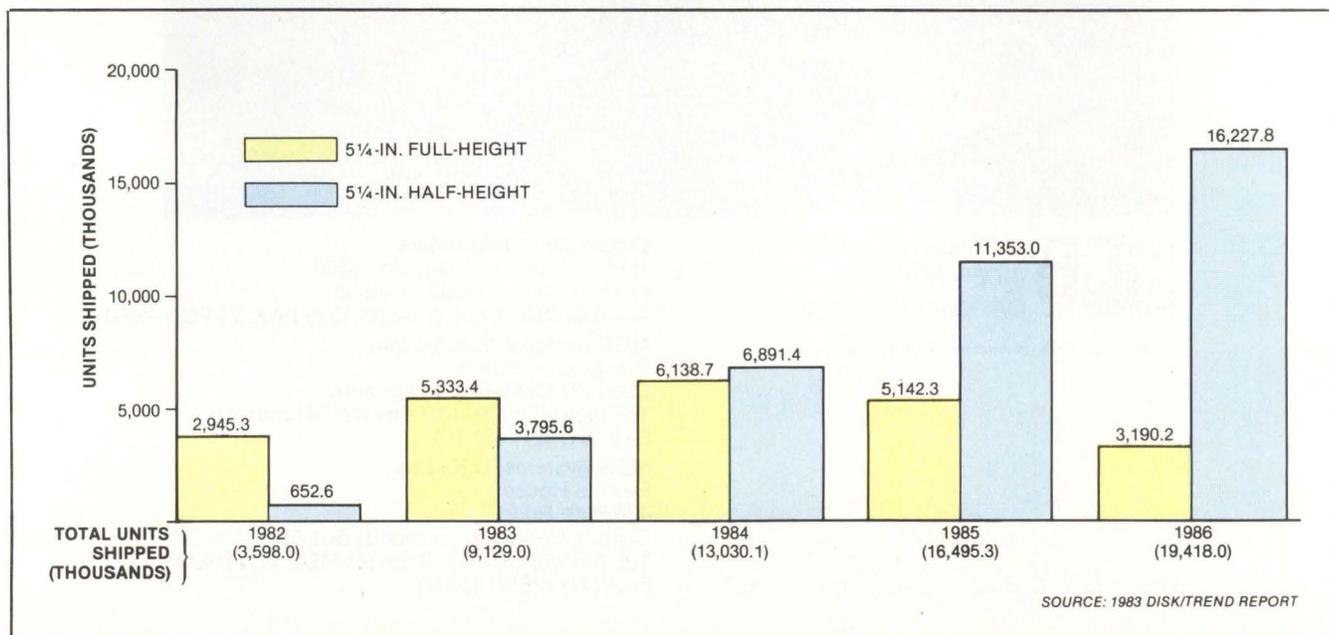
Half-height, 5¼-inch floppy disk drives have met with tremendous success in the OEM/system integration market. The newer half-height arrivals—5¼-inch Winchester—are expected to explode from 72,000 units shipped in 1983 to more than 2 million units shipped in 1986, according to the *1983 Disk/Trend Report*. This rapid growth is not only because integrators can fit two drives into the space formerly occupied

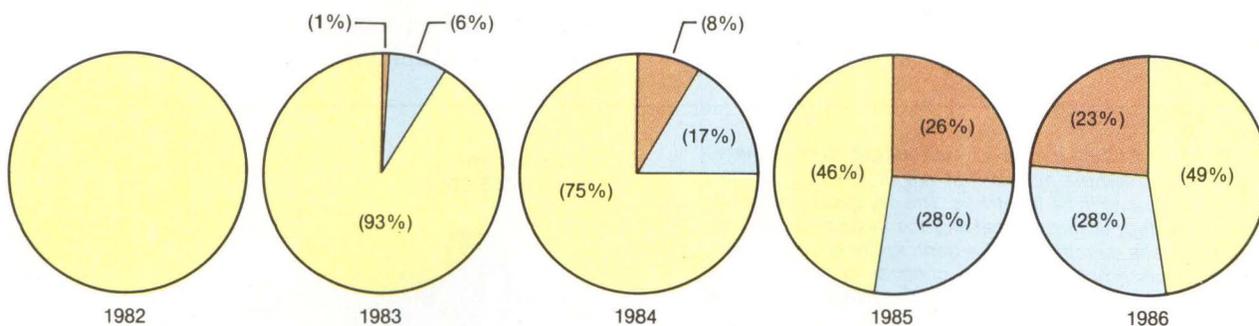
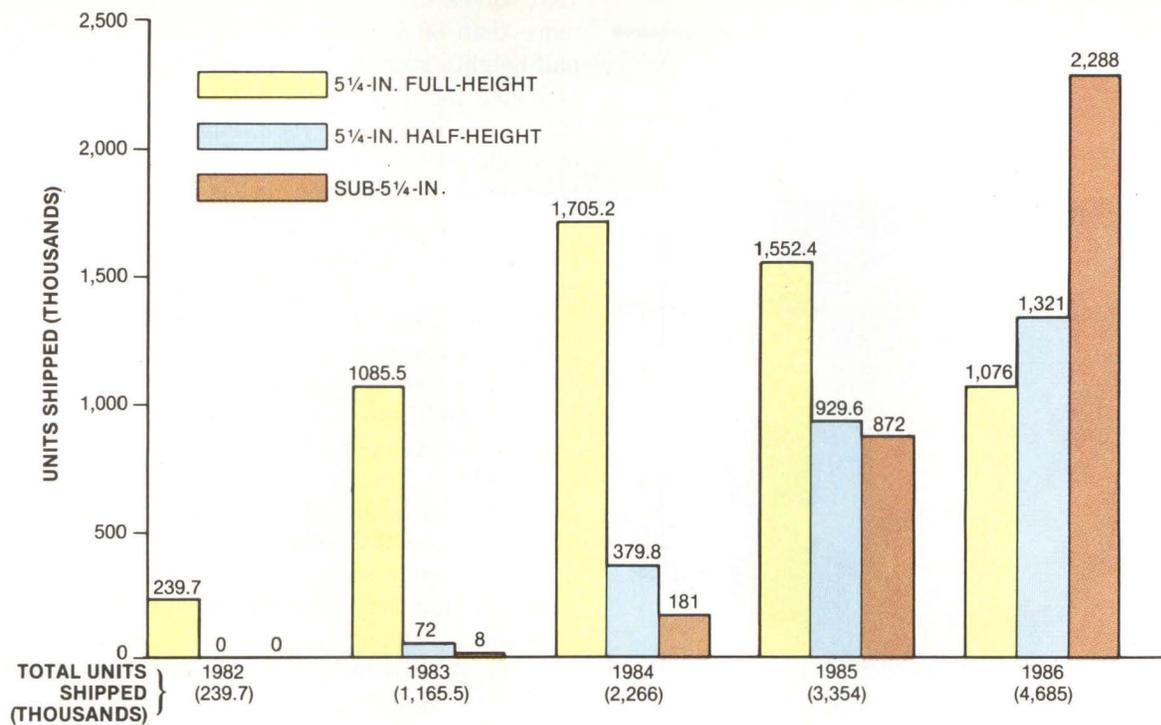
by one, but also because manufacturers of half-height drives have increased their drives' performance in relation to that of full-height drives. Because of these improvements, 5¼-inch, half-height Winchester and floppy disk drives are expected to dominate the low-capacity storage market within the next two years.

Defining the field

The drives in this profile share some characteristics. All the 5¼-inch Winchester incorporate the ST-506/-

Fig. 1. Worldwide shipments of 5¼-inch floppy disk drives are expected to exhibit a 52.4 percent compound annual growth rate from 1982 to 1986. Half-height drives accounted for 18 percent of the market in 1982 but are expected to garner 84 percent of the market by 1986.





SOURCE: 1983 DISK/TREND REPORT

Fig. 2. Full-height drives dominate the less-than-30M-byte, 5 1/4- and sub-5 1/4-inch Winchester market. Half-height drives will reach production quantities this year and are expected to gain 17 percent of the market. Provided that standards are established for sub-5 1/4-inch drives by 1985, they are expected to dominate the market by 1986 with a 43 percent share, representing more than 2 million units shipped. Figures are for the worldwide market and include captive and OEM markets.

412 interface and have a maximum transfer rate of 5M bits per second (bps). Thus, integrators can use standard controllers and existing software. Further simplifying integration into full-height spaces, all of the Winchesters have the same dimensions—1.625 inches high (exactly half the standard height), 5.75 inches wide and 8 inches deep.

The market for half-height floppy disk drives is less homogeneous. Most half-height floppy drives incorporate the SA400/450 standard interface for 5 1/4-inch floppies, but some manufacturers incorporate the SA850 standard for 8-inch floppy disk drives. The SA850 interface facilitates accessing as many as 154 tracks per surface (tps), compared with 40 tps for single-density, 48-track-per-inch (tpi) SA400/450-based drives, and 80 tps for double-density, 96-tpi drives. The 8-inch drive interface uses a 50-pin connection, while the 5 1/4-inch interface uses a 34-pin connection. The

main decision left to integrators is choice of a controller.

Floppy drive dimensions vary. Most are 8 inches deep, facilitating their integration into terminals and personal computers. Most measure 1.61 to 1.63 inches high, but some are smaller, such as BASF Systems Corp.'s 6138 (1.32 inches), Canon U.S.A. Inc.'s MDD211 (1.32 inches) and Epson America Inc.'s SD320 (1.1 inches). To be listed in the profile, a manufacturer of half-height drives must be able to fit two of its drives into the space typically occupied by a full-height drive. This includes manufacturers of sub-6.1-inch drives that offer half-height front panels and adaptive mounting brackets to simplify integration.

Half-height floppies are well-established

Half-height, 8-inch floppy disk drives, such as Shugart Corp.'s SA810/860, found rapid acceptance in



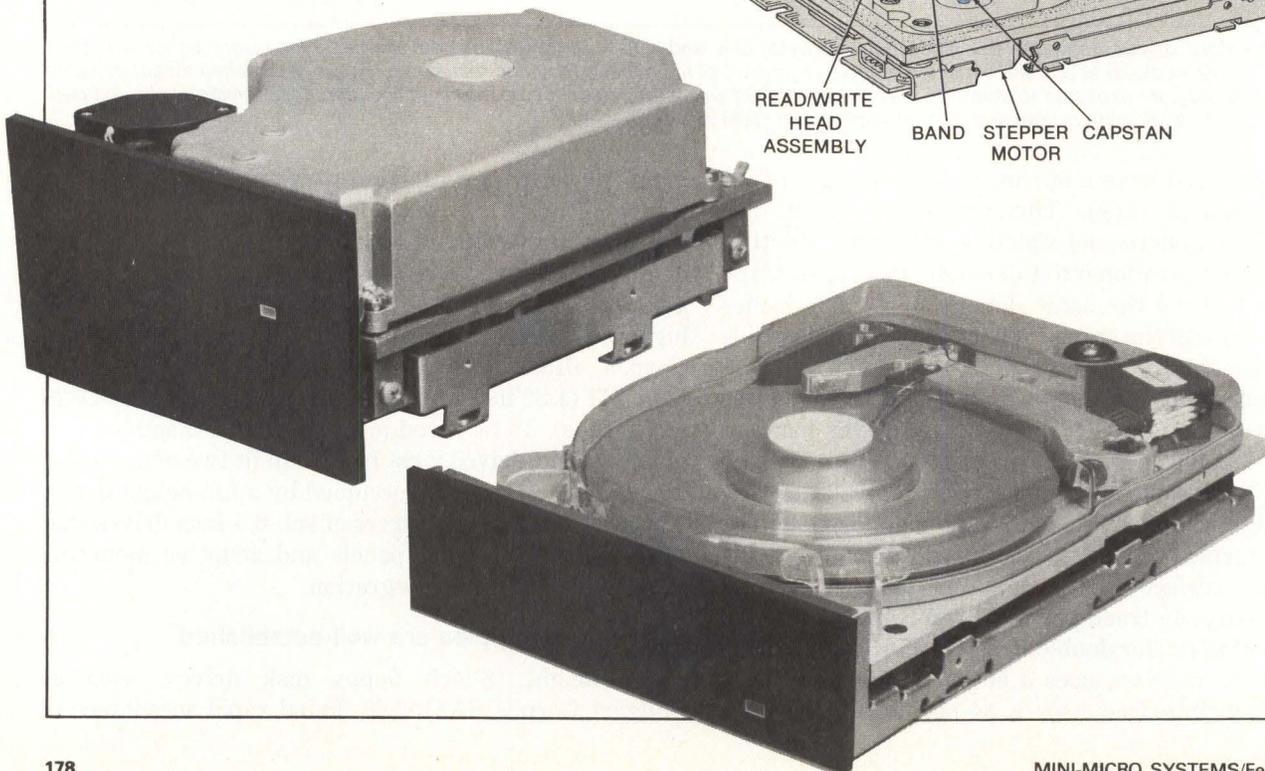
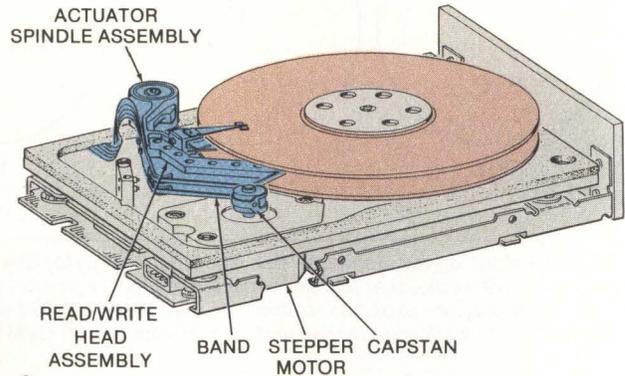
Tandon's half-height TM250 Winchesters offer 6.4M or 12.8M bytes of unformatted storage. The drives use plated media and a rotary stepper motor. The plating consists of a nickel and cobalt layer on an aluminum substrate.

1981. Quick to follow were 5¼-inch versions; there are more than 60 5¼-inch versions on the market. Early half-heights stored 250K or 500K bytes. By mid-1983, Drivetec Inc. pushed this limit to 3.3M bytes with its 320 drive (MMS, July 1983, Page 219) through the use of a closed-loop servo system that records servo-positioning information in the gaps between data tracks. As a result, the drive achieves 192-tpi track density. The 320 has a maximum transfer rate of 500K bps, in contrast to 125K bps for standard single-density drives and 250K bps for double-density drives.

Prices are dropping as the competition increases. The entry of major manufacturers such as Control Data Corp. (CDC) and Micro Peripherals Inc. (MPI) has pushed the cost-per-megabyte level below that of the full-heights. Amdek Corp.'s Amdisk-V holds 500K bytes and sells for \$160 in quantities of 500. MPI's 1M-byte model 902 sells for \$200.

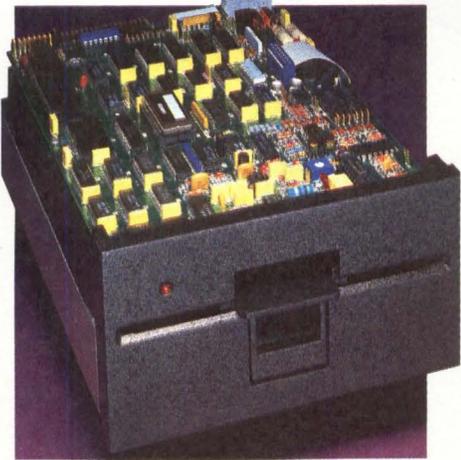
Until recently, system integrators bought half-height drives so that they could fit two of them into the space typically occupied by a full-height unit. But, as half-height, 5¼-inch Winchester hit the market, half-height floppies will function primarily as backup for high-capacity rigid disks. Most half-height, 5¼-inch floppy disk drives are used in desktop personal computers and terminals and in portable units in which space is at a premium.

Shugart's SA700 series of half-height Winchesters incorporate spindle motors that are 50 percent smaller than those used in earlier drives. The capstan is mounted over the stepper motor, enabling the system to transmit motor pulses directly from the band to the head/actuator carriage assembly. This is in contrast to conventional designs, which send pulses from the motor through an intermediate arm and actuator spindle.



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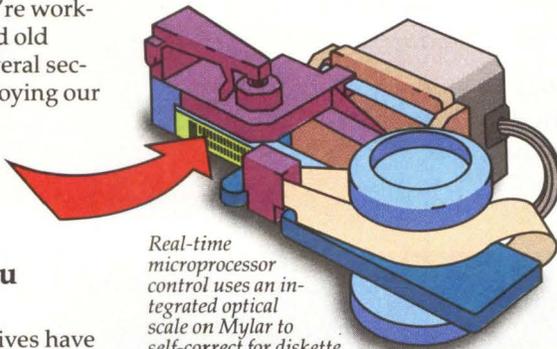
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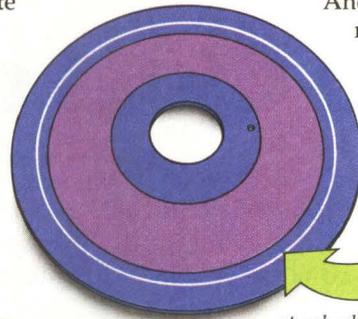
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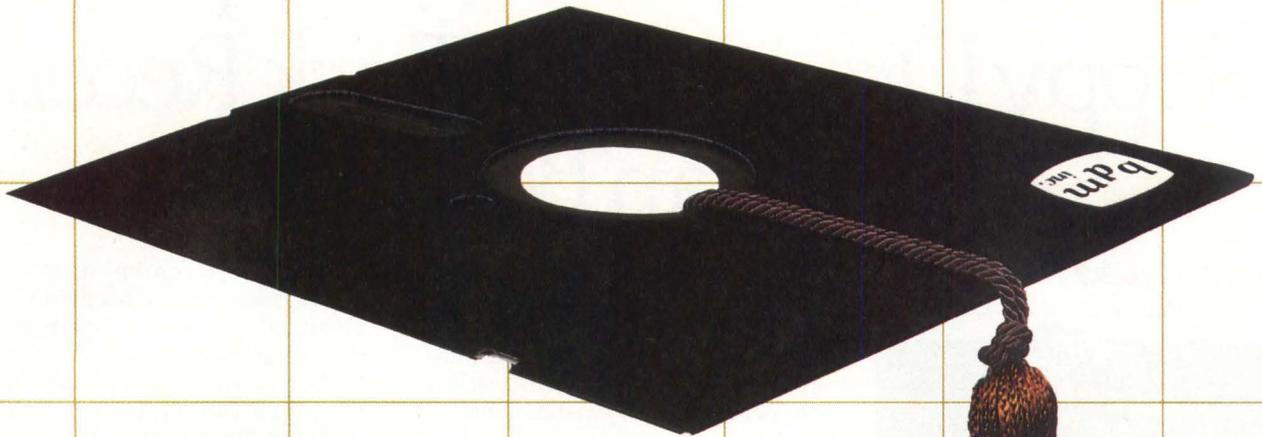
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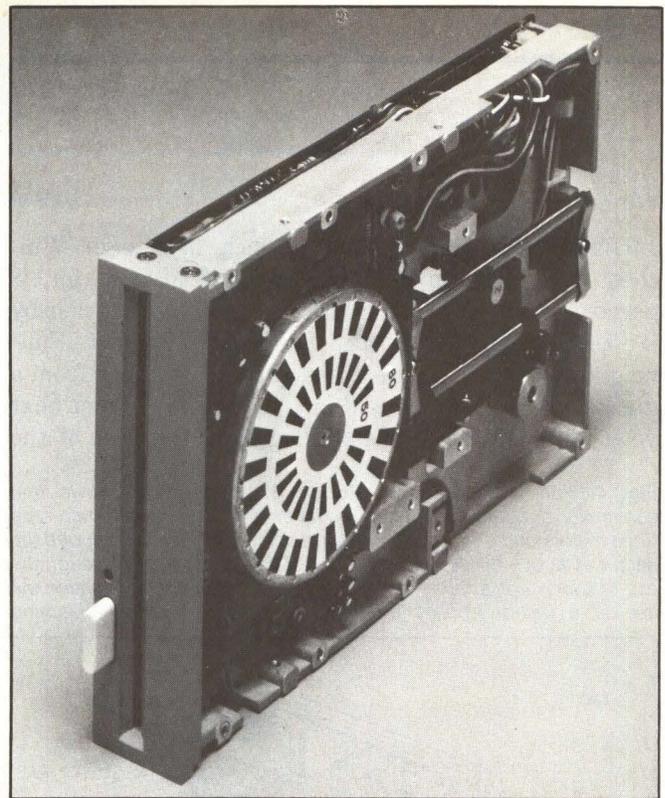


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DISK DRIVES

The only impediment to the half-heights' dominance in the low-capacity diskette market is the sub-5¼-inch drive, whose acceptance is still a few years away. Canon, Hitachi America Ltd., Sony Corp. of America, Tabor Corp. and Tandon Corp. have all developed such drives, but disagreement exists over interface, media and drive-configuration standards for the drives. Sony was first in the fray with its 3½-inch, 437K-byte (unformatted) drive, but it is questionable whether it can establish a single standard for sub-4-inch drives. The American National Standards Institute (ANSI) and the Microfloppy Standards Committee (MSC), which comprises several media and drive manufacturers, are trying to establish standards, but most analysts agree that it won't happen within the next year. Furthermore, sub-5¼-inch drives will not reach the more-than-2M-byte capacities achieved by 5¼-inch half-heights such as those from Drivetec and Mitsubishi Electronics America Inc. Until the standards controversy is settled, 5¼-inch half-heights will move unimpeded into dominance of the low-capacity floppy market (Fig.1).



Canon U.S.A.'s MDD221 diskette drive measures 1.32 inches high, 5.9 inches wide and 8.7 inches deep. The double-sided, double-density drive holds 1M byte.

Shugart's half-height, 5¼-inch SA455/465 floppy disk drive (left) incorporates a low-profile, direct-drive, DC motor and custom LSI circuitry. The SA455 achieves a 48-tpi track density and stores 500K bytes, and the SA465 achieves 96 tpi and stores 1M byte.

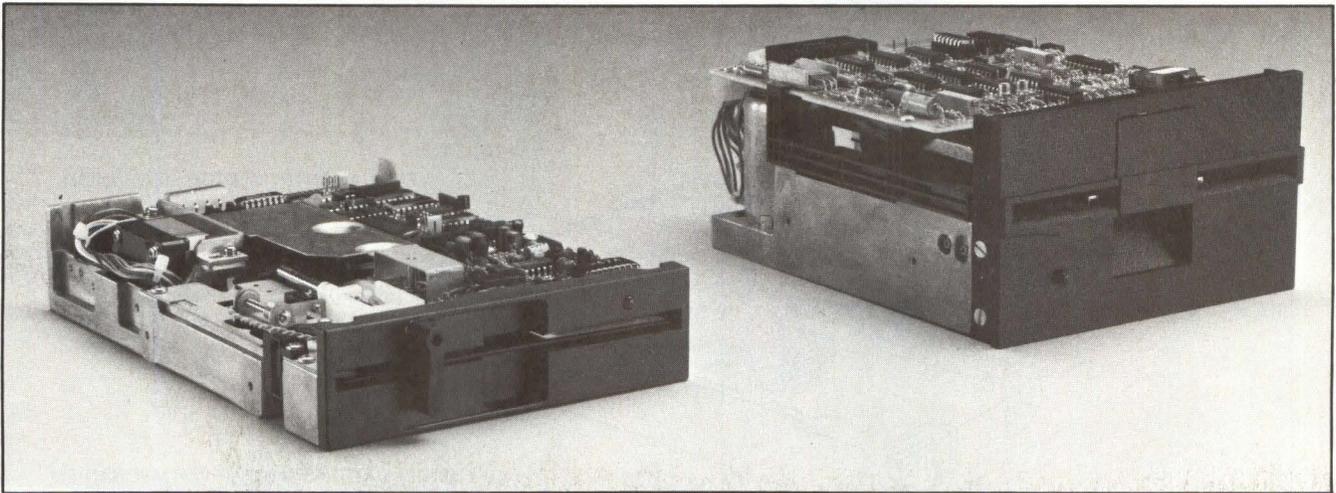
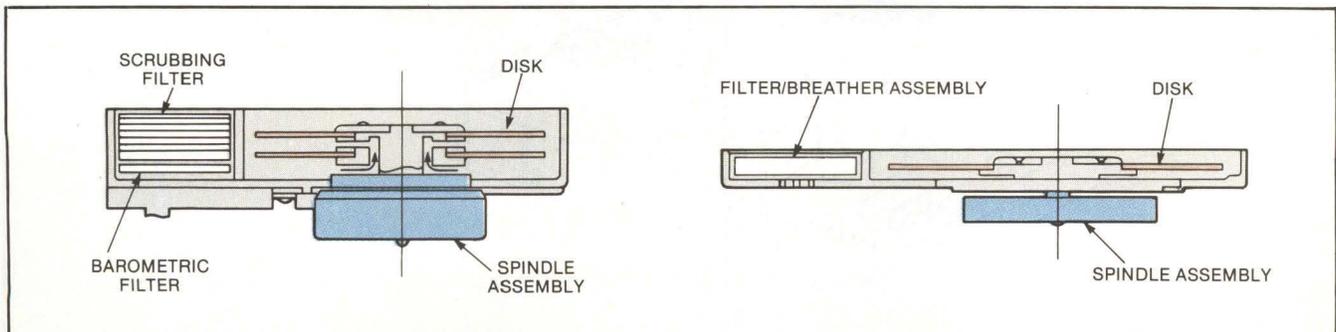


Fig. 3. Head/disk assembly cross sections of Seagate's half-height ST-212 (right) and standard-height ST-412 (left). The ST-212 achieves half-height primarily through the use of a low-profile spindle assembly and a filter assembly. Both drives store 12M bytes.



Winchesters follow suit

High-volume shipments of 5¼-inch, half-height Winchester drives will begin this year and will account for 28 percent of the less-than-30M-byte rigid disk market by 1985, according to the 1983 *Disk/Trend Report*. Full-height drives, in contrast, are expected to drop from a market share of 93 percent last year to 46 percent next year. Sub-5¼-inch drives will garner the rest of the

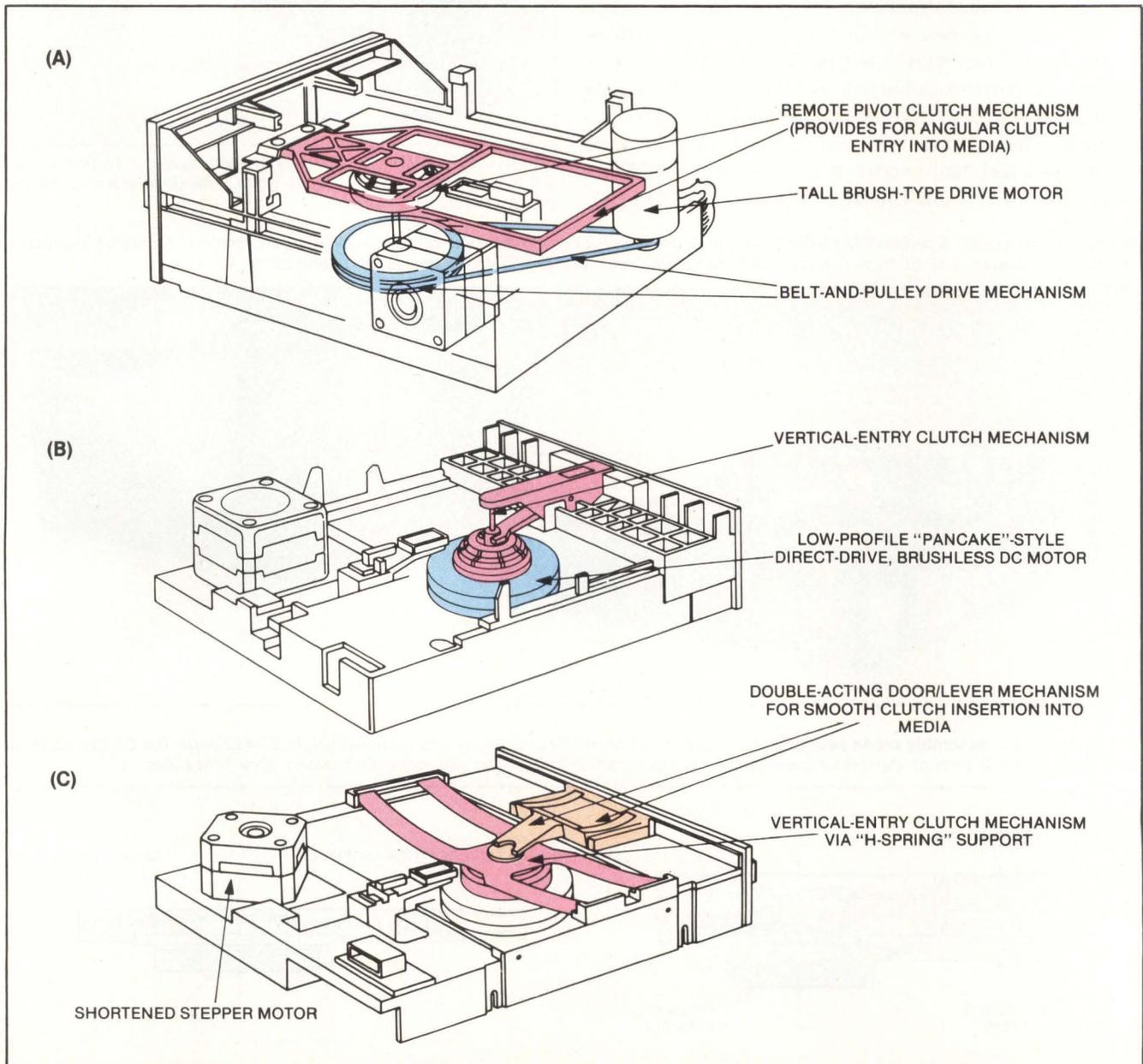
market (Fig. 2).

Most half-height, 5¼-inch Winchester drives store 5M or 10M bytes (formatted). The two newest entrants, however, are pushing this limit to 40M bytes. Disctron Inc.'s 640 drive stores 42.5M bytes (unformatted) on three platters, with one surface reserved for servo-positioning data. Disctron attributes the high density to the use of a closed-loop servo system that uses a linear voice-coil actuator, allowing more precise head positioning. Disctron's drives use thin-film media (see "Metal-film media challenges iron oxide," right), allowing a 960-tpi track density—the highest among half-height Winchester drives.

Tulin Corp.'s 213, 226 and 240 drives, introduced at

Fig. 4. Full- to half-height floppy disk evolution shows that conventional 5¼-inch, full-height drives (A) use large brush-type drive motors and angular clutching mechanisms. Remex reduced the height of its two-thirds-height RFD 480/960 (B), primarily through the use of a low-profile, direct-drive, brushless DC motor, eliminating the use of a belt-and-pulley mechanism. Using a vertical clutching

mechanism improves media centering. On the half-height RFD 485/965 drive (C), Remex shortened the stepper motor and moved the drive's circuitry to the underside of the frame assembly, making the drive smaller. The "H-spring" further reduced the size of the clutching mechanism while providing better torque pressure.



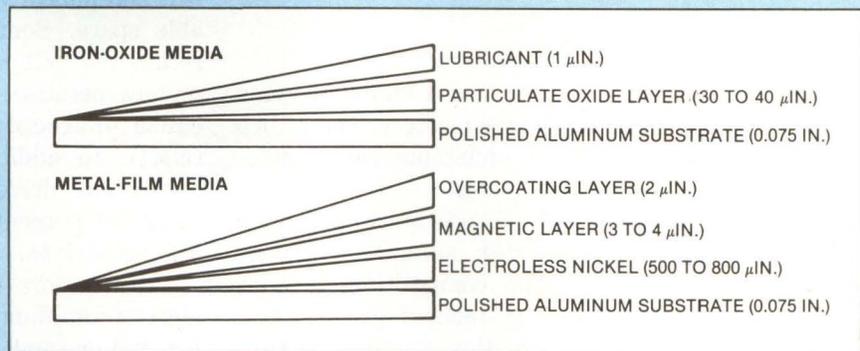
METAL-FILM MEDIA CHALLENGES IRON OXIDE

Of the two types of media used in 5¼-inch Winchester drives—iron oxide and metal film—iron oxide is the more common. It is a formulation of finely ground iron-oxide and alumina particles kept in suspension within an adhesive binder. The binder is applied to a rotating, polished aluminum substrate for longitudinal magnetic recording.

The term "metal-film media" describes the deposition of a thin- or thick-film coating on a polished aluminum substrate. Metal-film media includes thin film for longitudinal recording and thick film for vertical recording, in which bit cells are oriented perpendicularly to a disk's surface.

The key difference between metal and oxide media is homogeneity. Iron oxide is non-homogeneous; that is, iron-oxide particles are randomly suspended within a binder. Metal film, however, is homogeneous; that is, it consists of a uniform magnetic-layer composition. Metal film allows higher recording densities because of the substantially greater concentration of magnetic particles. The use of oxide media typically allows 8,000 to 10,000 bits per inch (bpi) and 960 tracks per inch (tpi), while thin-film media can accommodate 12,000 bpi and 1,500 tpi.

The magnetic layer of metal-film media is about one-tenth that of particulate-oxide layers, and the thin-film overcoating layer is smoother, which allows recording heads to fly closer to the disk surface. Thin-film media is also more durable than oxide, an advantage in portable and



rugged applications.

The major drawback to thin-film acceptance is that it costs more to manufacture on a per-disk (although not on a cost-per-megabyte) basis. When drive capacities were lower and drives didn't require high densities, oxide media was the economical choice. Now, 16- and 32-bit super-microcomputers for multiuser, multi-tasking environments are fueling the demand for higher-capacity disk drives. Current particulate-oxide media cannot meet the requirements of 5¼-inch drives storing more than 50M bytes with higher bit densities and data-transfer rates. As a result, many drive manufacturers are turning to metal-film media.

Market research companies disagree about the rate of acceptance, but all agree that thin film is the next wave in recording media. According to a recent study by Montgomery Securities Inc., San Francisco, thin-film media will account for 75 percent of all media used in 5¼-inch Winchester drives by next year, and a further increase is expected when the new

half-height and sub-5¼-inch drives come on-line. Dataquest Inc., a Cupertino, Calif., research company, expects the demand for thin-film media to outstrip supply by 300 percent this year. Dataquest's recent studies predict that metal-film media will account for 55 percent of the total media market for 5¼- and sub-5¼-inch Winchester disks by 1987. This translates into an estimated total of 11.5 million metal-film disks sold in 1987 and \$225 million in revenues.

In the 5¼-inch Winchester market, major manufacturers such as Evotek Corp. and Vertex Peripherals Inc. are using thin-film media. Evotek's ET-5000 drives have 49-msec. average access times and storage capacities from 7.81M to 51.6M bytes. Vertex's V170 packs 72.3M bytes into a 5¼-inch drive, due in large part to the use of thin-film media. In the half-height arena, Discron Inc.'s 620 and 640 drives offer 25.5M and 42.5M bytes, respectively, due to the use of a closed-loop servo-positioning system and thin-film media. Microscience International Corp. also uses thin-film media in its half-height drives, but others, such as Cogito Systems Inc., are relying on oxide-coated media until the question of thin-film-media availability is answered.

Start-up media manufacturers are eager to capitalize on the expected demand for thin-film media. Information Memories Corp. (IMC), for example, is committed solely to high-volume manufacturing of thin-film disks. IMC will begin high-volume shipments early this year, and, according to IMC president Burton Sisco, a co-founder of Evotek, IMC will roll out at least 150,000 disks this year and as many as 10 million substrates per year by 1987. Price of a 10M-byte IMC disk is expected to be \$32, says John Davenport, vice president of marketing. This compares to an average of \$25 for a 5M-byte oxide-coated disk.

Parameters	Oxide media	Metal media
Coercivity (oersteds) A measurement value of demagnetization force.	250-600	450-900
Amplitude (μV.) Head output	400-500	800-1000
Resolution range (%) Amplitude measured at the highest operating frequency (2F) over half of that frequency (1F).	60-70	80-90
Overwrite range (db) The ratio of a 1F signal remaining on the same track when rerecorded at a 2F signal.	26-30	30-34
Signal-to-noise ratio range (db)	26-28	28-32
Maximum tracks per inch	960	1500
Maximum bits per inch (MFM recording)	14,000	20,000
Hardness (mohs) Mohs' scale is a scale of hardness for minerals, in which 1 represents the hardness of talc and 10 represents the hardness of diamond.	2.5	5.5

Comdex last fall, store 13.34M, 26.7M and 40M bytes (unformatted) on one, two or three platters. The \$1,055 price of the 40M-byte model undercuts comparable-capacity, full-height, 5¼-inch drives.

As with floppies, the only foreseeable barrier to half-height, 5¼-inch Winchester acceptance comes from sub-5¼-inch drives. The competition includes CDC, Rodime Plc. and SyQuest Technology. The new drives offer comparable capacities (SyQuest's two-platter model stores as much as 25.5M bytes) and compatibility with all 5¼-inch disk standards. Analysts predict that shipments of sub-5¼-inch units will equal 5¼-inch disk shipments by the end of next year and will double them in 1986. Manufacturers of half-height Winchesters are eyeing the sub-5¼-inch market, although none acknowledges plans to enter the market.

Innovations slash size, increase performance

The major space saver in the move from full- to half-height drives, whether floppies or Winchesters, is the use of brushless, direct-drive, DC spindle motors

that are as much as 60 percent smaller than their AC predecessors (Fig. 3). Direct-drive motors replace belt-and-pulley mechanisms, which consume considerable space. Some manufacturers, such as Drivetec, retain the belt mechanism with their low-profile DC motors because they claim that direct-drive motors cause unacceptable electromagnetic interference (EMI). In addition to reducing spindle-motor size, half-height drives employ stepper motors that are about 50 percent shorter than those used in earlier 5¼-inch drives.

DC motors require high-precision speed-control electronics. Manufacturers use customized LSI circuits for motor and read/write control, which reduces electronic parts count and board size. Drivetec's 320 minifloppy, for example, uses four custom LSI chips and a 6805 microprocessor. The reduced electronic parts count has the added benefit of reducing power consumption. Seagate Technology's ST-212 Winchester, for example, dissipates only 17W, and Tulin's half-heights dissipate only 15W. This is in contrast to an average of 25W for full-height drives.

While reducing the size of the motors, manufacturers of half-height drives have also refined motor technology. The stepper motor in Shugart's SA706/712, for example, is a 16-pole motor, as opposed to older,

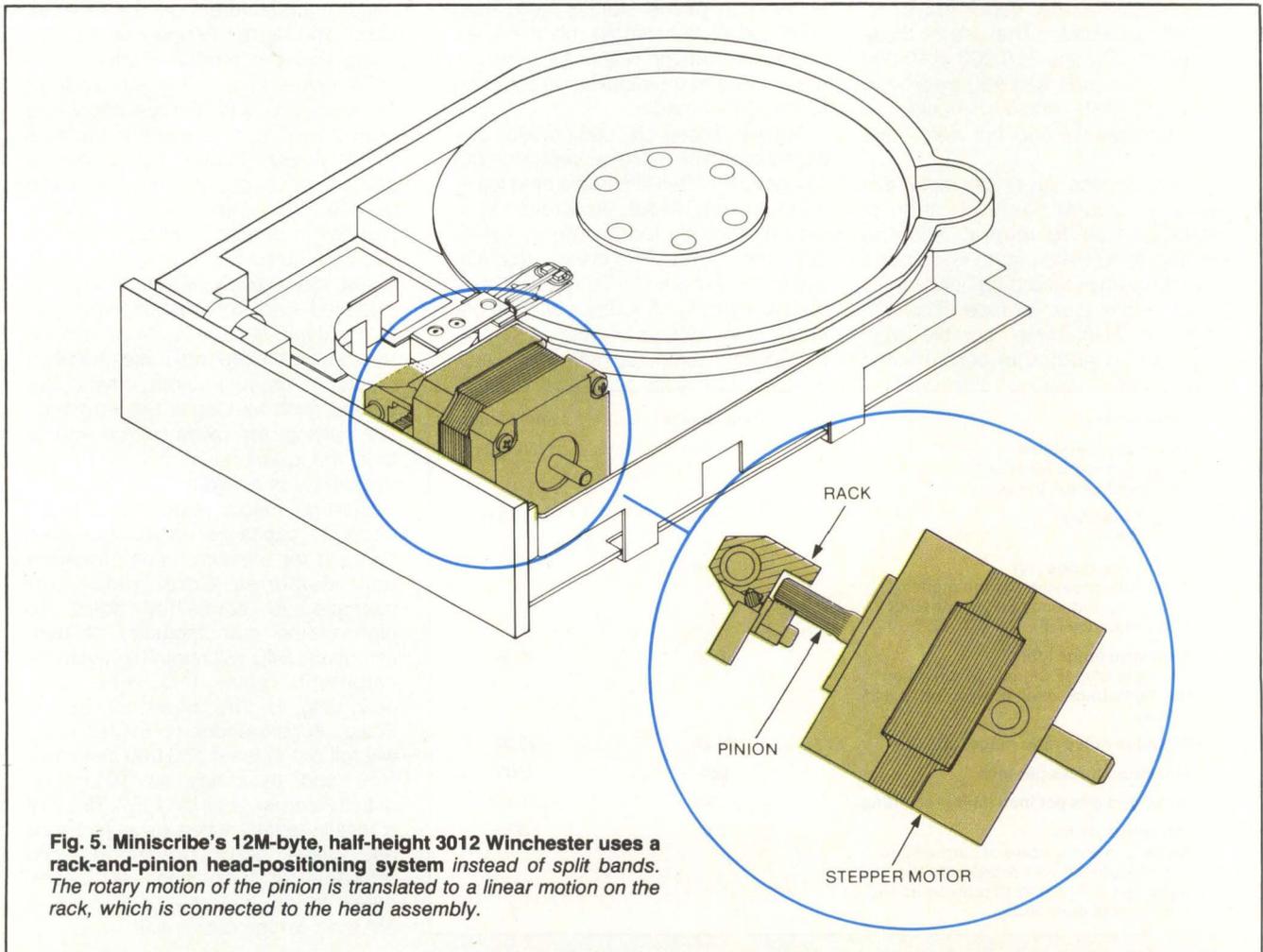
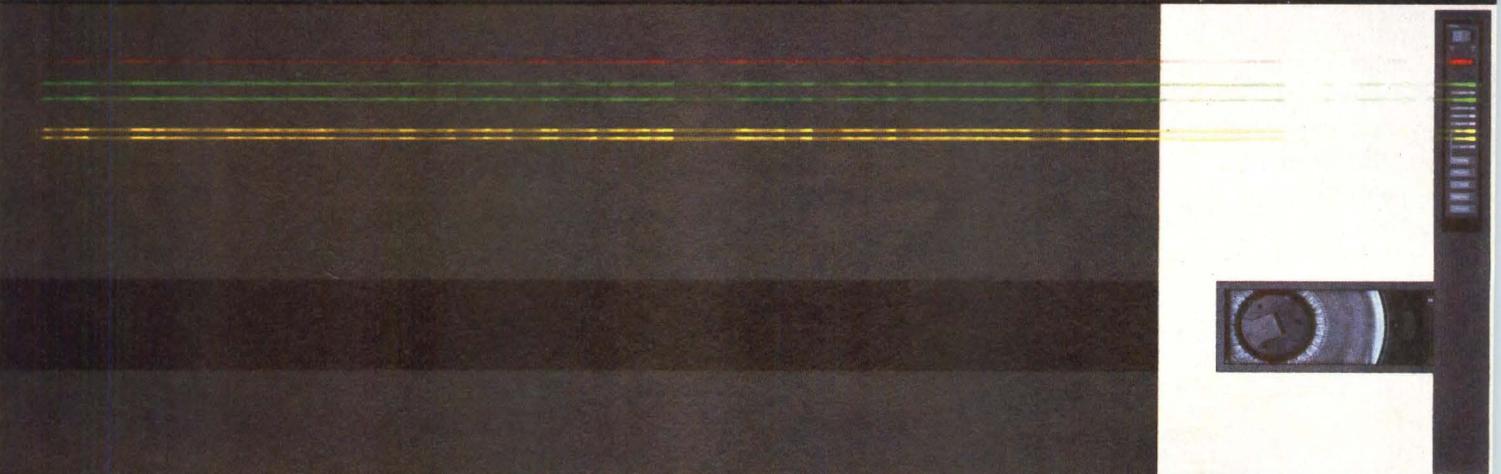
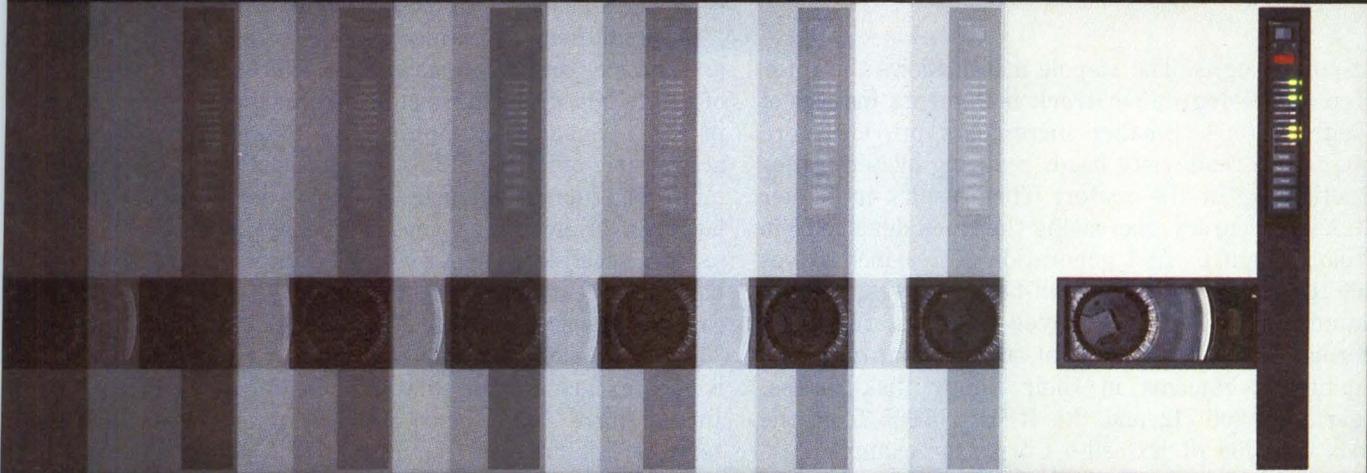


Fig. 5. Miniscribe's 12M-byte, half-height 3012 Winchester uses a rack-and-pinion head-positioning system instead of split bands. The rotary motion of the pinion is translated to a linear motion on the rack, which is connected to the head assembly.

Start/Stop or Streaming?



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Now we've enhanced this 2920 with an added 100 ips streaming capability. Combined with the 2920's existing start/stop capability, it makes this device the most versatile, low-cost tape subsystem on the market today.

The 2920's innovative mechanical design coupled with an extensive LSI implementation provides outstanding subsystem reliability and simplicity-of-service. It performs equally well whether off-loading a disk drive or executing a sort/merge. As a start/stop device, the 2920 features a very fast 5 ms start time. As a streamer, the 2920 will back-up a 100 MByte disk in 2.7 minutes using less than one reel of tape.

For a well rounded tape subsystem that can handle all of your tape needs — at a price you can afford — with performance and quality you can appreciate, contact OEM Marketing at Storage Technology Corporation, (303) 673-4066, and inquire about our 2920 Tape Subsystem's new dual-speed feature. Or write Storage Technology Corporation, OEM Marketing, Mail Drop 3N, Louisville, Colorado 80028.

The 2920 OEM Tape Subsystem Features:

- Dual-Density 6250/1600 bpi
- 50 ips Start/Stop
- 100 ips Streaming
- Automatic Threading
- CMOS LSI

StorageTek

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eight-pole designs. The 16-pole motor allows the rotor to step at 0.9-degree-per-track increments instead of 1.8-degree steps. Smaller increments provide more torque to the read/write head, reducing hysteresis, or magnetic lag, in the motor. This results in higher positioning accuracy, increasing the track density from 256 tpi in Shugart's first generation of 5¼-inch drives to 360 tpi in the SA706/712 half-height drives.

Manufacturers have also saved space and increased performance by using vertical, rather than angular, clamping mechanisms in their floppy disk drives. Shugart's SA706/712 and the RFD 485/965 from the Remex Division of Ex-cell-o Corp., for example, use vertical clamping. In vertical clamping, the clamp is placed on the same centerline as the spindle, which provides better diskette centering and reduces media wear resulting from misclamping. Vertical clamping devices also have the benefit of being smaller than angular pivot clamps (Fig. 4).

Reduced access times of half-height drives are another performance improvement over full-heights. Shugart's SA465 half-height drive, for example, has a 94-msec. average access time, compared with the

252-msec. average access time of the full-height SA400. The improvement is a result of more accurate positioning, which in turn is due to improved stepper and spindle motors, greater track densities and improved read/write heads.

Most full-height, 5¼-inch Winchester drives have average access times around 85 msec., but some manufacturers of half-height drives have cut this time by more than 50 percent. Seagate attributes the 65-msec. average access time of its ST-212 to an improved linear stepper motor and increased track densities. Disctron's 620/640 has an average access time of 35 msec., the result of using a closed-loop, linear voice-coil actuator, which can handle more tracks per surface (816) and achieve a greater track density (960 tpi). The 620/640 uses a "dedicated" closed-loop system; that is, one disk surface is used exclusively for servo information. Microscience International Corp. and Tulin also use closed-loop servo-positioning systems in their half-height drives.

High-capacity, half-height diskette drives use closed-loop servo-positioning systems to pack 3.3M bytes per drive.

Stepping to the beat of a different band, Miniscribe Corp.'s half-height 3006/12 drives employ a rack-and-pinion positioning system (Fig. 5). In contrast to conventional split-band actuators, the rack-and-pinion actuator allows full revolutions of the stepper-motor shaft, enabling the system to access more tracks per surface and, because it has no bands, to withstand a wider range of operating temperatures than band actuators. The drives can achieve recording densities as high as 10,000 bits per inch (bpi), a track density of 588 tpi and can access 1,224 tps.

Full-height and sub-5¼-inch drives will continue to affect half-height Winchester and floppy disk drives in capacity, performance and cost. To meet this competition, more half-height floppy disk drives will enter the multimegabyte storage range within the next year. Access times will decrease in proportion to available recording densities and head/actuator advances. Because full-height drives are field-proven and manufacturing techniques are geared toward current technologies, full-height drives are not expected to incorporate the technological advances of half-height drives.

Manufacturers of half-height Winchester drives will increasingly turn to drives storing more than 10M bytes. As more companies adopt thin-film media, thin-film read/write heads and advanced positioning techniques, recording densities will climb from a current maximum of 10,568 bpi to around 15,000 bpi. Track densities will push the 1,000-tpi mark, and average access times are expected to be consistently less than 85 msec. by next year. □

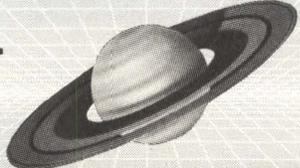
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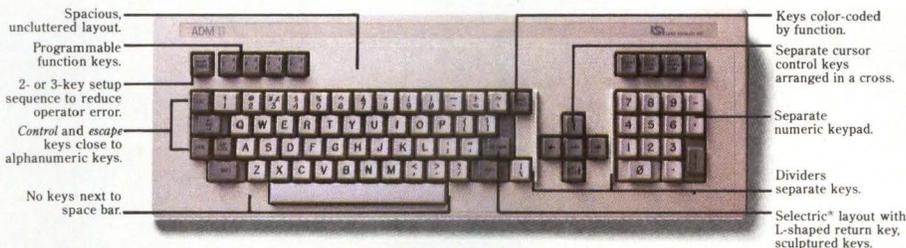
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Programmable Function Keys	4 (Shiftable to 8)	16 (Shiftable to 32)	16 (Shiftable to 32)
Non-Volatile Function Keys	Optional	Standard	Standard
Function Key Legends on 25th Line	From Host	From Host	Standard Non-Volatile
No. of Pages of Display Memory	1	2	4
Display Memory Configurations (Plus 25th Message/Status Line)	24 Lines by 80 Characters	(2) 24 x 80 or (1) 48 x 80 or (1) 24 x 158	User Definable up to 96 x 80
Scrolling	Standard Scrolling	Smooth, Jump or Horizontal Scrolling Split Screen	Smooth or Jump Scroll Split Screen
Transmission Mode	Conversation Mode	Conversation or Block Mode	Conversation or Block Mode
Editing	Limited	Full Editing & Protected Fields	Full Editing & Protected Fields
Visual Attributes: Reduced Intensity, Blink, Blank and Reverse Video. Underline also on ADM 12 and ADM 24E	3 Embedded 1 Non-Embedded	4 Embedded, 1 Non-Embedded or All Non-Embedded, plus Full Screen Reverse Video	5 Embedded, 1 Non-Embedded or All Non-Embedded, plus Full Screen Reverse Video and Highlight
OEM Flexibility	Modifiable Set-Up Characteristics	Modifiable Set-Up Characteristics & Personality	Modifiable Set-Up Characteristics. Add to Program in ROM or Down-Line Load in RAM (56K ROM or RAM. Up to 22K Display Available) Room for additional Logic Boards.
Terminal Compatibility	ADM 3A, ADM 5, ADDS Viewpoint & Regent 25, Hazeltine 1400, 1420 & 1500, DEC VT-52	ADM 3A, ADM 5, ADM 31, ADM 32	ADM 3A, ADM 5, ADM 31, ADM, 32, ADM 42

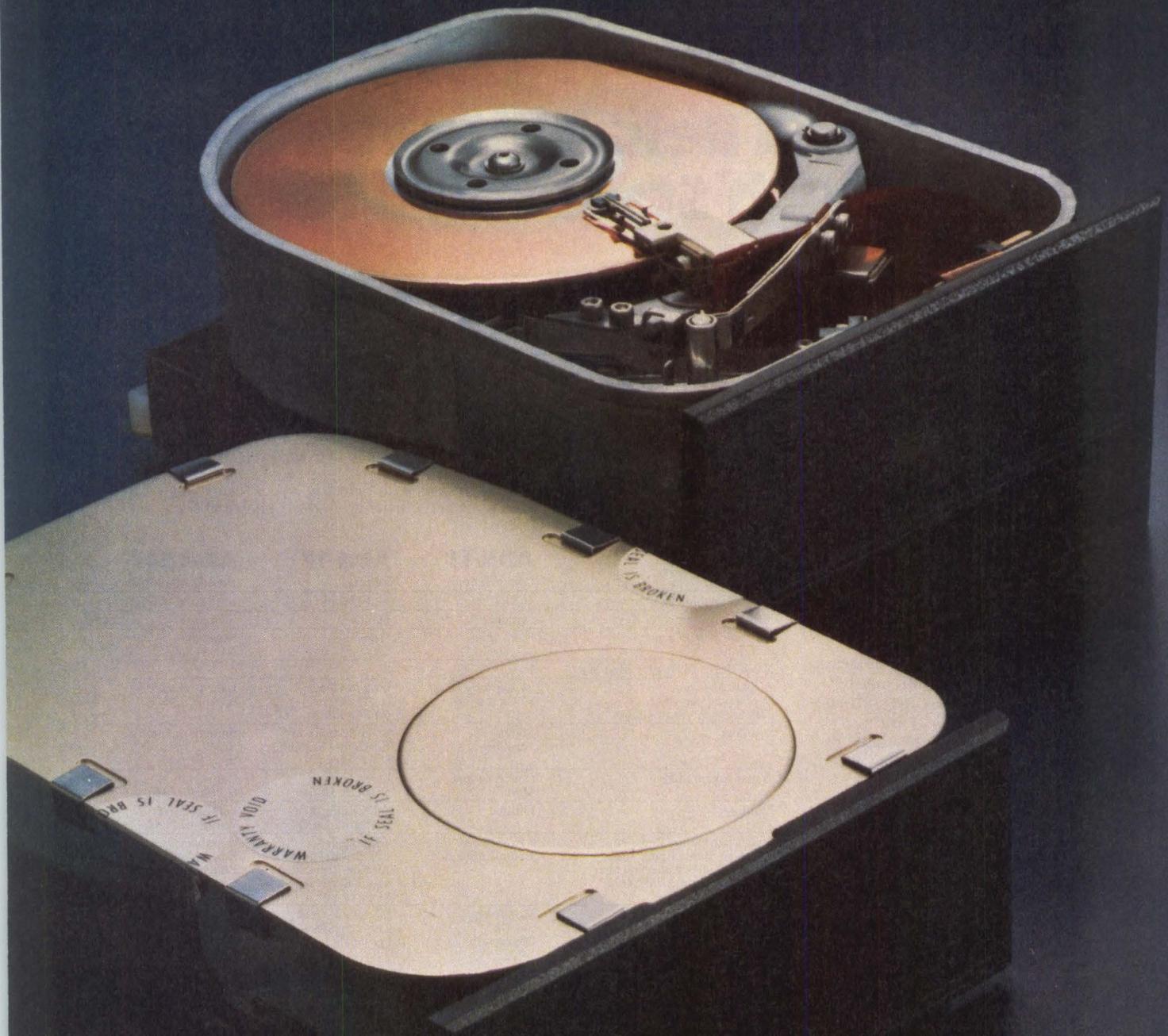
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Otari Singapore Pte., Ltd. Golden Mile Complex, 5001 Beach Rd. #03-50, Singapore 0719 Phone: 294-5370, Telex: RS36935 OTARI

5¼-inch, half-height Winchester

Company Model(s)	Unformatted capacity (M bytes)	Average access time (msec.)	Number of data surfaces	Number of read/write heads	Bytes/track (unformatted)	Tracks/surface	Tracks/inch	Bits/inch	Actuator type	Date of first delivery	Price (Q500)	Notes, features, options	Circle no.
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COGITO SYSTEMS

2355 Zanker Rd.
San Jose, CA 95131
(408) 942-8262

819

CG906/912	6.38, 12.76	85	2/2, 4/4	10,416	306	345	8,783	linear stepper motor	6/83	595; 695	oxide-coated media	
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DISCTRON INC.

1701 McCarthy Blvd.
Milpitas, CA 95035
(408) 946-6692

820

620/640	25.5, 42.5	35	3/3, 5/5	10,417	816	960	9,300	closed loop, linear voice coil	mid-1984		thin-film media; dedicated surface for servo information	
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FUJITSU AMERICA INC.

3075 Oakmead Village Dr.
Santa Clara, CA 95051
(408) 988-8100

799

M2230AT/ 2233AT	6.7, 13.3	95	2/2, 4/4	10,416	320	300	10,200	linear stepper motor	3/84	750 (Q100), 850 (Q100)		
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INTERNATIONAL MEMORIES INC.

10381 Bandley Dr.
Cupertino, CA 95014
(408) 446-9779

821

2306/2312	6.38, 12.75	85	4/	10,417	306	303	9,706	linear stepper motor		615		
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MICROSCIENCE INTERNATIONAL CORP.

575 E. Middlefield
Mountain View, CA 94043
(415) 961-2212

822

HH-612	12.76	50	2/4	10,416	612	648	9,680	closed loop linear stepper motor	5/83	490 (Q10,000)	plated media; servo information recorded in gaps between tracks (embedded)	
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MINISCRIBE CORP.

1871 Lefthand Circle
Longmont, CO 80501
(303) 651-6000

823

3006/12	6.4, 12.8	85	2/2	10,416	612, 1224	588	8,290; 10,000	rack and pinion	11/82	425 (Q1,000); 499 (Q1,000)	dedicated head shipping zone; carriage locking mechanism	
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SEAGATE TECHNOLOGY

920 Disc Dr.
Scotts Valley, CA 95066
(408) 438-6550

824

ST212	12.76	65	2/4	10,416	612	550	10,568	linear stepper motor	10/83	690 (Q1,000)	17-watt power requirement; can withstand 40 g's	
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SHUGART CORP.

475 Oakmead Pkwy.
Sunnyvale, CA 94086
(408) 733-0100

825

SA706/712	6.3, 12.7	99	2/2, 4/4	10,416	306, 612	360	9036	linear stepper motor	1st quarter '83	444	automatic spindle and actuator locks; dedicated head landing/shipping zone	
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5¼-inch, half-height Winchester

Company Model(s)	Unformatted capacity (M bytes)	Average access time (msec.)	Number of data surfaces Number of read/write heads	Bytes/track (unformatted)	Tracks/surface	Tracks/inch	Bits/inch	Actuator type	Date of first delivery	Price (\$500)	Notes, features, options	Circle no.
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TANDON CORP.

20320 Prairie St.
Chatsworth, CA 91311
(213) 993-6644

826

TM251/252	6.4, 12.8	85	2/2, 4/4	10,416	306	345		rotary stepper motor	6/83	475; 525	plated media (nickel and cobalt layer over an aluminum substrate)	
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TULIN CORP.

2393 Qume Dr.
San Jose, CA 95131
(408) 942-9025

827

213/26/40	13.34, 26.7, 40.0	85	2/2, 4/4, 6/6	10,416	640	656	10,000	closed loop rotary stepper	8/83	650; 850; 1,055	embedded servo wedge; landing/shipping zone; automatic actuator lock	
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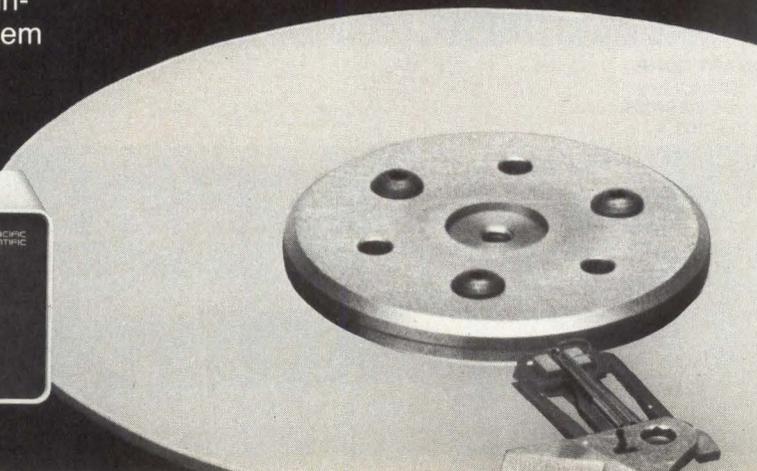
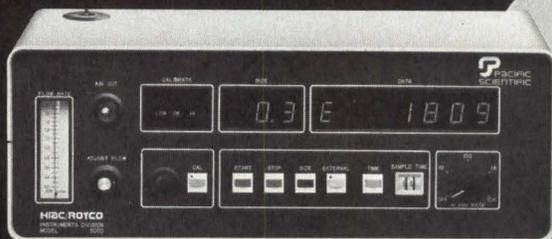
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	3½"		5¼" (1/2 High)			5¼" (1/3 High)
MEDIA SIZE	4" x 1.57" x 5.98"		5.75" x 1.6" x 7.68"			5.75" x 1.1" x 9.27"
Max. Capacity (2 Sides) (Unformatted)	500 KB	1000 KB	500 KB	1000 KB	1604 KB	500 KB
Drive Motor Speed	300 RPM	300 RPM	300 RPM	300 RPM	360 RPM	300 RPM
Track Density	67.5 TPI	135 TPI	48 TPI	96 TPI	96 TPI	48 TPI
Access Time	6 msec	3 msec	6 msec	3 msec	3 msec	15 msec

500KB to 1.6MB and access times down to 3 msec. And the one-third height 5¼" drive is the industry's slimmest.

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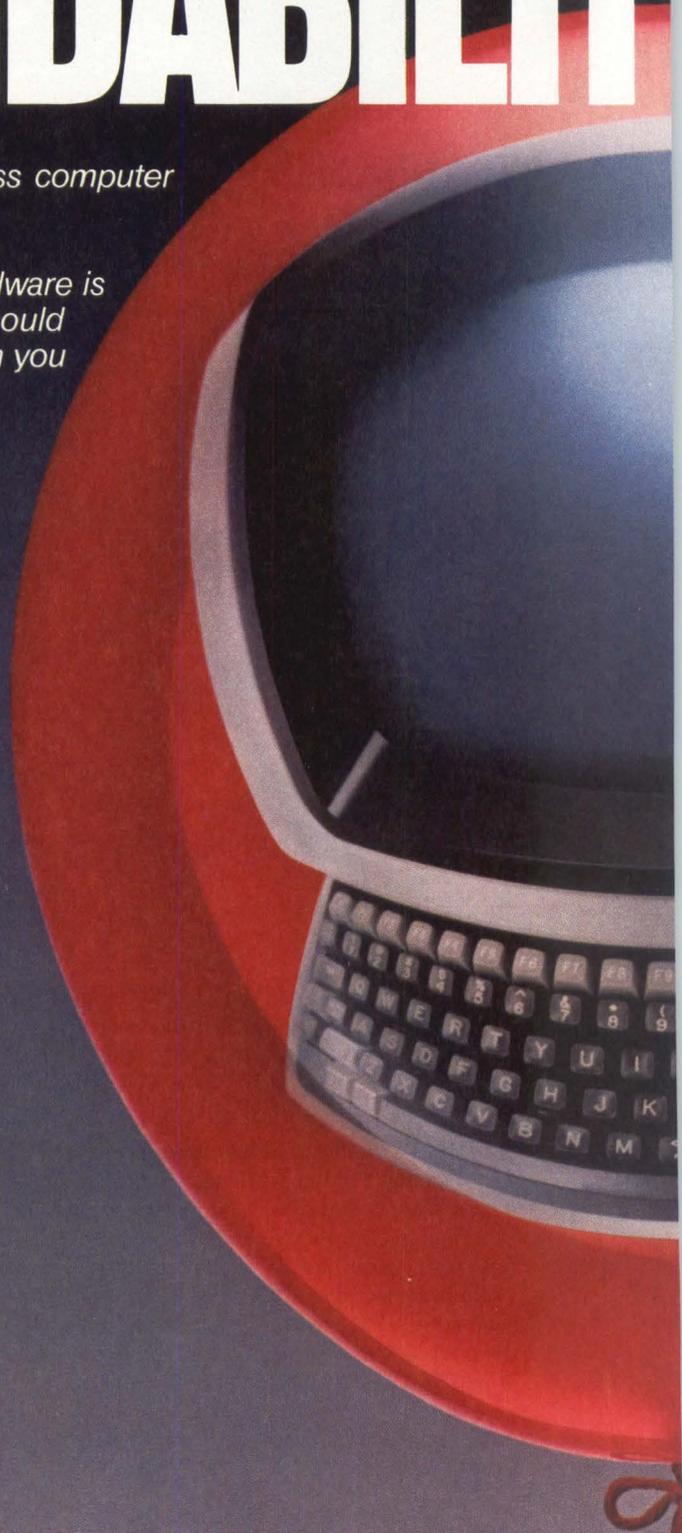
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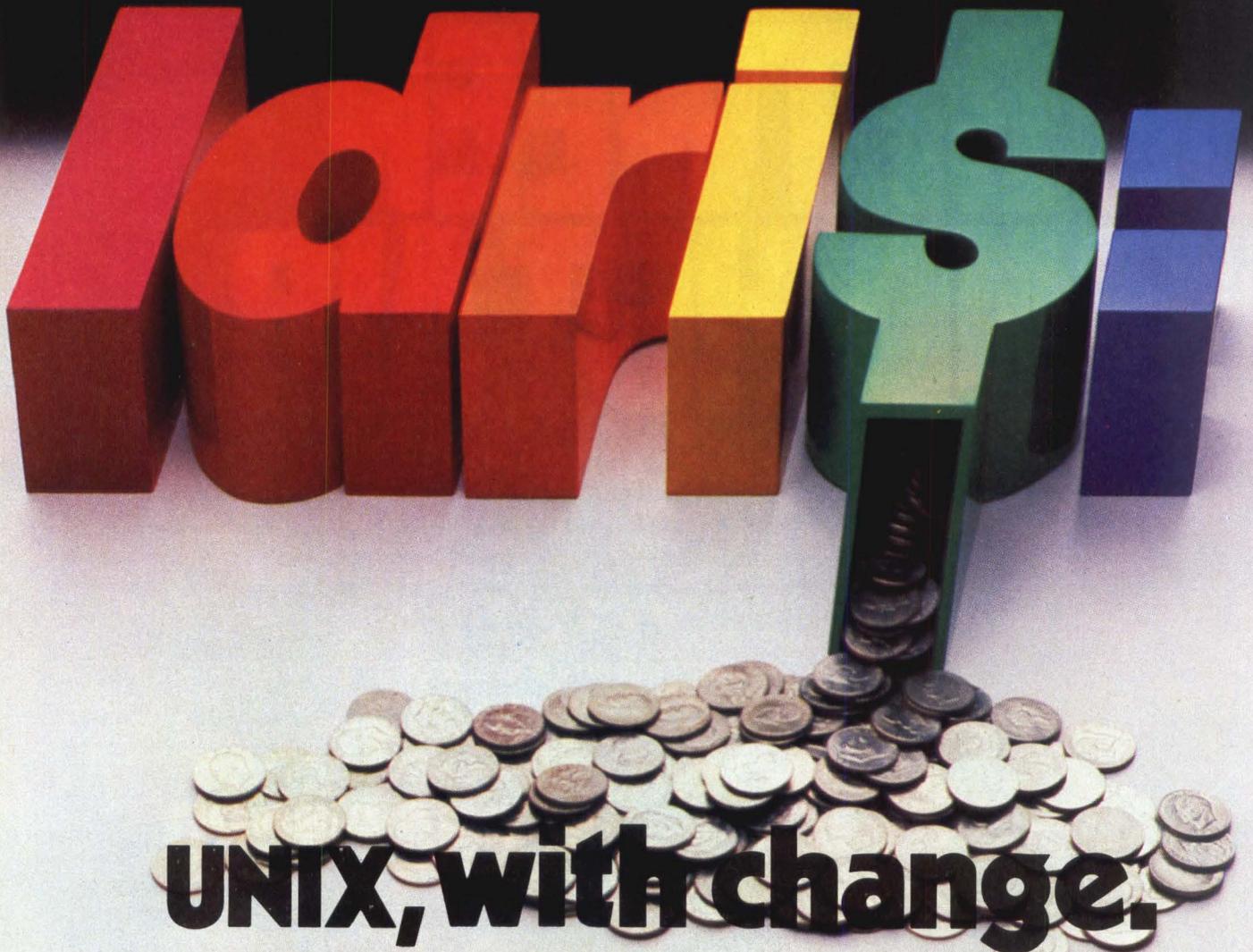
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5¼-inch half-height diskette drives

Company Model(s)	Unformatted capacity (K bytes)	Single-sided (SS) Double-sided (DS)	Average access time (msec.)	Transfer rate (K bits/sec)	Tracks/surface	Tracks/inch	Dimensions (H x W x D inches)	Date of first delivery	Price	Notes, features, options	Circle no.
ALPS ELECTRIC CO. LTD. 1-7 Yukigawa, Ohtsuka-Cho, Ota-ku, Tokyo 145, JAPAN (03) 726-1211											800
AFD211/212	250, 500	SS, DS	156	250	40, 80	48	1.61 x 5.75 x 8.0			optional analog control board; optional standard-height front panel	
AFD 221/222	500, 1000	SS, DS	94	250	80	96	1.61 x 5.75 x 8.0	6/83		optional analog control board; optional standard-height front panel	
AMDEK CORP. 2201 Lively Blvd. Elk Grove, IL 60007 (312) 964-1180											801
Amdisk-V	500	DS	82	250	40	48	1.61 x 5.73 x 7.97	6/83	160 (Q500)	one-year warranty	
AMLYN CORP. 2450 Autumnvale Drive San Jose, CA 95131 (408) 946-8616											780
1865	3300	DS	88	500	154	170	1.61 x 5.75 x 8.0	2/84 (for evaluation units)	300 (Q500)	closed loop servo with optical sensor; reads 4896 BPI diskettes as well as higher density	
BASF AG Gottlieb-Daimler-Strasse 10, 6800 Mannheim, Federal Republic of Germany 621-4008-459											802
6138	1000	DS	79	125, 250	80	96	1.32 x 5.91 x 8.7				
C. ITOH ELECTRONICS INC. 5301 Beethoven St. Los Angeles, CA 90066 (213) 306-6700											803
YD-380	1600	DS	91	500	77	96	1.6 x 5.8 x 8.0	12/83	270 (Q500)		
CANON USA INC. One Canon Plaza Lake Success, NY 11042 (516) 488-6700											804
MDD 211	500	DS	100	250	40	48	1.32 x 5.9 x 8.7	12/82	300 (Q1)	push-button loading; optional half-height front panel	
MDD 221	1000	DS	100	250	80	96	1.32 x 5.9 x 8.7	12/82	350 (Q1)	push-button loading; optional half-height front panel	
CONTROL DATA CORP. OEM Sales, P.O. Box O Minneapolis, MN 55440 (612) 853-4000											805
9428	250, 500	DS	81	125, 250	40	48	1.625 x 5.88 x 8.0	9/83	150 (Q2,500)		
9429	500, 1000	DS	95	125, 250	80	96	1.625 x 5.88 x 8.0	9/83	185 (Q2,500)		
DRIVETEC INC. 2140 Bering Dr. San Jose, CA 95131 (408) 942-1515											806
320	3330	DS	118	500	160	192	1.62 x 5.75 x 8.0		333 (Q500)	closed-loop servo positioning system	

5¼-inch half-height diskette drives

Company Model(s)	Unformatted capacity (K bytes)	Single-sided (SS) Double-sided (DS)	Average access time (msec.)	Transfer rate (K bits/sec)	Tracks/ surface	Tracks/ inch	Dimensions (H x W x D inches)	Date of first delivery	Price	Notes, features, options	Circle no.
EPSON AMERICA INC.											
23530 Hawthorne Ave. Torrance, CA 90505 (213) 373-9511											807
SD 320	250, 500	DS	220	125, 250	40	48	1.1 x 5.7 x 9.3	10/83	200 (Q1,000)	½-height	
SD 521	250, 500	DS	97	125, 250	40	48	1.6 x 5.7 x 7.7	10/83	165 (Q1,000)		
SD 540	500, 1000	DS	96	125, 250	80	96	1.6 x 5.7 x 7.7	10/83	165 (Q1,000)		
SD 560	800, 1600	DS	93	250, 500	77	96	1.6 x 5.7 x 7.7	10/83	165 (Q1,000)		
HI-TECH PERIPHERALS CORP.											
15192 Triton La. Huntington Beach, CA 92649 (714) 891-0027											808
548-25/50	250, 500	SS, DS	95	125, 250	40	48	1.66 x 5.75 x 8.0	4/83	127 (Q10,000); 159 (Q10,000)	automatic disk eject	
596-05/10	500, 1000	SS, DS	95	125, 250	80	96	1.66 x 5.75 x 8.0	5/83	155 (Q10,000); 190 (Q10,000)	automatic disk eject	
596-08/16	800, 1600	SS, DS	92	250, 500	77	96	1.66 x 5.75 x 8.0	5/83	178 (Q10,000); 225 (Q10,000)	automatic disk eject	
MICRO PERIPHERALS INC.											
9754 Deering Ave. Chatsworth, CA 91311 (213) 991-0830											809
501/501C/502	250, 500	SS, DS	72	125, 250	40, 80	48	1.68 x 5.75 x 7.5	12/82	155 (Q500); 165 (Q500); 205 (Q500)		
901/902	500, 1000	SS, DS	85	125, 250	80, 160	96	1.68 x 5.75 x 7.5	12/82	205 (Q500); 260 (Q500)		
MITSUBISHI ELECTRONICS AMERICA INC.											
991 Knox St. Torrance, CA 90502 (213) 515-3993											810
M4851/53	500, 1000	DS	94	250	40, 80	48, 96	1.61 x 5.75 x 8.0		210 (Q1,000); 240 (Q1,000)		
M4854/55	1600, 2000	DS	91, 94	500	77, 80	96	1.61 x 5.75 x 8.0		300 (Q1,000); 320 (Q1,000)	11,844 bits-per-inch recording density	

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And it's only the beginning.

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Or the Maxtor EXT-4000™ line. The highest capacity 5¼" drives on the market. With storage capacity from 75 to 380 MB. And a transfer rate of 10.0 Mbit/second.

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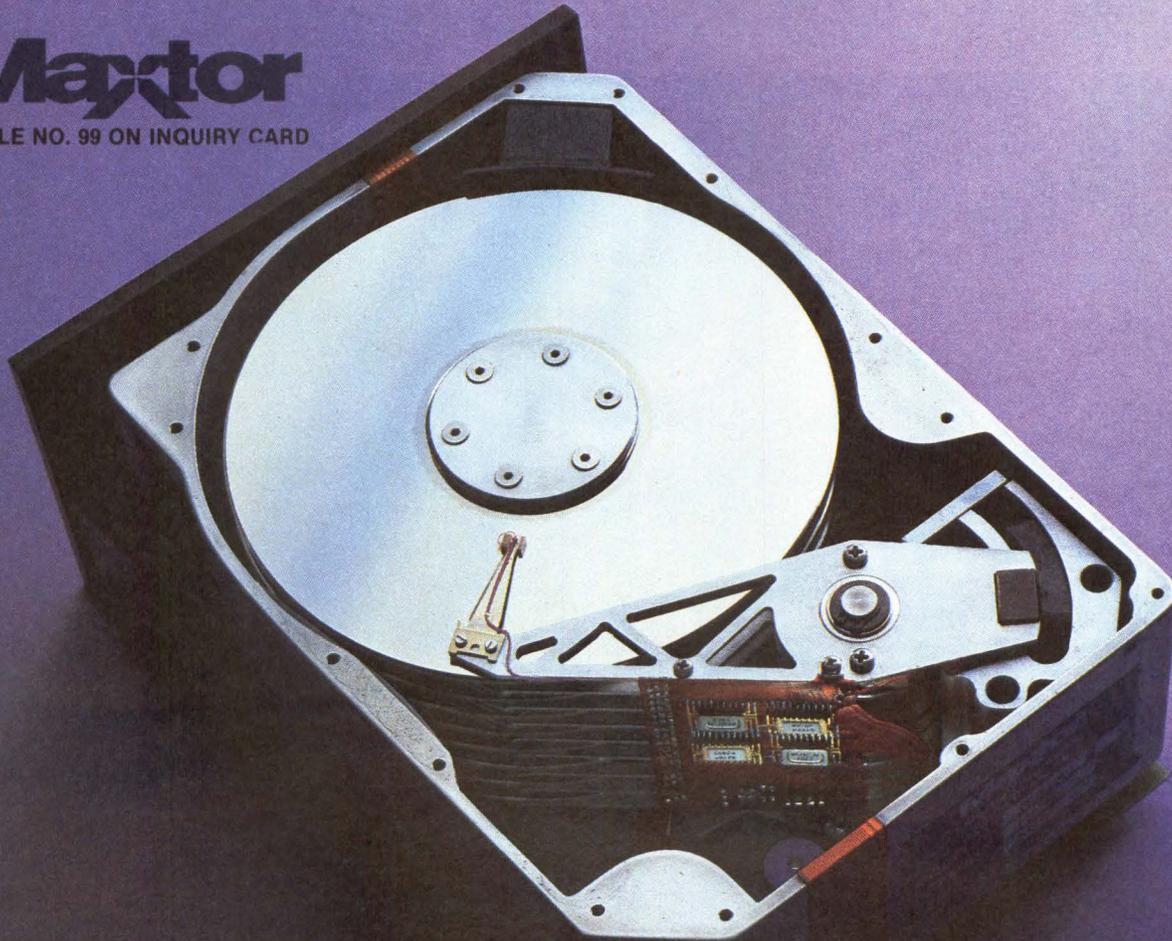
If not, give us a few months. We're working on it.

Our doors are always open to OEMs. Let's talk. Call Leon Malmel at (408) 942-1700. TELEX: 171074. Maxtor Corporation, 61 East Daggett Drive, San Jose, California 95134.

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We ship reliable drives. Every Davong hard disk system is run at elevated temperatures in dynamic burn-in tests. Customized dedicated disk drive simulator tests assure consistent quality. All Davong products carry a 90-day warranty.

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Davong Systems, Inc. □ 217 Humboldt Court Drive □ Sunnyvale, CA 94086
Telephone: (408) 734-4900

CIRCLE NO. 100 ON INQUIRY CARD



5¼-inch half-height diskette drives

Company Model(s)	Unformatted capacity (K bytes)	Single-sided (SS) Double-sided (DS)	Average access time (msec.)	Transfer rate (K bits/sec)	Tracks/ surface	Tracks/ inch	Dimensions (H x W x D inches)	Date of first delivery	Price	Notes, features, options	Circle no.
NISSEI SANGYO AMERICA LTD.											811
460 E. Middlefield Rd. Mountain View, CA 94043 (415) 969-1100											
FB501/502	250, 500	SS	81.2, 87.3	250	40, 80	48, 96	1.61 x 5.75 x 8.23		112 (Q5,000); 118 (Q5,000)		
FB503/504	500, 1000	DS	81.2, 87.3	250	40, 80	48, 96	1.61 x 5.75 x 8.23		137 (Q5,000); 170 (Q5,000)		
QUME CORP.											812
2350 Qume Dr. San Jose, CA 95131 (408) 942-4000											
QumeTrak 142	500	DS	160	250	40	48	1.59 x 5.75 x 8.0	3/82	185 (Q500)	6 or 12 msec. step rate; interchangeable bezels: ½- height, ⅔-height, full-height	
REMX DIVISION EX-CELL-O CORP.											813
2991 White Star Anaheim, CA 92806 (714) 630-7020											
RFD 485/486	250, 500	SS, DS	80	125, 250	40	48	1.61 x 5.75 x 8.0	9/83	160 (Q500); 210 (Q500)		
RFD 965/966	500, 1000	SS, DS	94	125, 250	80	96	1.61 x 5.75 x 8.0	10/83	210 (Q500); 255 (Q500)		
SHUGART CORP.											814
475 Oakmead Pkwy. Sunnyvale, CA 94086 (408) 733-0100											
SA 455/465	500, 1000	DS	93, 94	250	40, 80	48, 96	1.63 x 5.75 x 8.0	1st quarter 1983	197 (Q500)		
TANDON CORP.											815
20320 Prairie St. Chatsworth, CA 91311 (213) 993-6644											
TM 50-1/2	250, 500	SS, DS	287, 98	250	40, 80	48	1.625 x 5.75 x 8.0	8/82	110 (Q2,500); 137 (Q2,500)		
TM 55-2/4	500, 1000	DS	90	250	40, 80	48, 96	1.625 x 5.75 x 8.0	10/82	170 (Q2,500); 198 (Q2,500)		
TEAC CORP. OF AMERICA											816
Industrial Products Division 7733 Telegraph Rd. Montebello, CA 90640 (213) 726-0303											
FD-55A/B	250, 500	SS, DS	93	250	40	48	1.625 x 5.75 x 8.0	7/82	155 (Q500); 170 (Q500)	5-watt operating mode	

5 1/4-inch half-height diskette drives

Company Model(s)	Unformatted capacity (K bytes)	Single-sided (SS) Double-sided (DS)	Average access time (msec.)	Transfer rate (K bits/sec)	Tracks/surface	Tracks/inch	Dimensions (H x W x D inches)	Date of first delivery	Price	Notes, features, options	Circle no.
FD-55E/F	500, 1000	SS, DS	94	250	80	96	1.625 x 5.75 x 8.0	7/82	170 (Q500); 210 (Q500)	5-watt operating mode	
FD-55G	1600	DS	91	500	77	96	1.625 x 5.75 x 8.0	2/83	285 (Q500)	5-watt operating mode	

WORLD STORAGE TECHNOLOGY

14251 Franklin Ave.
Tustin, CA 92680
(714) 838-1491

817

Titan FDD 112-5	125, 250	SS	95, 280	125, 250	40	48	1.62 x 5.75 x 8.0	3/83	140 (Q1,000)	daisy chains as many as four drives	
Titan FDD 212-5	250, 500	DS	95, 280	125, 250	40	48	1.62 x 5.75 x 8.0	6/83	170 (Q1,000)	daisy chains as many as four drives	

Y-E DATA INC.

Sunshine 60, PO Box 1171, Toshima-ku,
Tokyo, 170 JAPAN
03-989-8001

818

YD-480/580	500, 1000	DS	95, 148	250	40, 80	48, 96	1.61 x 5.75 x 8.0				
YD-380	1600	DS	91	500	77	96	1.61 x 5.75 x 8.0				

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CIRCLE NO. 101 ON INQUIRY CARD

data processing

1959 - 1984

DATA PROCESSING, the international journal for computer managers, and the leading authority on information management issues and computing developments, is publishing an important special issue

What advances have been made in computing in the last 25 years?

In its special silver jubilee issue, DATA PROCESSING will review computing developments from punched card readers, to personal computing and networking.

Where will computing go in the next 25 years?

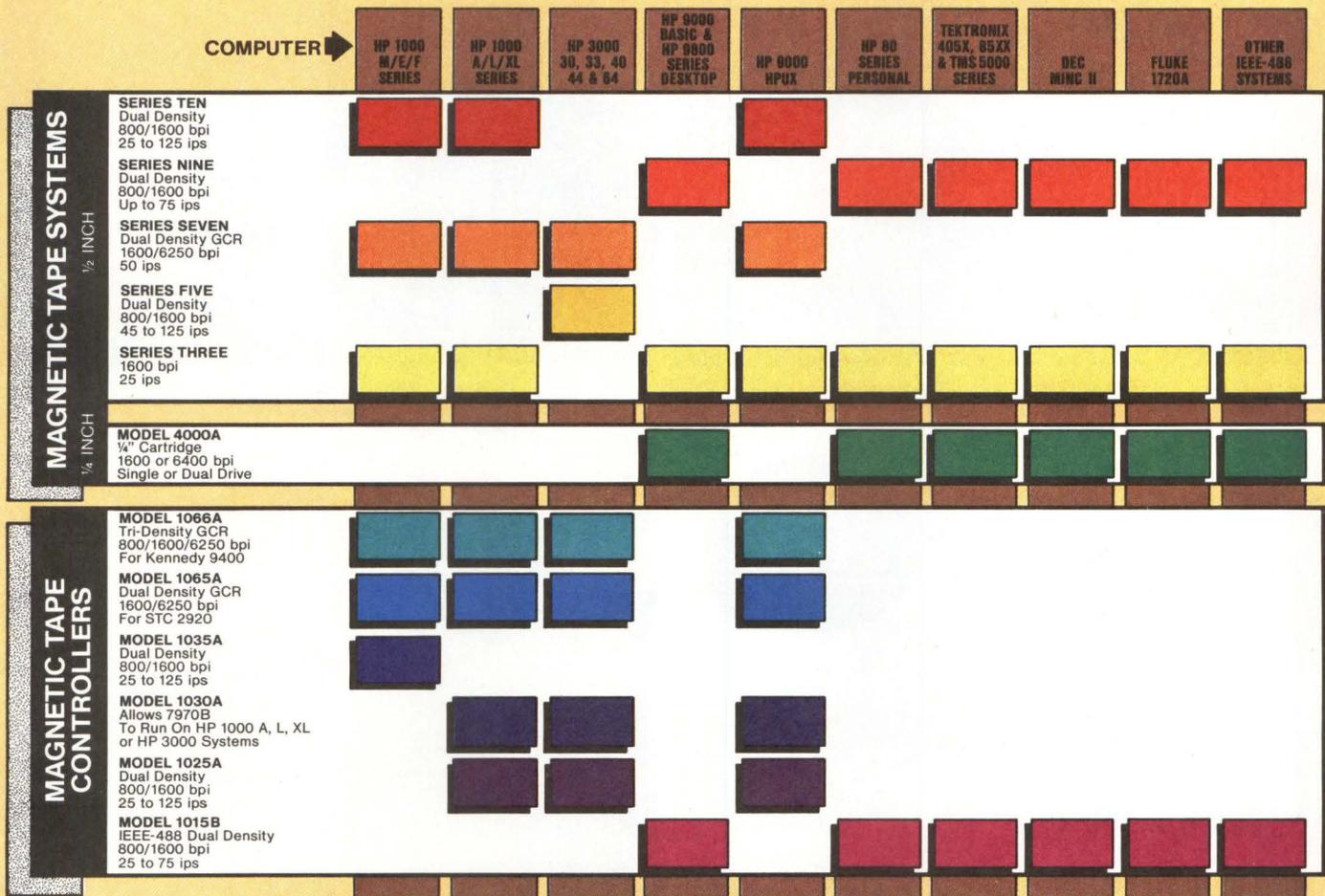
The topics in DATA PROCESSING's anniversary issue include: fifth generation computers; expert systems; knowledge engineering; optical discs; speech technology; biochips.

DATA PROCESSING is published 10 times a year. Subscription price is \$140.00 per annum. Limited numbers of the anniversary issue are available at the single copy price of \$16.80. To subscribe to DATA PROCESSING or to order your special issue contact Elena Softley, Data Processing, Butterworth Scientific Ltd, PO Box 63, Guildford, Surrey GU2 5BH, UK. Tel: 0483 31261. Telex: 859556 SCITEC G.

CIRCLE NO. 102 ON INQUIRY CARD

MINI-MICRO SYSTEMS/February 1984

FASTER TAPE PROCESSING FOR LESS COST



COMPARE THE PERFORMANCE ALTERNATIVE

Dylon, one of the leading manufacturers of magnetic tape recording systems and controller products, gives you the PERFORMANCE ALTERNATIVE. Higher Speed. Lower Cost. For virtually every HPIB and GPIB user.

Dylon's cost-effective, high-performance tape systems are suitable for high-speed, real-time data collection, archival storage, information interchange, and disk back-up applications.

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Dylon provides the lowest-cost ownership of all GCR tape peripherals for HP computers, plus other IEEE-488 compatible systems such as DEC, Tektronix, and Fluke.

For higher speed, dual density, and lower cost, discover Dylon—the PERFORMANCE ALTERNATIVE.

For information on how you can increase your computer performance while reducing your costs, call Dylon today! (619) 292-5584

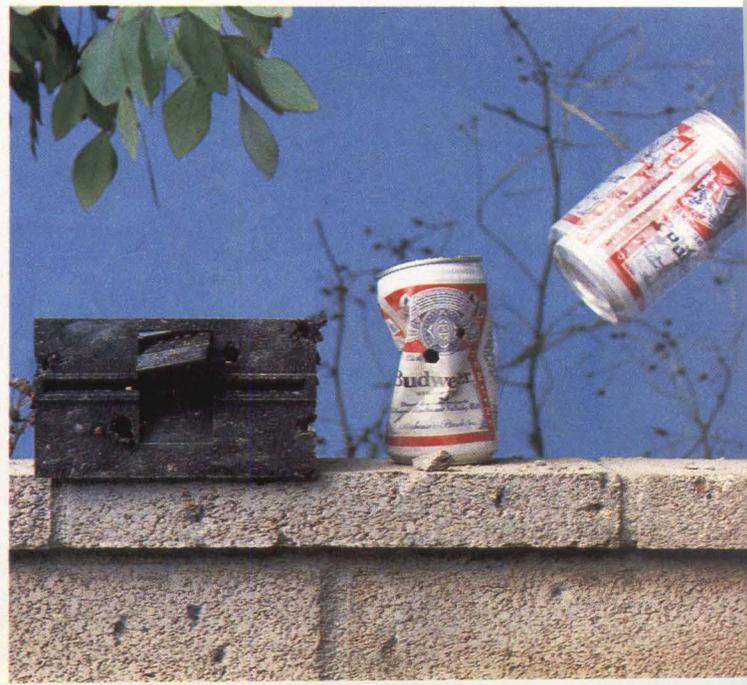
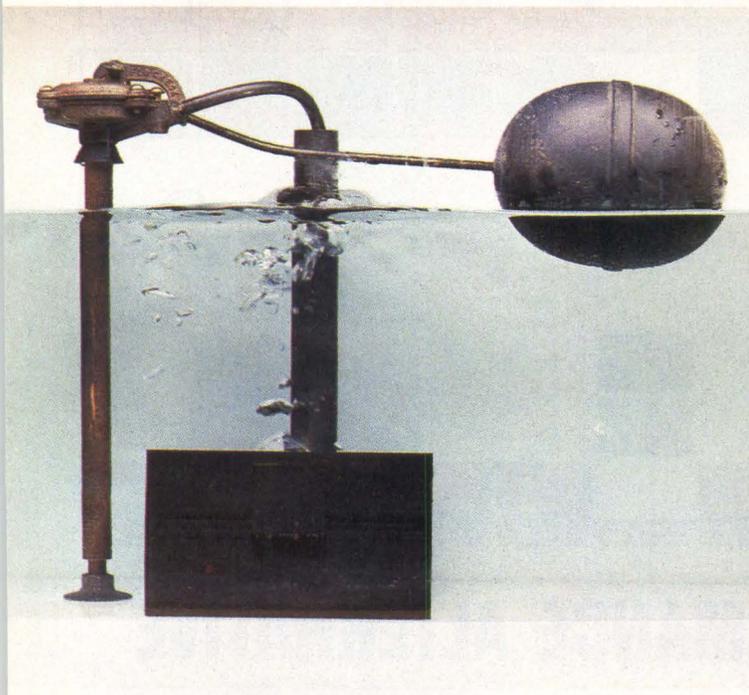
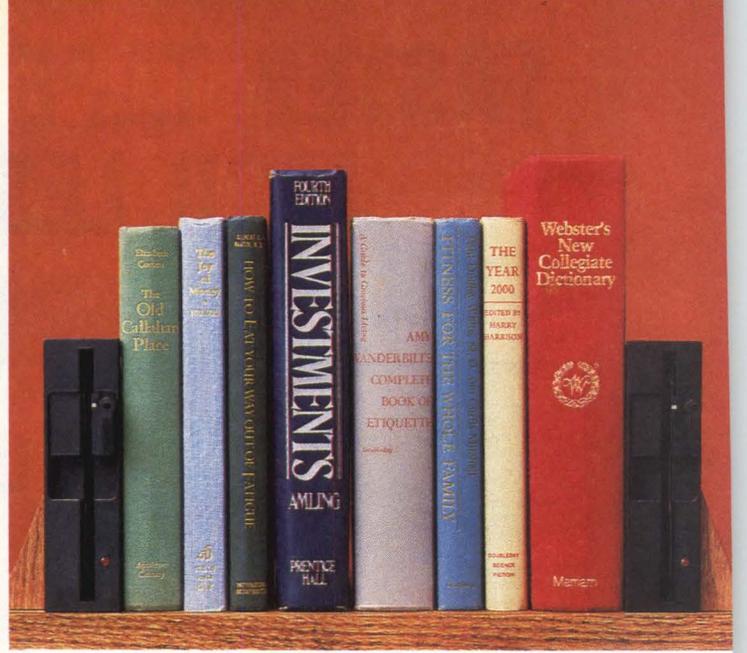


CIRCLE NO. 103 ON INQUIRY CARD

Dylon Data Corporation

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San Diego, California 92123
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The DMA 360 packs 10 megabytes on a single ANSI-standard cartridge. Floppies don't. It takes up to 33 floppy disks to achieve an equal capacity.

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a floppy. But it gives you so much more.

Like an average access time of 98 milliseconds. A transfer rate of 625 kilobytes per second. And an error rate that's on par with the most reliable conventional Winchester disk drives.

There's no way you'd get that kind of performance from a floppy!

In fact, anything you can do with a floppy, you can do even better with a DMA 360. That's why we call it the floppy replacement.

For more information on what you can do with your obsolete floppies, write DMA Systems, 601 Pine Avenue, Goleta, CA 93117. Or call us at (805) 683-3811, Telex 658341.

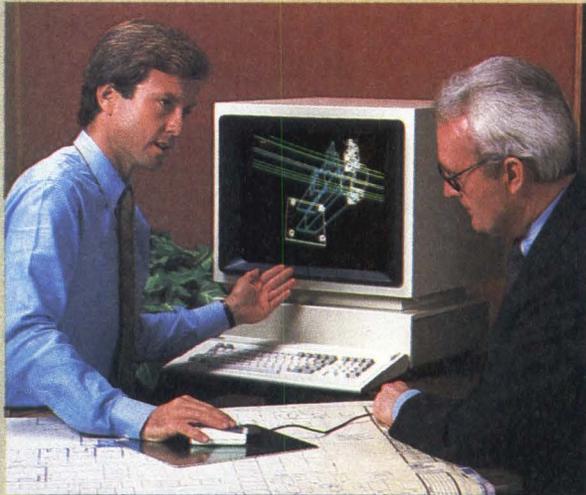
Introducing the floppy replacement: DMA Systems' new half-height removable 5¼" Winchester.



DMA
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CIRCLE NO. 104 ON INQUIRY CARD

FOR A REFRESHING NEW LOOK AT COLOR GRAPHICS PUT A GENISCO G-2200 IN YOUR SYSTEM. IMPELL CORPORATION DID!



The G-2200 is truly a refreshing approach to raster color graphics. It combines vivid colors, flicker-free picture clarity, and big screen readability with high speed graphics and extensive software support. The result is the most cost effective system on the market. That's why Impell Corporation selected it as the perfect color graphics companion to CAEMIS, their Computer Aided Engineering & Management Information Services package.

Impell is a major supplier of computer software and computer based management and engineering services to the utility industry worldwide. CAEMIS is a modular, three dimensional engineering design and data base management system which provides simultaneous access for all design functions and on-line access to design information. And, the Genisco G-2200 is its window to the world.

The G-2200 has all the features desired for CAD/CAM, CAE, scientific and business graphic applications including built in peripheral support for mouse, tablet and printer. It is software compatible with the Tektronix 4014 and supported by third party software. It will also emulate the DEC VT100 for text editing and data entry.

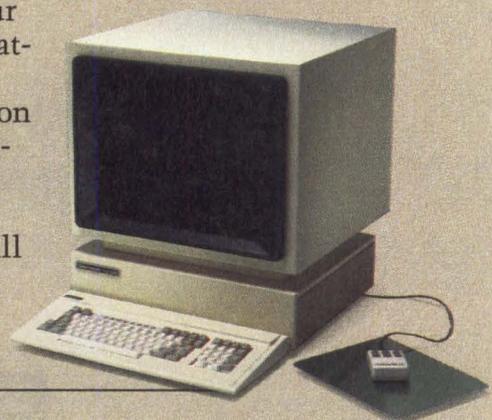
But the best reason to put a G-2200 in your system is picture quality. Up to 16 colors can be selected from a palette of 4,096 hues with a unique black matrix glass bringing them vividly to life. Graphics are displayed on a big 19 inch screen that is refreshed at 60Hz for flicker-free viewing while the 1024 x 792 resolution ensures sharpness and clarity. No comparably priced system can match the picture quality of the G-2200.

The G-2200 is available as an attractive, ergonomically designed desktop terminal, or it can be integrated in your own system as a board or as a controller. Whatever the configuration, you can be sure of Genisco's commitment to design and production excellence and to on-site support by its international network of offices.

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TWX 910-595-2564



CIRCLE NO. 105 ON INQUIRY CARD

A case study in manufacturer/vendor disk evaluation

Common testing procedures ensure reliability

Richard Taylor, Quantum Corp., and
Gregory Pelletier, Wang Laboratories Inc.

"Quality" and "reliability" are two of the most frequently used and misused words in the electronics industry. However, by using common tests and procedures, manufacturers and vendors can quantitatively measure and improve product quality and reliability. Quantum Corp., a Winchester disk drive manufacturer, and Wang Laboratories Inc. have developed such a set of procedures and ongoing inter-company communications to ensure a consistent level of reliability in the disk drives used in Wang office-automation systems. A look at the tests and procedures that the two companies conducted during the development, manufacture and integration of the Q500 and Q2000 disk drives illustrates a mutually-beneficial OEM relationship.

Charts and graphs monitor failure rates

Bell curves show the cumulative average and distribution of observed data points. Manufacturers often use bell curves to track yields recorded in several lots of drives during subassembly manufacturing stages (Fig. 1). The curve shows the observed failures on the x-axis and the percentage of lots that fall into each failure range on the y-axis. The mean is the average number of failures per lot and, as might be expected, the majority of the population is clustered around the mean. In the case of Quantum's Q500 and Q2000, the mean was 12.5, indicating that an average of 12.5 drives per lot failed. (Lots ranged from 175 to 225 drives.) Quality-control departments use the portion of the chart that includes 99.7 percent of the overall population to determine the upper and lower control limits for manufacturing yields.

The bell curve is also a useful tool for quick examination of repetitive lot data compared to previously observed norms. Should the observed failure rates of several lots exceed the upper control limits, the

process responsible for the improvement would be incorporated into the other lots. If the failure rates of a lot dropped below the lower control limit, management personnel would examine the manufacturing process, determine the cause of failure and correct the process.

Manufacturers often use "bathtub" curves to show

Preliminary test table. DVT tests and procedures are performed on prototype or evaluation drives.

PRELIMINARY TEST TABLE

1. **Data error-rate testing**
 - A. Test to Soft Error Rate Specification (1×10^{-10}) bits read using worst-case data patterns
2. **Seek error-rate testing**
 - A. Test to specification 1 million seeks no errors
 - B. Test worst-case seeks for power dissipation
 - C. Test seek times for single track, average track and maximum track
3. **Read recovery margins**
 - A. Measure head resolution
 - B. Measure overwrite saturation
 - C. Measure read/write switching transition timing versus data format timing
 - D. Read worst case data patterns when written without write pre-compensation
4. **Voltage testing (AC and DC)**
 - A. Vary voltages within specification while under computer control (no errors)
 - B. Same as A, but find point where errors occur
5. **Interface testing**
 - A. Timing
 - B. Termination and signal shapes
6. **Power cycling**
 - A. Turn power on and off frequently and test units for short period to determine if any components are stressed or any power-on sequences fail
7. **Latency tests - rpm of disk**
 - A. Measure to specification at room temperature over voltage variations
 - B. Measure during temperature and humidity tests while voltages are varied
8. **Vendor contacts**
 - A. Visit vendor and report on production and test capabilities also on quality control
 - B. Work out technical problems with vendor if they arise
9. **Software**
 - A. Request any software required to assist in timely evaluation
 - B. Request software for manufacturing test at all levels

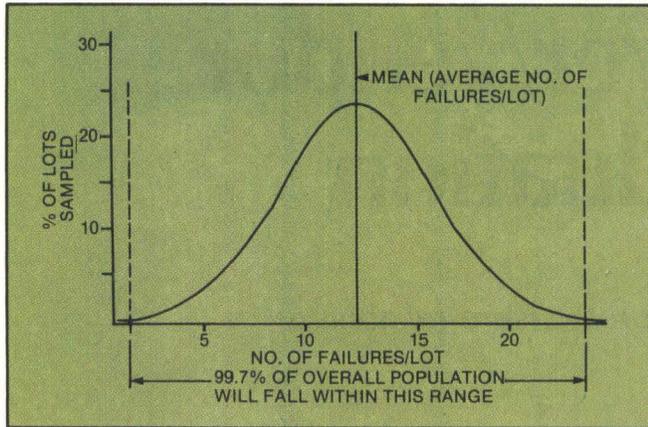


Fig. 1. Bell curve shows the failure ranges at the subassembly stage of drive assembly. Recorded failures in each lot sampled ranged from zero to 25, and the average number of failures was 12.5. The curve also measures the expected percentage of lots that fall into each number-of-failure category. Most lots had 10 to 15 failures. The area within the dotted lines determines the upper and lower control limits of each test level.

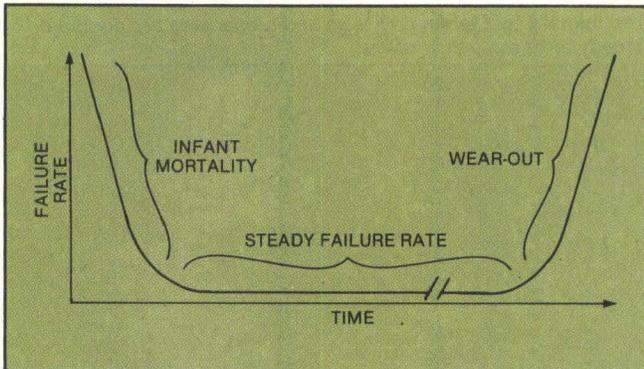


Fig. 2. A bathtub curve shows failure rates of a product over time. In the beginning, "infant mortality" results in a high failure rate. After burn-in, the product exhibits a steady failure rate during its operating life. Finally, the product begins to wear out, and the failure rate increases sharply.

Fig. 4. The process-control program for the Q500 drive used a variety of tests and charts in the assembly process. Percentage (\bar{P}) charts, mean/range (\bar{X}/R) charts and Pareto charts graph failure and reliability statistics.

PROCESS-CONTROL PROGRAM FOR Q500 MANUFACTURING PROCESS			
1. DRIVE ASSEMBLY		2. SUBASSEMBLY AND REWORK	
AREA	CHART TYPES	AREA	CHART TYPES
ENCODER ADJUST	\bar{P}	PCB	PARETO OF FAILURE MODES, CUM YIELD
PARTICLE COUNT	\bar{X}/R (PARTICLES/DRIVE, RANGE)	ENCODER WIRE BOND	\bar{X}/R (PULL STRENGTH, RANGE)
SERVO WARM-UP	\bar{P}	ENCODER CELL TEST	\bar{P}
SERVO WRITE	\bar{P}	ENCODER ASSEMBLY/TEST	\bar{P}
SCANNER	\bar{X}/R (AMPLITUDE/DRIVE, SEEK TIME/DRIVE)	HEADSTACK ELECTRICAL	\bar{P}
BURN-IN	YIELD	HEADSTACK MECHANICAL	\bar{P}
ACT	\bar{X}/R (WINDOW MARGIN/DRIVE, ERRORS/DRIVE)	SCALE ARM	\bar{X}/R (LEVELNESS, RANGE)
FINAL AUDIT	\bar{P}	HEADSTACK REWORK	PARETO OF FAILURE MODES
		ARM REWORK	PARETO OF FAILURE MODES
		HEADSTACK REWORK/DRIVE	\bar{P} , PARETO OF FAILURE MODES
		DRIVE REWORK	PARETO OF FAILURE MODES

the failure rates of a product over time (Fig. 2). A relatively high number of failures occurs in the first few hours of operation. These quickly-occurring failures are referred to as "infant mortality." The failure rate then drops dramatically, and a consistent failure rate develops over the life of the product. The various

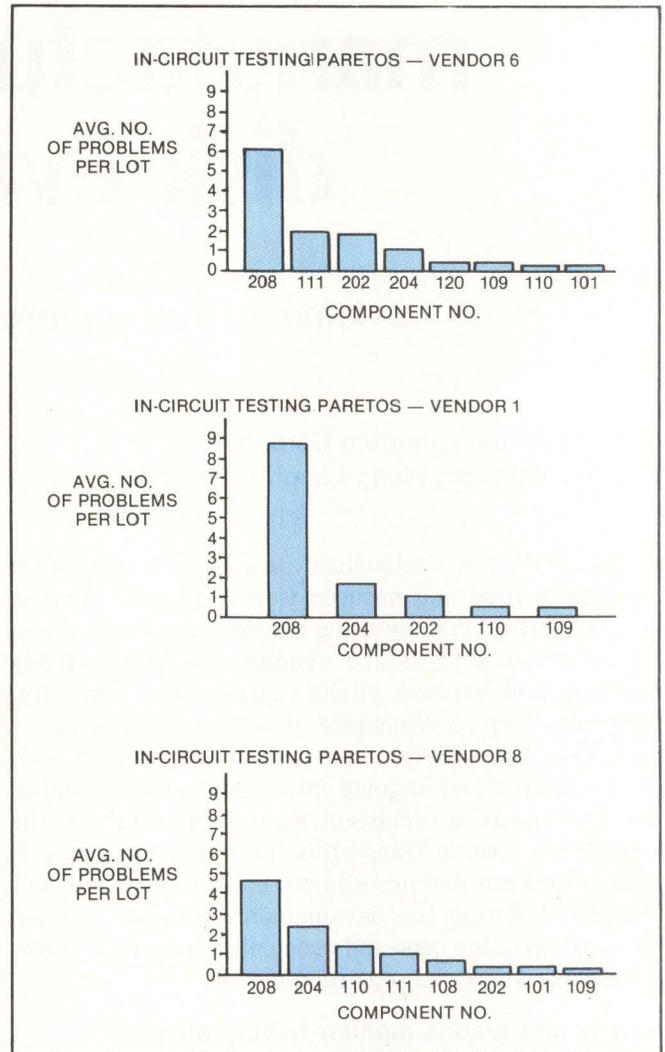


Fig. 3. Pareto charts graph recorded failures by type and frequency. Codes on the x-axis are Quantum Corp.'s internal codes identifying each failure mode. (Each of the charts applies to a different vendor.)

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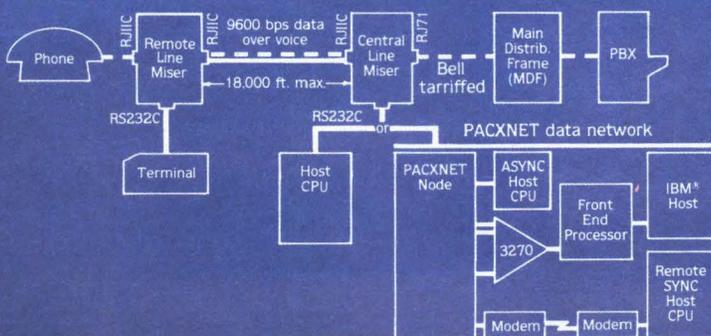
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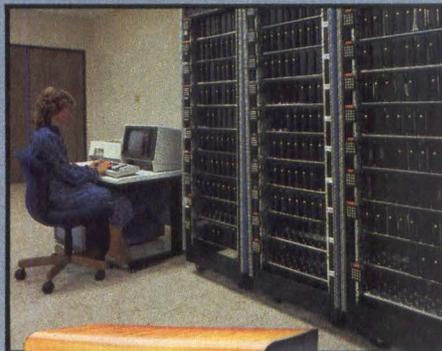
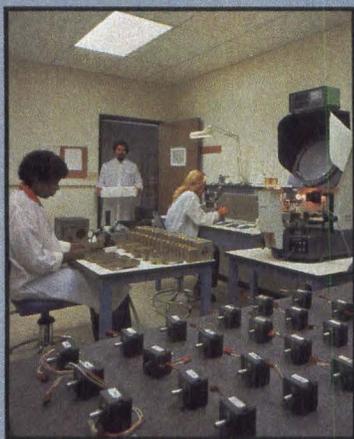
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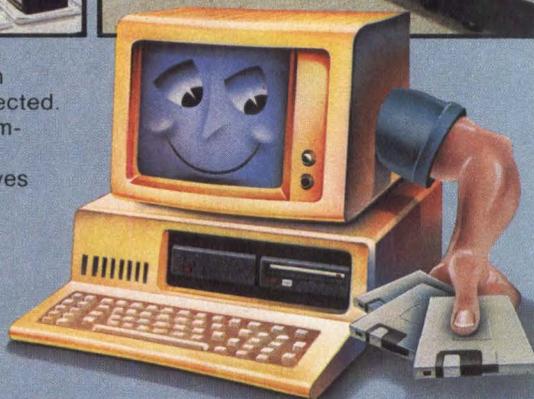
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components will eventually begin to wear out, and the failure rate will increase. At this point, the product will have reached the limit of useful life.

The mean time between failures (MTBF) of a product is the average operational time before a failure occurs. MTBF should not be confused with "wear-out," which occurs much later in the life of the product. The wear-out of a drive typically occurs after many tens of thousands of hours. For example, the MTBF of the Quantum Q500 is 10,000 hours. As do many manufacturers and vendors, Quantum and Wang use the military specifications MIL-217 handbook, which outlines mathe-

tical methods of calculating the MTBF of components and assemblies, to calculate the theoretical MTBF of a product. Design-verification-testing (DVT) checks a variety of parameters on prototype or evaluation units (see "Preliminary test table, Page 207).

Bell and bathtub curves are useful for looking at the "big" picture, but evaluation-engineering and quality-control departments must use more detailed charts to analyze the product at various assembly stages. These include the \bar{x}/R chart, the \bar{P} , or percentage, chart and the Pareto chart. The \bar{x}/R chart measures the variables observed in a process, such as the number of particles within the clean tunnels in which the drives are assembled. The \bar{P} chart measures the yields of attributes associated with a sample lot, as in the percentage of seek failures per lot. This information is compared with previous norms. The Pareto chart analyzes failures by type and indicates which failure modes are responsible for the most failures (Fig. 3). Quantum uses

MONTHLY VERIFIED RETURN LEVEL—NOVEMBER 1982							
NO. OF UNITS TESTED	NO. OF DEFECTS	% OF DEFECTS	TYPE OF DEFECT				ADC
			ELECTRICAL	%	MECHANICAL	%	
395	8	2.0%	8	2.0%	—	—	8

DEFECT BREAKDOWN BY PART NUMBER/HZ						
PART NO. Q2020/278-4024/60 HZ						
TTL QTY. TESTED	QTY. DEFECTIVE	PERCENT DEFECTIVE	DEFECT CODE	FAMILY /	CODE/DESCRIPTION	DEFECT
64	0		/	/		
TOTAL	0					
PART NO. Q2020/278-4024-1/50HZ						
TTL QTY. TESTED	QTY. DEFECTIVE	PERCENT DEFECTIVE	DEFECT CODE	FAMILY /	CODE/DESCRIPTION	DEFECT
98	0		/	/		
TOTAL	0					
PART NO. Q2040/278-4025/60HZ						
TTL QTY. TESTED	QTY. DEFECTIVE	PERCENT DEFECTIVE	DEFECT CODE	FAMILY /	CODE/DESCRIPTION	DEFECT
189	2	1.1	33/99		Electrical/Access too high	
	2	1.1	33/12		Electrical/Won't step	
	1	0.5	33/99		Electrical/Drive won't recalibrate	
	1	0.5	33/21		Electrical/No TKO	
	1	0.5	33/19		Electrical/Fails margin	
	1	0.5	33/05		Electrical/Noisy	
TOTAL	8	4.2%				
PART NO. Q2040/278-4025-1/50HZ						
TTL QTY. TESTED	QTY. DEFECTIVE	PERCENT DEFECTIVE	DEFECT CODE	FAMILY /	CODE/DESCRIPTION	DEFECT
44	0		/	/		
TOTAL	0					

Fig. 5. Wang's monthly failure-analysis chart (above) shows the various lots of Q2000 drives tested during November 1982 and the reasons for each of the reported failures. All failures occurred in the same lot, indicating a problem in the components used in that lot or in the manufacturing process. Of the 395 units tested that month, 2 percent (eight drives) failed for electrical reasons.

Quantum's product-development plan (right) involves manufacturing personnel at the early stages of drive design. Design-verification testing (DVT) is conducted during the prototype stage. Design-maturity testing (DMT) occurs during the pre-production stage. Quantum and Wang use both testing procedures, as well as ongoing reliability testing (ORT), during full-scale production.

QUANTUM PRODUCT/PROCESS DEVELOPMENT SUMMARY
<p>Architecture configuration (3 months)</p> <ul style="list-style-type: none"> Select architecture compatible with product objectives Actuator, servo and head/media technology
<p>Prototype stage (6 months)</p> <ul style="list-style-type: none"> Verify successful architecture Configure ultimate manufacturing process <ul style="list-style-type: none"> Test equipment Tooling Experimentally verify error budgets Complete fatigue testing Place small number with selected customers for early feedback on compatibility and system performance
<p>Pre-production stage (6 months)</p> <ul style="list-style-type: none"> Verify hard-tooled parts perform similarly to prototype hardware Workout assembly process, test equipment and tooling problems Continue engineering test Focus on solving technical problems, not maximizing ramp
<p>Begin production ramp (6 months)</p> <ul style="list-style-type: none"> Continuous process of rapid response to field, mfg. and engineering - discovered problems Remove barriers to increasing ramp

all three of these charts at various stages in the subassembly, rework and drive-assembly processes (Fig. 4).

Tests ensure quality control

In addition to specific failure-analysis testing, both manufacturer and vendor follow initial-evaluation testing procedures and employ ongoing reliability tests. Wang uses a variety of tests to ensure that a product meets design specifications.

DVT confirms that the design of a product meets the

required specifications. Design-maturity testing (DMT) assures that the "mature" product meets final specifications, including MTBF, under typical volume requirements. Process-maturity testing (PMT) verifies that production procedures are sufficient to minimize any process- or component-related infant mortality in the final product.

The vendor performs ongoing-reliability testing (ORT) using random samples from lots that have received a manufacturer's final acceptance and are ready for shipment. These tests verify that infant-mortality has been removed and ensure that all previously-defined reliability specifications, including the MTBF, are met. The minimum incoming acceptance rate for Wang products is 90 percent.

Fig. 6. \bar{X}/R chart showing particle-count tracking within the clean tunnel in which disk drives are assembled. The maximum allowable number of particles (measured at 0.5 μm .) is 25. As shown, measured levels are far lower, yielding an upper control level (UCL) of 2.86. Measurements showing readings higher than the upper control level indicate a problem. Each problem was investigated and solved, and particle counts receded to acceptable levels. The R portion of the chart (bottom) shows ranges between readings. A significant increase in range would lead to an investigation.

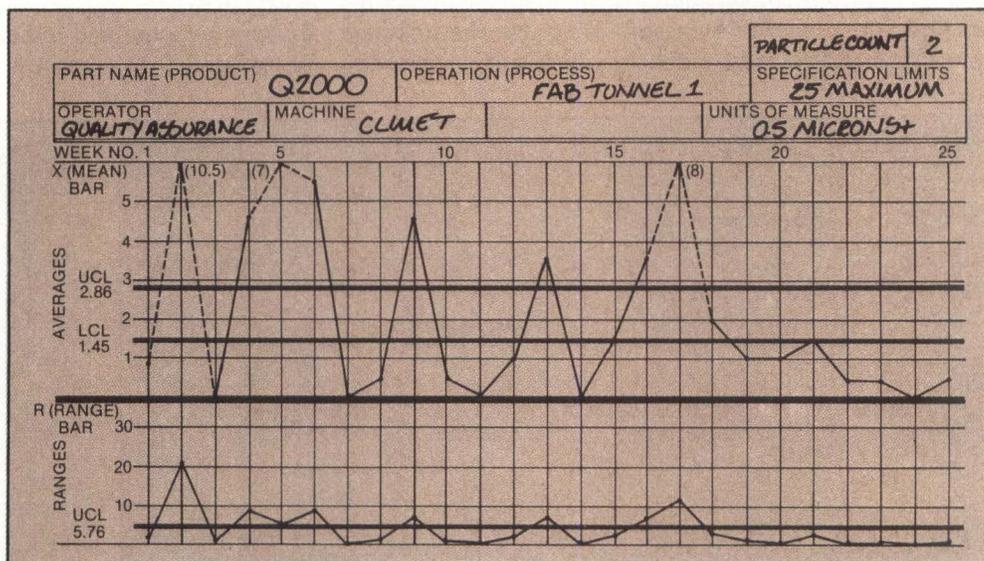
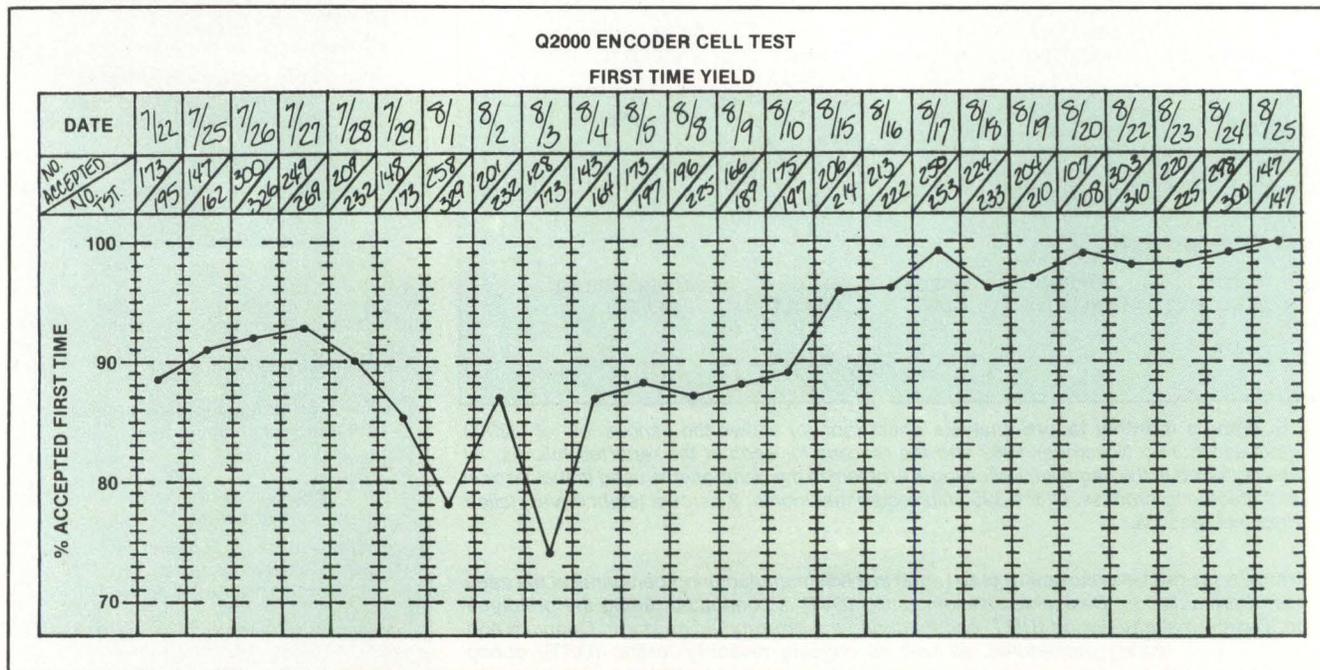
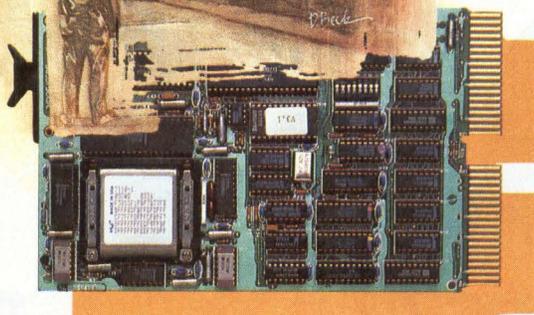


Fig. 7. \bar{P} chart plotting the reliability of a drive's encoder cell. When the yield fell below 90 percent, the manufacturer analyzed the problem and conducted small-sample testing. When this failed to produce acceptable yields, the supplier of the failing component conducted 100 percent testing, screening out the problem. Acceptable yields rose to more than 95 percent.



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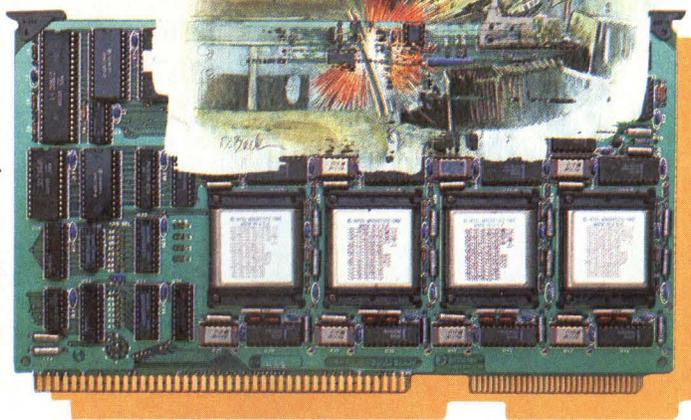
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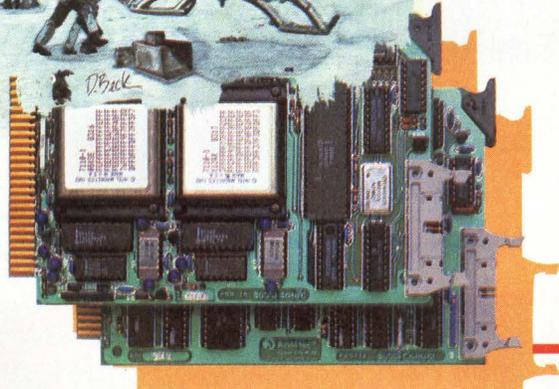
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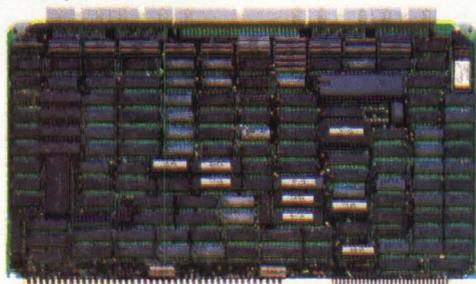
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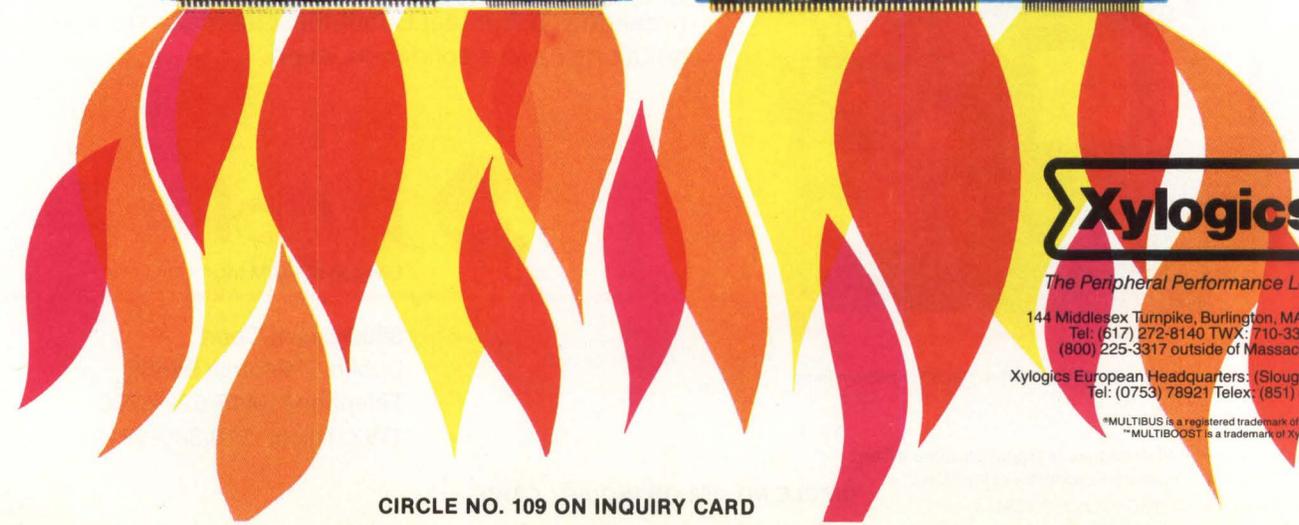
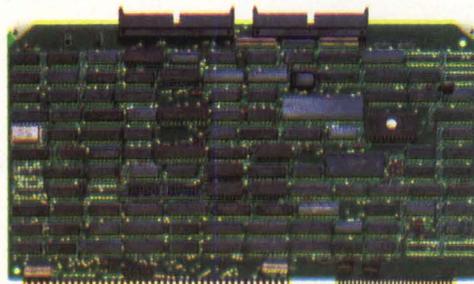
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CIRCLE NO. 109 ON INQUIRY CARD

Testing on the production line

During manufacturing, engineering and manufacturing personnel inspect and test subassemblies, and quality-control personnel audit them. The following examples illustrate failure detection and correction.

During the assembly of the 8-inch Q2000 drive, Quantum plotted \bar{X}/R charts of particle-count measurements (Fig. 6). During manufacture, none of the readings was outside the specification—an upper limit of 25 particles. However, readings were well above the upper control limit of 2.86 particles on three occasions. Although this particle level would not have seriously affected drive performance, it was a significant deviation from expected results. An investigation uncovered three reasons for the high particle count: in the first case, manufacturing personnel had handled assembly parts outside of the Class 100 clean tunnel in which the drives are assembled; in the second case, the subassemblies had become slightly contaminated and needed to be cleaned; in the last case, a new operator had failed to observe the required procedures for decontamination before entering the clean tunnel. Fortunately, the \bar{X}/R chart indications led to corrective action before the problems had reached a critical stage.

In another example, a \bar{P} chart identified a problem with an outside supplier (Fig. 7). The chart plotted the reliability of the drive's encoder cell (a light-sensitive cell used to generate positioning information in the Q2000 servo system). When the acceptable yield dropped to 90 percent or lower, Quantum conducted sample-lot testing. The problem was traced to faulty

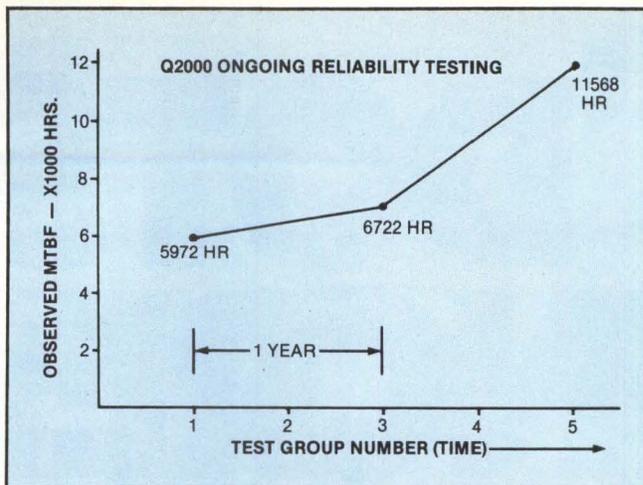


Fig. 8. The mean time between failures (MTBF) of the Q2000 drive consistently improved over time. The first test group rated the drive early in the production ramp. The 11,568-hour MTBF was recorded during full production.

encoder cells used in certain lots. The cells were replaced, and acceptance levels improved; however, acceptable yield rates did not rise to the desired level of 95 percent. The company then requested that the supplier of the failing part do 100 percent testing. The problem was attributed to faulty cell arrays. The supplier corrected the problem, and yields increased from 95 percent to 99 percent levels.

Intensive DVT and in-process and post-assembly quality testing result in predictably high MTBFs (Fig. 8). Common testing procedures and test duplication also lead to reduced incoming test costs and fewer failures in the field. □

Richard Taylor is vice president of quality and reliability at Quantum Corp., Milpitas, Calif., and **Gregory Pelletier** is peripherals product-line manager at Wang Laboratories Inc., Lowell, Mass.

CAN INCOMING TESTING BE ELIMINATED?

Market trends in the small computer field show that most companies are moving into expanded distribution channels. Computer systems that were previously sold directly through a field sales force are now being pumped through multilayered distribution channels such as large OEMs, dealers and distributors. In addition, the increasing sophistication of microcomputer users has encouraged manufacturers to offer peripherals as add-ons or field upgrades to installed systems.

In response to these trends, many companies have set up stocking warehouses to support local distribution channels. These warehouses are usually in regional sites far from the primary assembly facilities. Products

and subassemblies are directed through incoming and final testing procedures at the vendor's (such as Quantum Corp.) manufacturing facility, at the manufacturer's (such as Wang Laboratories Inc.) central facility and then again at the remote sites before being shipped to the dealers or final end users.

With microcomputer systems becoming a commodities market, and volumes increasing from thousands to millions per year, the logistics and overhead costs involved in this mass transportation and multiple testing of subassemblies have become major burdens to companies competing in an increasingly cost-sensitive market. To reduce the costs involved in multiple testing procedures, handling

of assemblies and storage in multiple sites, some manufacturers are examining "ship-to-stock" programs with peripherals vendors. Instead of shipping drives to the manufacturer, which performs incoming and system tests and then ships the disk drives to remote sites that repeat the testing procedures, the vendor would ship directly to the remote sites. The remote facility would then perform the tests as part of system integration, eliminating the intermediate step of sending the drives to the manufacturer's central facility. Eliminating several loops of the incoming test/final assembly/system test procedures would greatly reduce overhead in manpower, facilities and transport.

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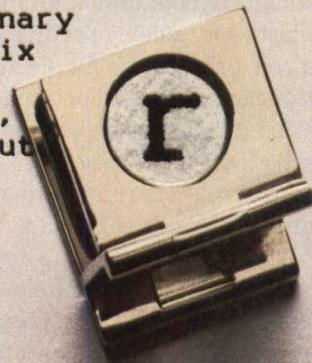
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CIRCLE NO. 110 ON INQUIRY CARD

Magnetic media market rides on drive advances

A market in flux presents new opportunities for media manufacturers and OEMs

Melissa A. Yonge, Venture Development Corp.

For years, the spotlight on magnetic storage focused on drive technology and size. Center stage is widening, however, as magnetic media plays an increasingly significant role in advancing drive performance. The media market has evolved into a multibillion-dollar industry and is expected to reach more than \$5 billion by 1987. New recording technologies, such as vertical and optical recording, and new media materials like chromium dioxide and "spin-coated" disks, present new marketing as well as technological challenges for media manufacturers.

Market snapshot

End users, system integrators and drive manufacturers now have more than 40 primary suppliers of magnetic media from which to choose. The media leaders vary according to their products. 3M Co. leads in magnetic-tape revenues, with their cartridge sales accounting for approximately 90 percent of that market segment and reel-to-reel sales accounting for more than 20 percent of all reel tapes sold. Verbatim Corp. dominates the floppy disk market with more than 28 percent of all revenues. Dysan Corp. commands almost 30 percent of fixed rigid media sales, and Control Data Corp. leads in cartridge disks and disk packs with more than 35 percent of that market.

Joint ventures are on the rise, largely because companies cannot afford to do all the long-term research and development and stay competitive in the short run. Joint ventures also decrease the odds of missing out on a technological innovation. Dysan, for example, has invested in Charlton Associates under an agreement

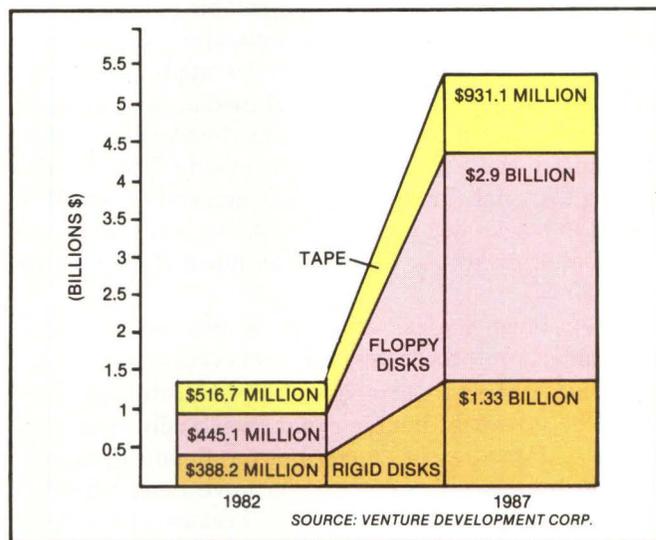


Fig. 1. Total magnetic media revenues are expected to exceed \$5 billion by 1987. In 1982, the market was worth \$1.3 billion. The growth is due in large part to the rise in floppy disk sales.

whereby Dysan obtains all rights to Charlton's manufacturing process. Dysan has also collaborated with Brown Disc Manufacturing Inc. to develop spin-coated media.

The magnetic media market was valued at \$1.35 billion in 1982. Over five years, revenues are expected to increase at a 30.9 percent compound annual rate (Fig. 1), primarily due to growth in floppy disk sales. Sales are expected to grow from \$445.1 million in 1982 to \$2.9 billion in 1987, a 45.8 percent annual rate increase. And users will demand more microflopsies and double-sided, 5¼-inch floppies, which will comprise more than 50 percent of diskette revenues in 1987.

Hard disk media sales will more than triple between 1981 and 1987. The increasing popularity of desktop microcomputers has made media for small Winchester drives the most explosive growth products. Cartridge disk media is the second fastest growing sector of the market because of the strength of 5¼-inch and smaller cartridge drive sales and the availability of high-capacity 14-inch cartridges (Fig. 2). Disk pack sales should increase because of new 8-inch packs and very high-capacity, 14-inch disk packs.

Trends and future developments

An onslaught of new drive technology developments will enable media manufacturers to optimize product performance. Several innovations are available. For example, thin coatings, such as chromium dioxide, let media manufacturers increase data densities. IBM Corp. is expected soon to introduce a cartridge using chromium-dioxide tape with 30,000-bit-per-inch (bpi) density, compared to the current standard of 6,250 bpi.

Spin coating, commonly used to apply very thin layers of coating material to rigid media, is being used for some floppy disks. Pre-cut Mylar blanks are spun at high speed while a needle valve evenly deposits the coating material. Products from Dysan and Brown Disc have 170 tracks per inch (tpi) at 9,500 bpi, and future spin-coated diskettes will have as much as 15,000 bpi and 200 tpi.

Other technologies are still a few years away. Perpendicular recording is especially promising. Vertimag Systems Corp. has shipped prototypes of a 5M-byte, 5¼-inch double-sided, vertically recorded diskette. Densities of 20,000 bpi for floppy disks and 100,000 bpi for rigid disk media have been reported with this recording technique. But because of problems in manufacturing these media in large quantities, perpendicular recording is not expected to become commonplace for three to five years.

Optical recording is another technique that offers increased densities. Optical drives are rotating devices that use lasers to record and access data on a variety of media, none of which has so far received overwhelming support from researchers.

The magnetic media industry is very sensitive to developments in tape and disk drives. Thin-film-head technology specifications, for example, begin where the limitations of older ferrite-head technology end. Both IBM and Dastek Corp. have released product specifications for thin-film-head, 14-inch rigid drives with approximately 600 tpi and 12,000 bpi.

Drive designs can also maximize media recording density. MegaTape Corp., for example, produces a

½-inch tape cartridge that stores 330M bytes. Amlyn Corp. manufactures a floppy disk that stores 10M bytes on an accordion-like stack of 5¼-inch diskettes. And Maxtor Corp. has announced a 5¼-inch hard disk drive that stores 140M bytes by using more of the media surface.

Distribution channels are changing

The marketing of magnetic media, like that of small computer systems, has been changing over the past few years. Media is no longer purchased exclusively by data-processing managers. Secretaries are now more apt to order computer supplies, basing their decisions on brand recognition, media type and manufacturer. Just as magnetic media product lines are diversifying, so are the options that manufacturers must explore to sell them.

To reach new consumers more efficiently, media manufacturers will have to use multitier distribution channels and rely increasingly on resellers. The more complex the media and storage device, the more limited the distribution options. Floppy disks are so standard and inexpensive that they are sold in department stores, but the more sophisticated rigid disk media is sold only through OEMs and direct sales forces.

The dramatic rise in personal computer sales will increase the market share for floppy disk drives and

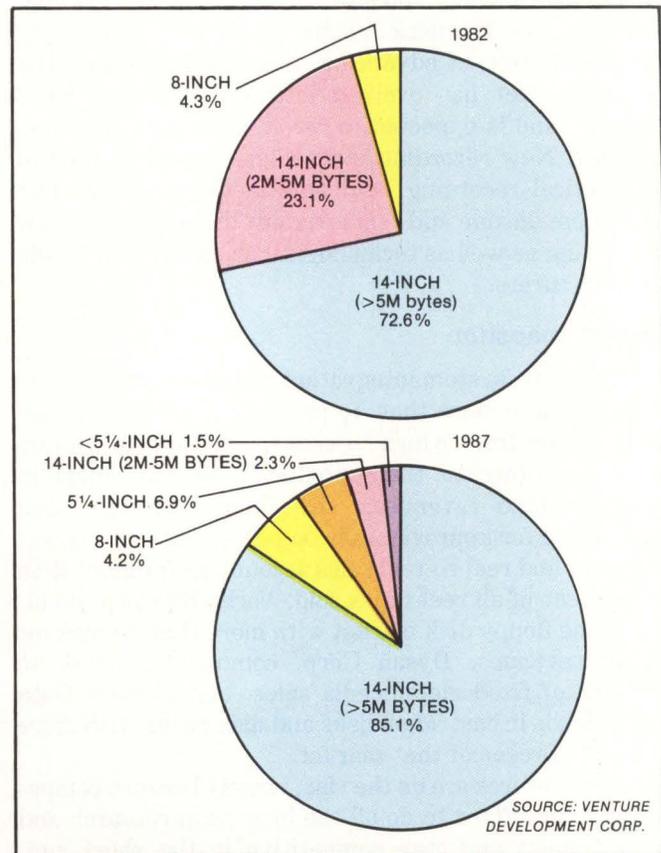
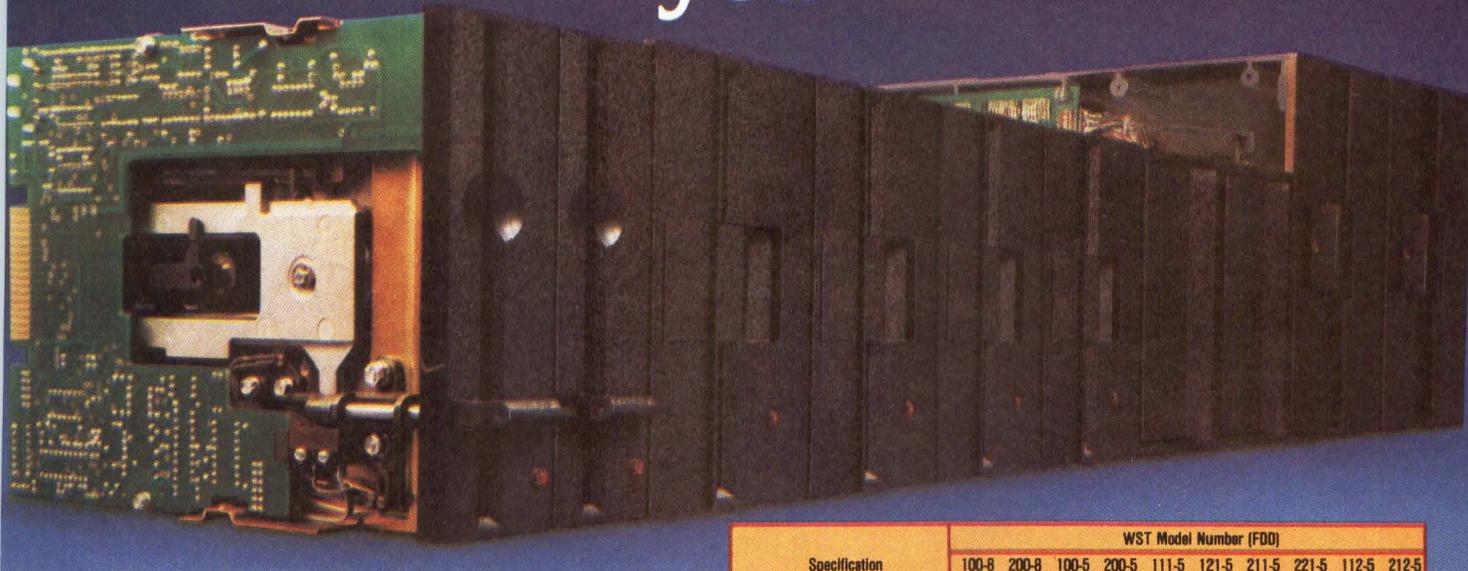


Fig. 2. Market-share revenues by the various cartridge disk segments will change due to the increase in sales of 14-inch cartridges with more than 5M-byte capacities and the introduction of 5¼-inch and smaller drives.

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Specification	WST Model Number (FDD)									
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Media Size (in.)	8.0	8.0	5.25	5.25	5.25	5.25	5.25	5.25	5.25	5.25
Heads (number)	1	2	1	2	1	1	2	2	1	2
Access:										
Track-to-Track (msec)	3	3	20	20	5	3	5	3	20	20
Average (msec)	91	91	275	275	80	110	80	110	275	275
Unformatted Capacity (Kbytes)										
(FM)	400	800	125	250	125	250	250	500	125	250
(MFM)	800	1600	250	500	250	500	500	1000	250	500
Track Density (TPI)	48	48	48	48	48	96	48	96	48	48
Drive Size (in.)										
Height	4.5	4.5	3.25	3.25	3.25	3.25	3.25	3.25	1.62	1.62
Width	8.55	8.55	5.75	5.75	5.75	5.75	5.75	5.75	5.75	5.75
Length	14.25	14.25	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0

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- West Associates—(214) 248-7060
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are the half-height 5¼-inch flexible disk drives. We've identified them as FDD112-5 and FDD212-5. They maintain WST's reputation: quality, competitive pricing, and availability. These new models take up half the space of the conventional 5¼-inch flexible disk drives. And they're deliverable in OEM quantities now.

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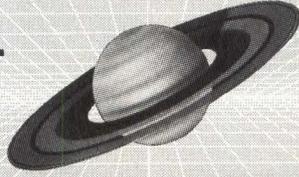
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MAGNETIC MEDIA

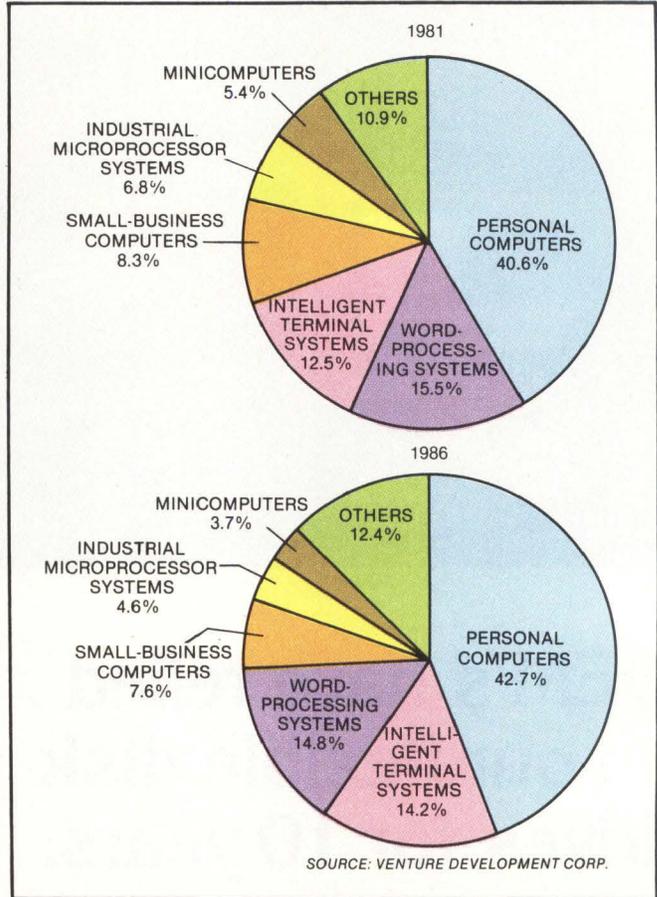


Fig. 3. Floppy disk drive shipments by system type.

diskettes (Fig. 3). As a result, pricing strategies will differ from product to product. High-priced "name brand" media is supported by much advertising and promotion and is sold through retail and traditional distribution channels.

Low-priced media is sold almost exclusively through retailing channels to consumers whose primary concern is costs. With more frequent use of consumer-oriented marketing techniques, those products with strong consumer recognition from companies with expertise, such as BASF Systems Corp., Maxell Corp. of America and TDK, will have an advantage. As media develops into a commodity, a diversified strategy will determine market share as much as will product quality brand recognition and competitive pricing. □

Melissa A. Yonge is a market analyst specializing in computer memory at Venture Development Corp., a management consulting and market research firm in Wellesley, Mass.

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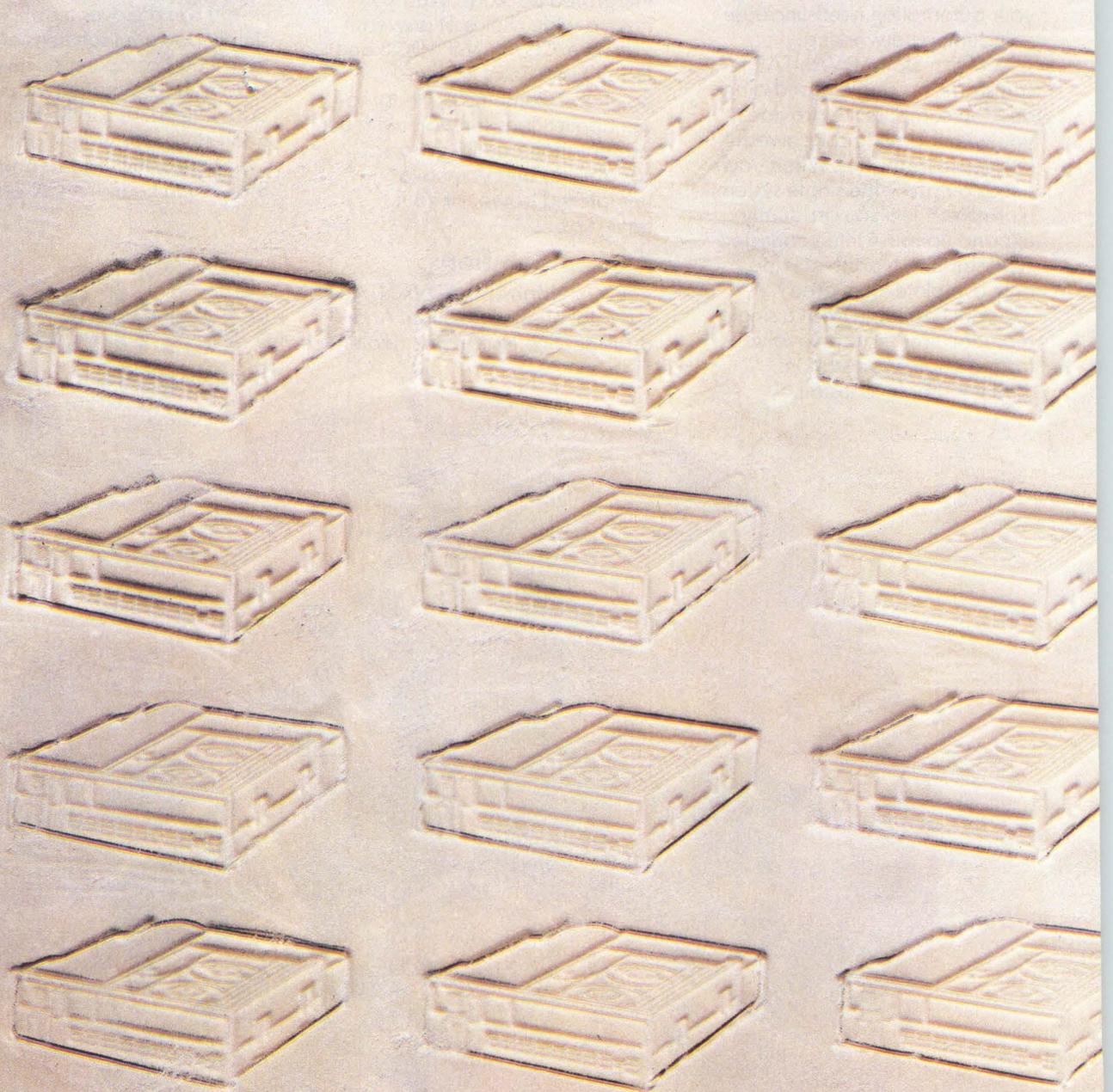
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Archive's to building



approach 1/4" streamers.



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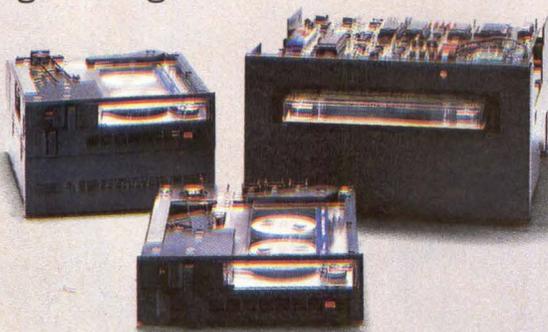
At Archive, that goal was met. In the last three years, we've shipped more than 50,000 streamers—nearly three times as many drives as the rest of the industry combined.

Others are still learning how to build streamers in quantity. But we perfected our production process years ago.

Today we're shipping over 5,000 streamers each month. And everything is in place to boost our capacity to 15,000 streamers per month.

Of course we haven't sacrificed quality for quantity. Our 98% reliability rate is among the industry's best.

But still, we're improving our products. For example, our recent advancements in LSI technology have reduced the number of parts in our newest streamers by 40%. So there's even less of a chance that something will go wrong.



Archive offers 8", 5 1/4" full-height and 5 1/4" half-height streaming tape drives.

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 - ✓ VERY ACCURATE HEAD POSITIONER
 - ✓ AVAILABLE QIC-2 / QIC-24
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- 5 1/4" PC VERSION AVAILABLE

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If you do, and you'd like more information or an evaluation unit, call us. We're available with the answers. Now. (313) 973-4600. Or write, Northern Telecom Inc., Memory Systems Division, 100 Phoenix Drive, P.O. Box D, Ann Arbor, MI 48106.



Streaming-tape cartridge and cassette drives extend back-up abilities

*Higher tape speeds, transfer rates and capacities
broaden the role of tape drives*

David Simpson, Associate Editor

Buoyed by the demand for inexpensive Winchester back-up, ¼- and ½-inch streaming-tape drive manufacturers are enjoying a new wave of prosperity. World-wide shipments of ¼-inch cartridge streamers, for example, are forecast to go from 80,000 units in 1983 to 375,000 units in 1987, according to Freeman Associates, a management consulting and publishing company in Santa Barbara, Calif.

One-half-inch tape cartridges are experiencing delays due to lack of standards but are expected to be the dominant class of ½-inch tape drives by 1987. Meanwhile, streaming-tape cassette drives are pushing the 40M-byte mark while preparing to jump into the 3½-inch form factor drive market.

Streamers offer advantages over start/stop units

Streaming-tape drives read and write data in a continuous stream. These drives use microprocessor-controlled servo systems that replace costly start/stop tape mechanisms. Streamers record inter-record gaps "on the fly." The gaps are usually about 13 bytes, in contrast to the 960-byte gaps used in most start/stop tape drives. Thus, streamers can use 97 percent of the tape, whereas start/stop drives use only 35 to 70 percent.

Start/stop drives pause in inter-record gaps on the tape surface as they read or write data. The gaps are ⅜- to ⅝-inch, depending on the recording format. The drive performs read-after-write data verification, stops and then accelerates to operating speed. This action

requires complex mechanisms that typically limit tape speed to 45 inches per second (ips) in drives using tension arms, and to 125 ips in drives using vacuum columns to maintain proper tape tension.

Streaming-tape drives offer higher tape speeds, transfer rates and capacities than start/stop models. MegaTape Corp.'s MT300 and MT1220 drives, for example, operate at 200 ips, compared to a typical 30- or 60-ips speed for start/stop drives. Since streamers perform continuous dumps, data transfer rates can reach 192K bytes per second in Comark Corp.'s MT85 "Funnel" and 380K bytes per second in the case of Cipher Data Products Inc.'s CacheTape. In contrast, start/stop transfer rates rarely exceed 30K bytes per second. Because of better tape utilization, streamers can pack more bytes per drive. Northern Telecom Inc.'s ¼-inch 6112, for example, stores 100M bytes, and ½-inch tape drives from MegaTape and Rosscorp Corp. handle over 300M bytes.

One drawback to streaming-tape drives is the need for a continuous data stream for optimum performance. In the event of an interruption, the drive must undergo a relatively slow repositioning movement (See MMS, May 1983, Page 261). To overcome this, OEMs often write drivers that enable the CPU to maintain a continuous data flow. Cipher and Rosscorp solve this problem by using a cache buffer that ensures a continuous data flow from the host.

Quarter-inch streamers lead the pack

Quarter-inch streamers entered the market in 1981 with 9,500 units shipped. According to Freeman

Associates, this figure is expected to exceed 375,000 units in 1987, reflecting a compound annual growth rate of 84 percent. This success is due largely to the de facto quarter-inch cartridge (QIC)-02 interface standard and the QIC-24 recording-format standard. Several manufacturers agreed to support these standards in late 1982, and the standards are currently under review by the ANSI X3T9.6 committee. Almost all of the ¼-inch cartridge streamers support the QIC standards. An exception is 3M Corp., which still incorporates a proprietary interface. It has, however, recently joined the ranks of QIC-committee members.

Archive Corp. is the market leader, with a 50-percent share, followed by 3M, with a 16 percent slice, according to Freeman Associates. 3M and Data Electronics Inc. (DEI) lead in media sales.

The major trend in ¼-inch streaming cartridge drives is toward higher capacities. This tracks the response to similar trends in the Winchester-drive market. A variety of manufacturers offer over-45M-byte drives, including Archive, Cipher, Control Data Corp., Tandberg Data Inc. and 3M. Northern Telecom tops the list with its 100M-byte 6112, which uses 10,000-bit-per-inch (bpi) recording in 12 tracks on a 600-foot cartridge.

Half-inch streamers solve requirements

The market for ½-inch cartridge tape drives, including streaming and start/stop versions, is expected to go from \$5.8 million in 1983 to \$590 million in 1987, according to *Computer Tape Outlook*, published by Freeman Associates. It is difficult to predict the share that streamers will claim because the technology is new, and the lack of standards confuses the issue.

Half-inch tapes address high-capacity (>50M bytes) back-up applications. Cipher's CacheTape and Microstreamer, for example, can hold 92M bytes on 9-track tape, and Rosscomp's D161 can handle up to 320M bytes and can back up 160M bytes in less than 20 minutes with a 130-ips tape speed and 130K-byte-per-second transfer rate. MegaTape is expected to announce the 500M-byte MT-2210 and MT-2220 cartridge drives next quarter. The new drives will require the MDC-1100 cartridge and will use 1,500-foot tape that runs at 200 ips with 1,200 flux changes per inch. While traditional ½-inch reel-to-reel tapes handle the back-up requirements of 14-inch Winchesters, ½-inch streaming-tape cartridge drives target the 5¼- and 8-inch markets, competing with high-end ¼-inch tape drives.

The major impediment to market acceptance of ½-inch cartridge streamers is the lack of standards. All of the ½-inch streamers exhibit different form factors and interfaces. MegaTape opts for the 9-track Pertec-

compatible interface, while Tandon uses interfaces that are similar to the standards for 5¼-inch floppies and Winchesters, and Rosscomp supports the BSTI, SCSI, QIC-02 and Pertec interfaces. Many ¼-inch drive manufacturers are waiting for IBM to introduce a ½-inch cartridge before they jump into the market. However, major announcements from Cipher, Tandberg, Tandon Corp., and Memorex/EPI (the joint venture of Memorex Corp. and Electronic Processors Inc.) have legitimized the technology, although only MegaTape and Rosscomp are currently delivering production quantities.

Within the next year, look for ¼-inch cartridge drives that will accept ½-inch tape. Although no such products are currently available, DEI and Tandberg displayed prototypes at last fall's Comdex show.

Cassettes eye 3½-inch market

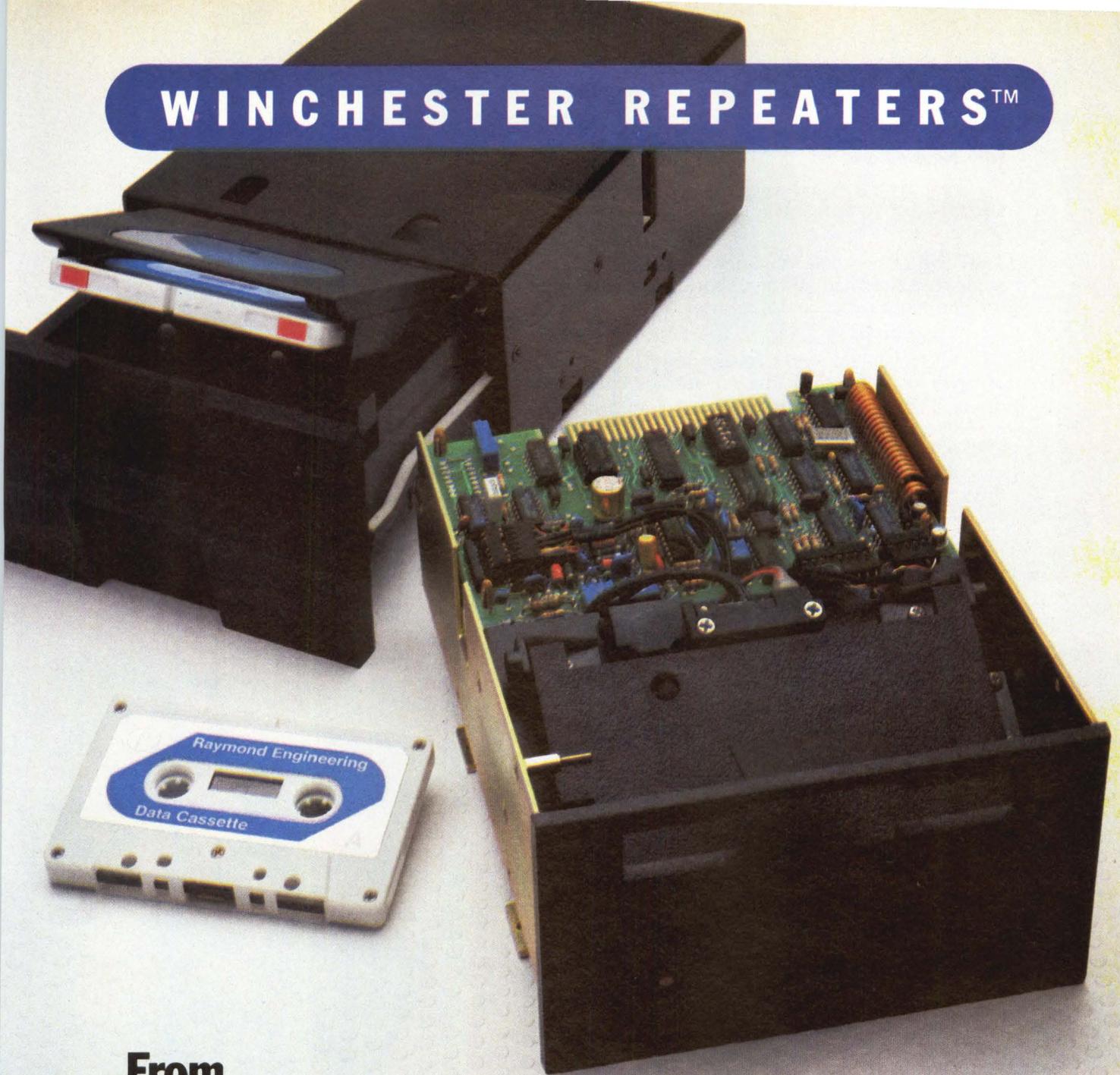
The high-performance cassette-drive market, a category that includes streamers, is expected to go from 31,000 units shipped (\$14 million) in 1983 to 140,000 units (\$42 million) in 1987, according to *Computer Tape Outlook*. Most of this growth will be due to the minicassette, which uses 0.15-in. tape. One such unit, Memtec Corp.'s 440, can hold over 40M bytes of data. The half-height 440 uses 4-track recording and can back up 40M bytes in 27 minutes.

Another major introduction in the streaming cassette market recently came from Teac Corp. The half-height MT-2ST operates at 90 ips, uses 10,000 flux-reversal-per-inch recording with 4-track serpentine tape. It can back up 20M bytes in 4 minutes at a data transfer rate of 87K bytes per second.

The major market opportunity for minicassettes lies in the yet-to-emerge 3½-inch arena, according to Raymond C. Freeman, president of Freeman Associates, who sees cassettes as companions to 3½-inch floppies in the near future. Another contender for this market is the minicartridge streamer, the first of which was introduced last month by Irwin Magnetics. The half-height 210 minicartridge uses 0.15-inch tape, holds 10M bytes, incorporates the SA450 interface and records at 6,400 bits per inch. Initial shipments of the drive will be in the 5¼-inch form factor, with a 3½-inch version to follow.

Other developments in the tape-drive market include attempts to keep up with the form-factor changes in the Winchester and floppy disk drive markets. Teac and Memtec have released half-height cassette drives. Quarter-inch streaming-tape drives, such as Archive's Scorpion series and Wangtek's Series 5000, are adopting the half-height form factor. These drives do not include the controller/formatter circuitry included with full-height models. These circuits typically occupy another half-height enclosure. Wangtek expects to ship half-height units that include controller and formatter electronics by the first quarter of 1985. The other trend in form factors is a move from the prevalent 8-inch packages to 5¼-inch packages. □

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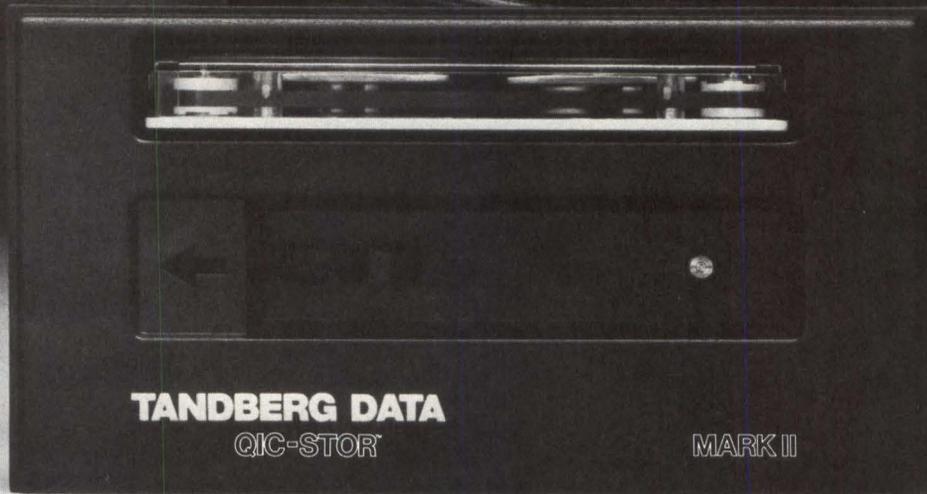
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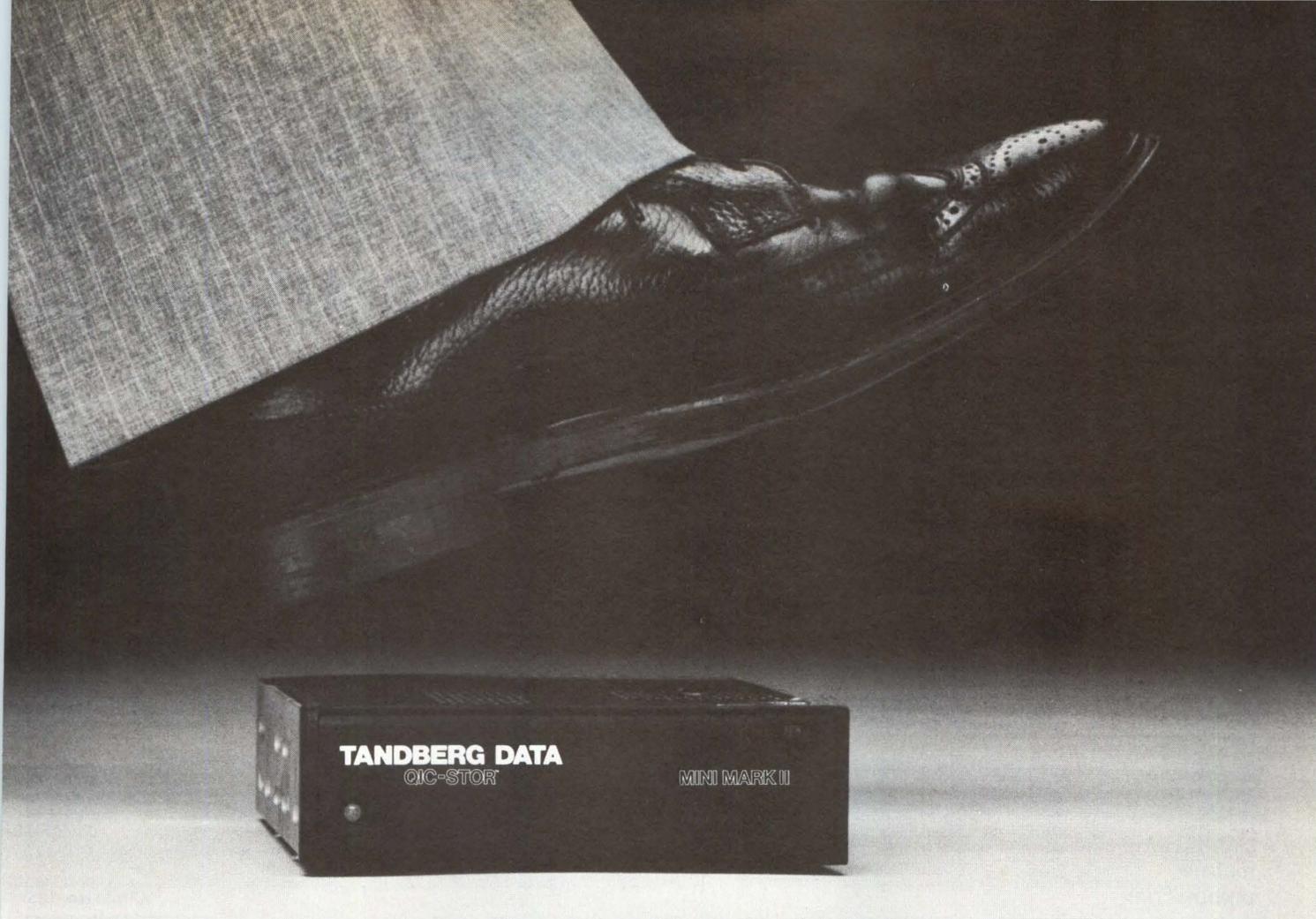
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CASSETTE/CARTRIDGE STREAMING TAPE DRIVES

Company Model	Type	Tape size (in.)	Operating mode	Storage capacity (M bytes)	Number of tracks	Recording density (bpi)	Tape speed (ips)	Data transfer rate (K bytes/sec)	Dimensions (HxLxD, in.)	Unit price (\$)	Interfaces
ARCHIVE CORP.											Circle No. 781
Scorpion 20MB	cartridge	.25	streaming	20	4	8000	30, 90	30.0, 90.0	1.625x5.75x8	900 (Q500)	QIC-02
Scorpion 45MB	cartridge	.25	streaming	45	9	8000	90	90.0	1.625x5.75x8	1,000 (Q500)	QIC-02
Sidewinder	cartridge	.25	streaming	20	4	8000	30, 90	30.0, 90.0	4.5x8.55x10	900 (Q500)	QIC-02
Super Sidewinder	cartridge	.25	streaming	45	9	8000	90	90.0	4.5x8.55x10	1,000 (Q500)	QIC-02
CIPHER DATA PRODUCTS INC.											Circle No. 782
Series 400	cartridge	.25	streaming	20	4	10,000	30, 90	28.9, 86.7	4.5x8.55x14	630	QIC-02
Series 540	cartridge	.25	streaming	60	9	10,000	90	86.7	3.25x5.75x8	890 (Q500)	QIC-02
Cache Tape	reel-to-reel	.5	streaming	46 92	9	1600, 3200	50, 100	120- 380	8.75x17x22	2,820 (Q500)	
Microstreamer	reel-to-reel	.5	streaming	46 92	9	1600, 3200	25, 100	120- 380	8.75x17x22	2,325 (Q500)	
COMARK CORP.											Circle No. 783
MT85 "Funnel"	cartridge	.25	start/stop, streaming	12	4	6400	30	192.0	4.62x8.55x 14.25	2,950	Multibus
CONTROL DATA CORP.											Circle No. 784
9219X Series	cartridge	.25	streaming, start/stop	26 70	11	8000	55	55.0	4.6x8.5x14	940 (Q250)	
9218X	reel-to-reel	.5	streaming, start/stop	46, 180	9	1600, 6250	25, 75	833.0	24x19x13.5	6,350 (Q100)	industry standard
DATA ELECTRONICS INC.											Circle No. 785
QIC-Stream III	cartridge	.25	streaming	60	4, 9	8000	45, 90	43.0, 86.0	1.62x5.75x8	980 (Q500)	QIC-02
Streaker	cartridge	.25	streaming	26.6	4	8000	30, 90	30.0, 90.0	4.5x8.5x6.4	685 (Q500)	SCSI/SASI
ELECTRONIC PROCESSORS INC.											Circle No. 786
STR-STREAM II	cartridge	.5	start/stop, streaming	83	20	20,000	50, 75, 150	225.0	3.25x5.75x8	1,140 (Q500)	ESDI
IRWIN MAGNETICS											Circle No. 787
110	cartridge	.15	start/stop, streaming	10	8	6400	40	3.0	1.625x5.65x8	275 (Q500)	SA450
210	cartridge	.15	start/stop, streaming	10	8	6400	40	3.0	1.625x4x4.96	275 (Q500)	SA450
MEGATAPE CORP.											Circle No. 788
MT 300	cartridge	.5	streaming	330	24	9600	50, 200	240.0	8.75x19x17.5	4,700	Pertec/Cipher
MT-1220	cartridge	.5	streaming	330	24	9600	50, 200	240.0	10.2x8.4x29	4,950	Pertec/Cipher
MEMTEC CORP.											Circle No. 789
420	cassette	.15	streaming	19.5	4		30, 90	37.5, 112.5	1.625x5.75x 7.6	400 (OEM)	QIC-02
440	cassette	.15	streaming	43.9	4		30, 90	37.5, 112.5	1.625x5.75x 7.6	500 (OEM)	QIC-02
510	cassette	.15	streaming	12.4	4		30, 90	24.0, 72.0	3.25x5.75x 7.6	375 (OEM)	QIC-02
520	cassette	.15	streaming	19.5	4		30, 90	37.5, 112.5	3.25x5.75x7.6	400 (OEM)	QIC-02



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CASSETTE/CARTRIDGE STREAMING TAPE DRIVES

Company Model	Type	Tape size (in.)	Operating mode	Storage capacity (M bytes)	Number of tracks	Recording density (bpi)	Tape speed (ips)	Data transfer rate (K bytes/sec)	Dimensions (HxWxD, in.)	Unit price (\$)	Interfaces
NORTHERN TELECOM INC.											Circle No. 790
6109	cartridge	.25	streaming	45 75	9	8000	30, 90	30.0, 90.0	3.9x7.7x5.7	936 (Q500)	QIC-02
6112	cartridge	.25	streaming	60, 100	12	8000	90	90.0	3.9x7.7x5.7	1,030 (Q500)	QIC-02
RAYMOND ENGINEERING											Circle No. 791
WR-100	cassette	.15	streaming	10	4	6400	30, 90	19.2	3.25x5.75x8	535 (Q500)	RS232C
WR-200	cassette	.15	streaming	10	4	10,000	30	30.0	3.25x5.75x8	590 (Q500)	QIC-02, SCSI
ROSSCOMP CORP.											Circle No. 792
D161	cartridge	.5	streaming	160	24	8000	90, 130	90.0, 130.0	4.62x8.55x11	1,625 (Q1,000)	QIC-02, SCSI, BSTI, Pertec
D5160	cartridge	.5	streaming	160	24	8000	90, 130	90.0, 130.0		750 (QOEM)	QIC-02, SCSI, BSTI, Pertec
SAYLOR ELECTRONICS INTERNATIONAL											Circle No. 793
4240	cassette		streaming, start/stop		4	3200	30		6x5.5x7	1,550	
TANDBERG DATA INC.											Circle No. 794
QIC-STOR/ MARK II TDC-3229	cartridge	.25	streaming	20, 27, 45, 60	4, 9	8000	45, 90	44.0, 88.0			QIC-02
QIC-STOR/ MINI MARK II TDC 3319	cartridge	.25	streaming	20, 27, 45, 60	4, 9	8000	45, 90	44.0, 88.0			QIC-02
TANDON CORP.											Circle No. 795
TM 951	cartridge	.5	streaming	50	20	6400	40	31.25	3.38x5.87x8	500 (OEM)	
TEAC CORP. OF AMERICA											Circle No. 796
MT-2ST	cassette	.25	streaming	20	4	10,000	90	87.44	1.625x5.75x8	700 (Q500)	QIC-02
3M DATA RECORDING PRODUCTS											Circle No. 797
DCD-1	cartridge	.15	streaming, start/stop	.2	1	800	30	2.4	3.9x5.7x3.8	534 (Q100)	TTL compatible
DCD-2	cartridge	.15	streaming, start/stop	.7	2	1600	30	4.8	4.2x5.7x4.8	426 (Q100)	TTL compatible
DCD-3	cartridge	.25	streaming, start/stop	4.3	4	1600	30	6.0	6.9x8.7x9.4	1,061 (Q100)	TTL compatible
HCD-75/30	cartridge	.25	streaming, start/stop	67	16		30	17.5	4.6x6.8x17.6	1,976 (Q100)	parallel 16-bit, 8-bit bi-directional or unidirectional
HCD-75/60	cartridge	.25	streaming, start/stop	67	16		60	35.0	4.6x6.8x17.6	1,976 (Q100)	parallel 16-bit, 8-bit bi-directional or unidirectional
WANGTEK											Circle No. 798
Series 5000	cartridge	.25	streaming	20, 45	4, 9	8000	30, 90	30.0, 90.0	1.625x5.75x8	495 (Q1,000)	QIC-02

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- A call-back security system that prevents unauthorized computer access.
- A UNIX-compatible network operating system that provides virtual file access.

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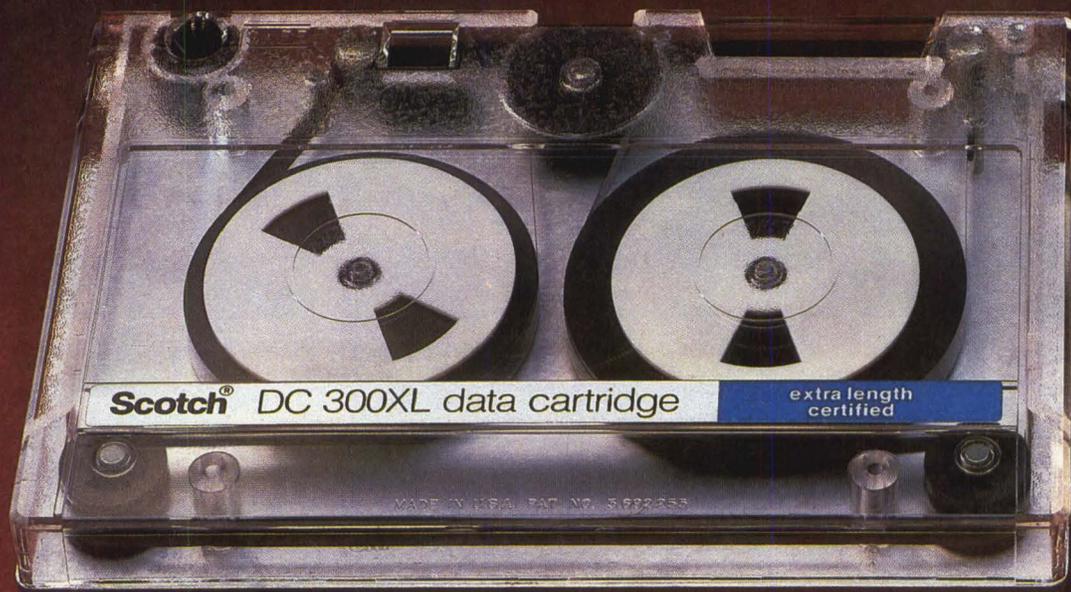
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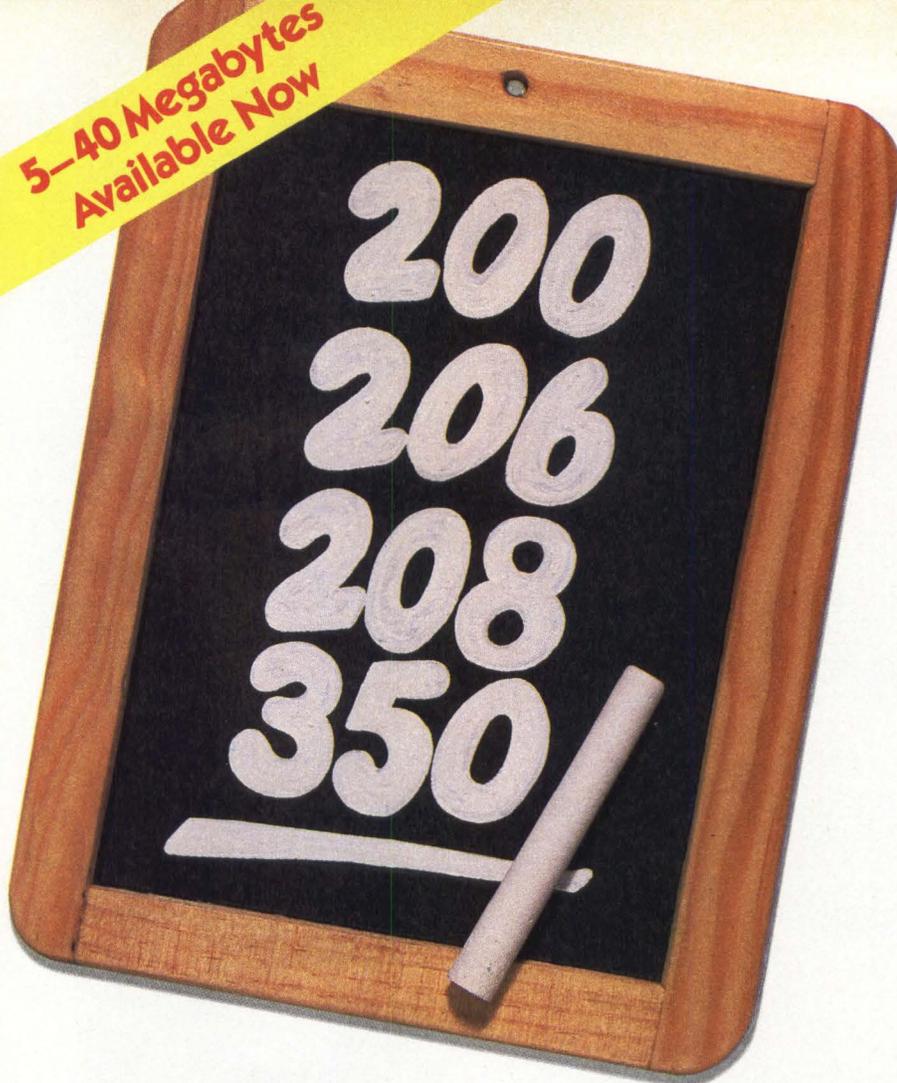
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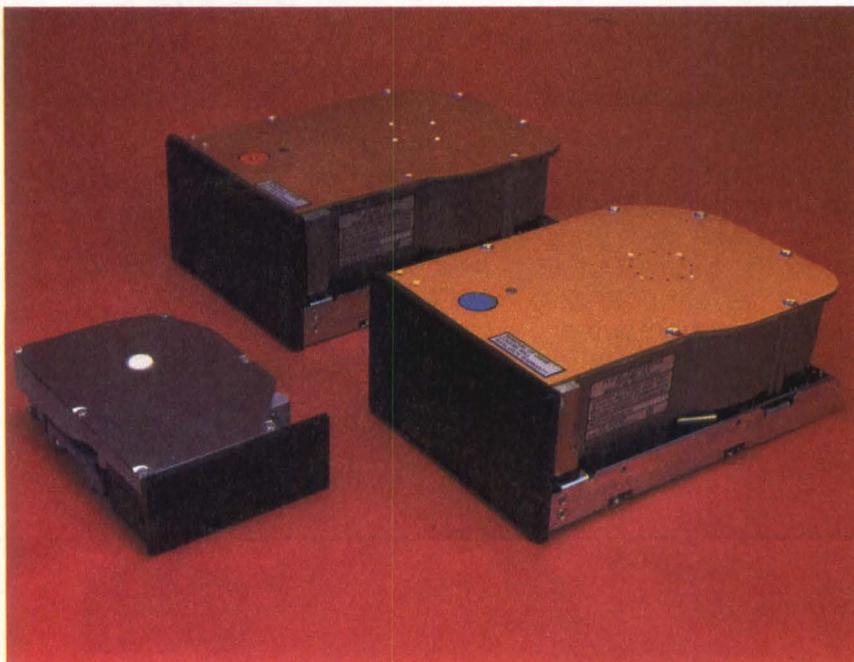
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CIRCLE NO. 121 ON INQUIRY CARD

Understanding head-positioning systems in Winchester drives

Voice-coil or stepper-based designs involve accuracy, speed, reliability trade-offs

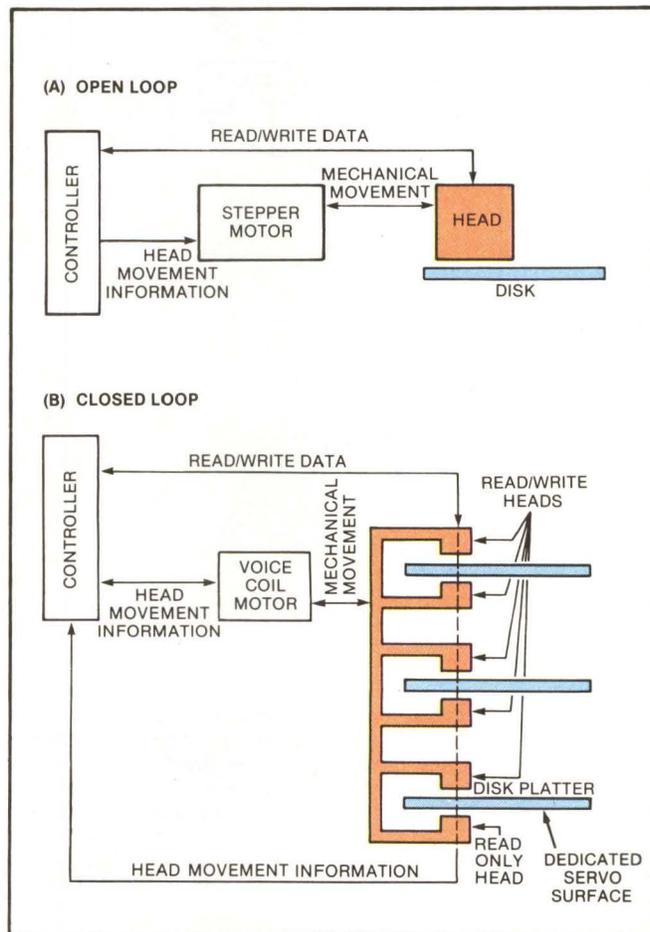
Clyde Czernek, MegaVault

One of the critical elements that determines—and limits—the performance of a Winchester disk drive is the actuation system that positions the read/write heads over the disk. Understanding how these positioning systems function and the trade-offs in accuracy, speed and reliability involved is therefore crucial to OEMs and system integrators in specifying the right hard disk drive for their systems. It will also provide a basis for gauging the performance—and limitations—of tomorrow's disk drives.

An extremely precise mechanism that positions a drive's read/write heads over a desired track, an actuator has an apparently simple task: it accepts a signal from the controller specifying the track to be accessed, moves the head to that location and sends a signal back to the controller when the head is ready to read or write. But performing this task involves careful calculations of accuracy, power, reliability and cost.

Today's Winchester drives use one of two types of actuators: open-loop systems that usually employ stepper motors or closed-loop systems that are generally based on linear or rotary voice-coil devices (Fig. 1).

Fig. 1. Both open-loop and closed-loop actuator systems are used in today's Winchester disk drives. Open-loop designs usually employ a stepper motor to position the drive's read/write head over the disk surface, with accuracy determined by the size of the steps. In contrast, a closed-loop dedicated-servo system relies on the feedback of positioning information from a dedicated servo disk to a voice-coil motor to place the read/write heads.



Some stepper-driven systems use a rack-and-pinion design, but most current stepper-based drives use split-band actuators (Fig. 2).

Many of the principles involved in the interaction of disk drive actuator components were developed during World War II to control massive gun turrets. These

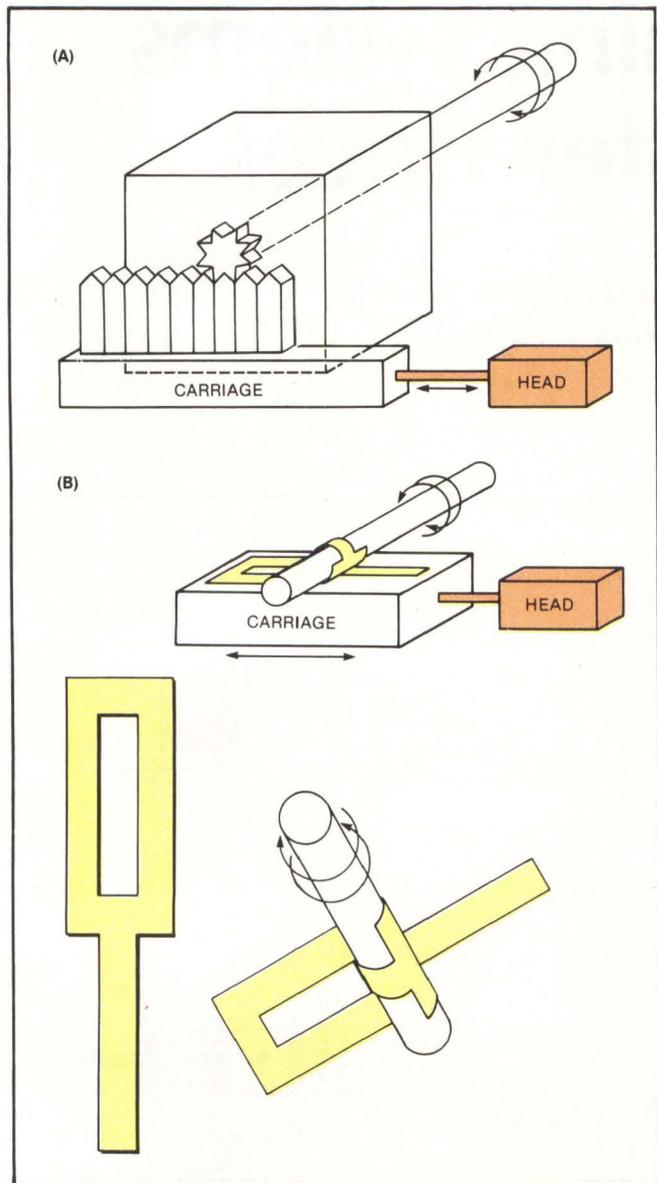


Fig. 2. Split-band-actuator-based designs have largely supplanted rack-and-pinion actuators in stepper-driven systems. Slow, cumbersome and unsealed, the rack-and-pinion actuators used in some early Winchester drives (A) produced contamination as a result of components grinding against each other, as well as a slightly sinusoidal movement that caused track-spacing variations. In current drives, most stepper motors connect to a split-band actuator—a thin metal band wrapped around the capstan that moves the head/carriage assembly (B). The band keeps a constant tension on the carriage, exhibiting essentially no backlash and minimal friction.

closed-loop servo systems had to overcome a tremendous amount of inertia and still aim the guns quickly and accurately. The experience these systems afforded was applied in the late 1950s to IBM Corp.'s early disk drives, although the hydraulic actuator in the drives had an open-loop control system that used mechanical detents to determine final head position. Early disk drives had heavy read/write heads and carriages, resulting in relatively long access times.

When high-power switching transistors replaced bulky thyatrons in the mid-1960s, the actuator outlook changed dramatically. For the first time, it was practical to build a power amplifier small enough to drive an electromechanical actuator directly. Furthermore, the voice-coil actuator then coming into use offered many advantages over hydraulic devices—as well as the early stepper-motor designs. It was faster, more accurate and less cumbersome and could be mounted in the smaller disk pack drives then under development.

Although some manufacturers are experimenting with designs that employ feedback, today's stepper-motor-driven actuators are open-loop designs (Fig. 3). The problem with steppers is rooted in the same characteristic that makes them easy to use: they furnish a simple way to move a drive's head a certain

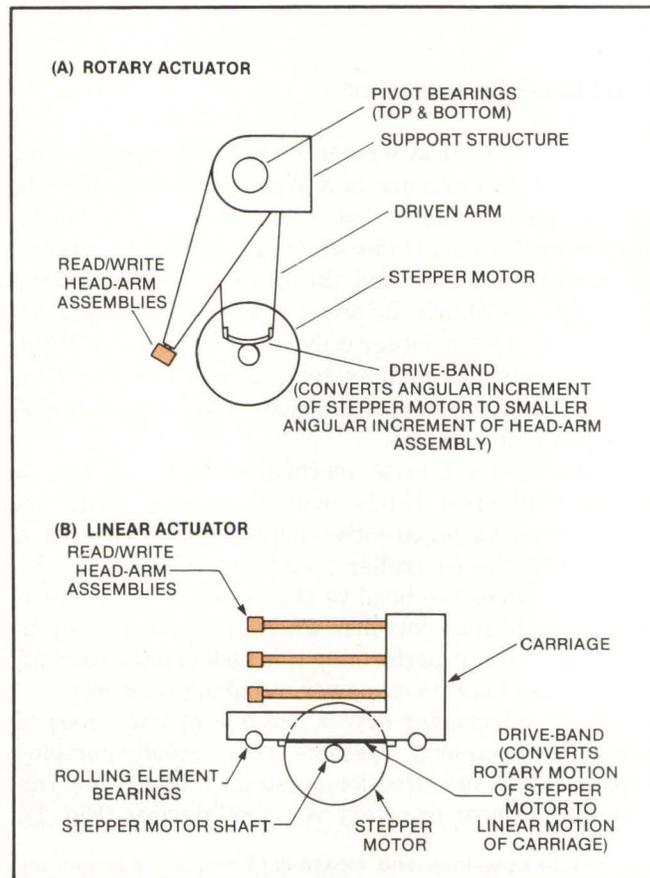
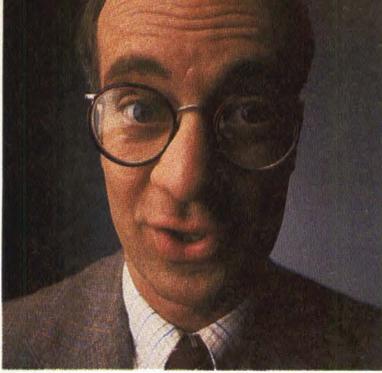


Fig. 3. Stepper-motor-driven actuators, like their high-end voice-coil relatives, come in rotary (A) and linear (B) configurations. Both types of rotary and linear systems employ approximately the same mechanisms. Voice-coil designs, however, use servo loops and feedback information to achieve precise head positioning.



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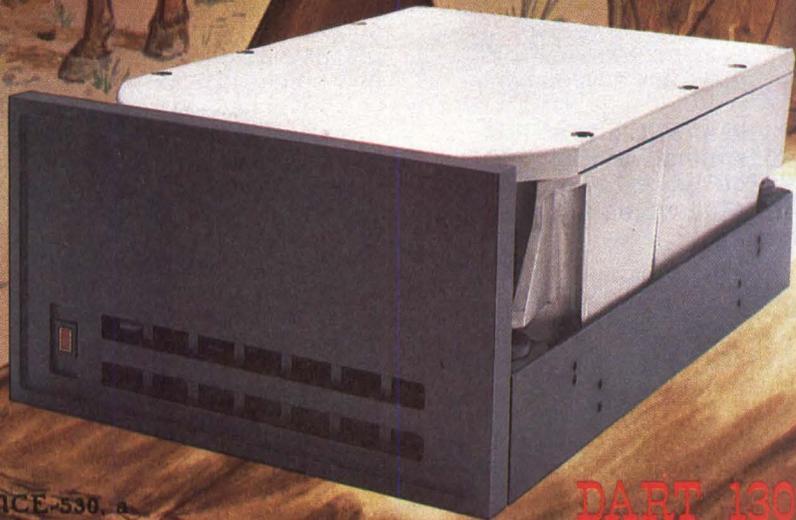
- The LANCE-850, an array of four 5.25" HDA's providing an 853-megabyte capacity and 18-millisecond positioning time, including settling, in a package measuring 2.5 cubic feet including power supply. And it's compatible with SMD and SCSI interfaces.
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DART 130



angular distance in response to an electrical pulse, but they cannot make fine adjustments to that movement, as can a closed-loop system. A stepper's precision is therefore limited to the size of its steps, which act as a magnetic detent within the motor. With most designs, it would be superfluous to provide feedback to determine whether a step is accurately positioning the head over the disk. The lack of feedback also prevents this type of system from compensating for variations in drive-shaft differential expansion due to temperature, bearing imperfections or other factors that can cause carriage misalignments.

Because stepper-based actuators lack great precision yet are very easy to implement, they are suited to

low-performance Winchester. Not only are the stepper motors inexpensive, but the simple circuitry needed to drive them costs very little. Their lack of precision puts an upper bound on how closely tracks can be packed,

The lack of feedback prevents a stepper-motor-driven actuator from compensating for variations in drive-shaft differential expansion due to temperature, bearing imperfections or other factors that can cause carriage misalignments.

though—approximately 500 to 600 tracks per inch (tpi)—ultimately limiting the capacity of the drive. Stepper-based actuator systems are also considerably

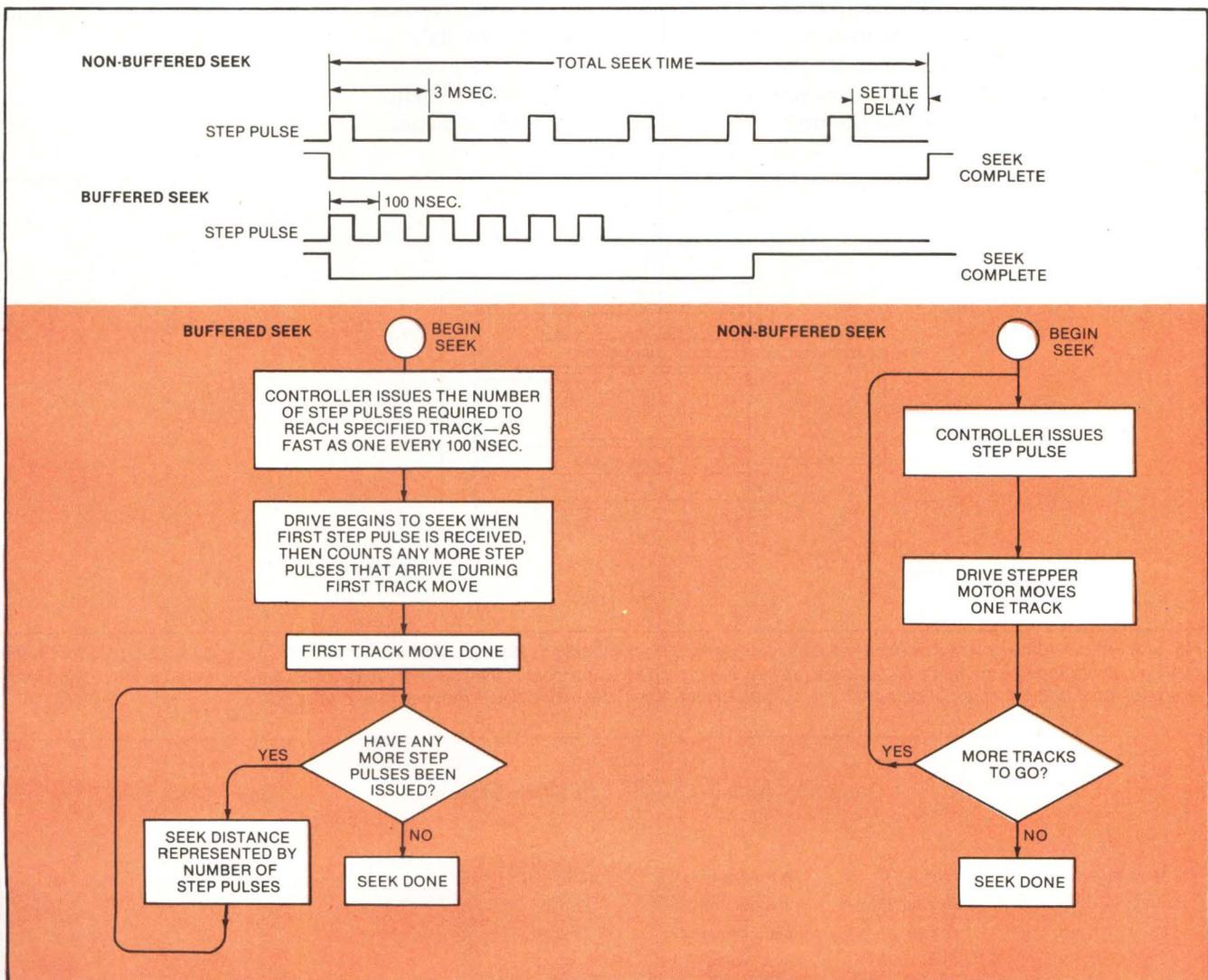


Fig. 4. Buffered seek can speed head positioning in stepper-based actuator systems. The microprocessor-based scheme allows a disk drive to accept all the step pulses for a seek at one time, thus keeping the stepping motor rotating. Non-buffered systems must accept one pulse, step the motor, stop and then accept another pulse before making another step. Buffered seek involves a more complex control procedure but significantly reduces access times.

HEAD POSITIONING

slower than voice-coil systems. The typical average access time of stepper-based drives is well above 60 msec. Some voice-coil positioner-based drives operate at nearly half that speed (see Table, below).

Low-performance Winchester drives usually use either an ST506 or an SA1000 interface, both of which call for a relatively low data-transfer rate (5M bps in the case of the ST506). A high-performance drive, such as MegaVault's 212M-byte unit, must be degraded to work with an ST506 interface; it's not possible to make full use of the drive's capacity with this de facto standard. However, both interfaces are inexpensive to implement.

Stepper designs advance

Manufacturers of stepper-based systems are beginning to use electronic schemes to overcome the mechanical difficulties inherent in the systems. For example, drives can use microprocessors to provide buffered seek or step, in which the processor compares

the actuator's current position with the position required to access a specified track. It then "knows" the distance the actuator must move and can feed a burst of drive pulses to the stepper to achieve that movement relatively quickly. Buffered seek thus consolidates the piecemeal pulses provided by an ST506 or SA1000 interface into a relatively smooth rotation (Fig. 4), while dramatically reducing average access times. For example, Seagate Technology's first 5¼-inch Winchester disk drive, the ST506, operated at a speed of 170 msec.; the company's ST400 series with buffered seek operates at 85 msec.

Microstepping improves accuracy

Another technique to improve drive accuracy that is being examined is microstepping. This method simulates a servo system by using feedback from the recorded data signal to position the actuator more accurately than an open-loop design. In microstepping, the stepper moves the positioner to its nominal position over a track, then makes very small back-and-forth steps while reading the data in that track. A circuit detects the data signal and tells the stepper to stop when the signal is at its peak (usually at the center of the track). Today's multipole steppers make this approach practical by providing several steps per

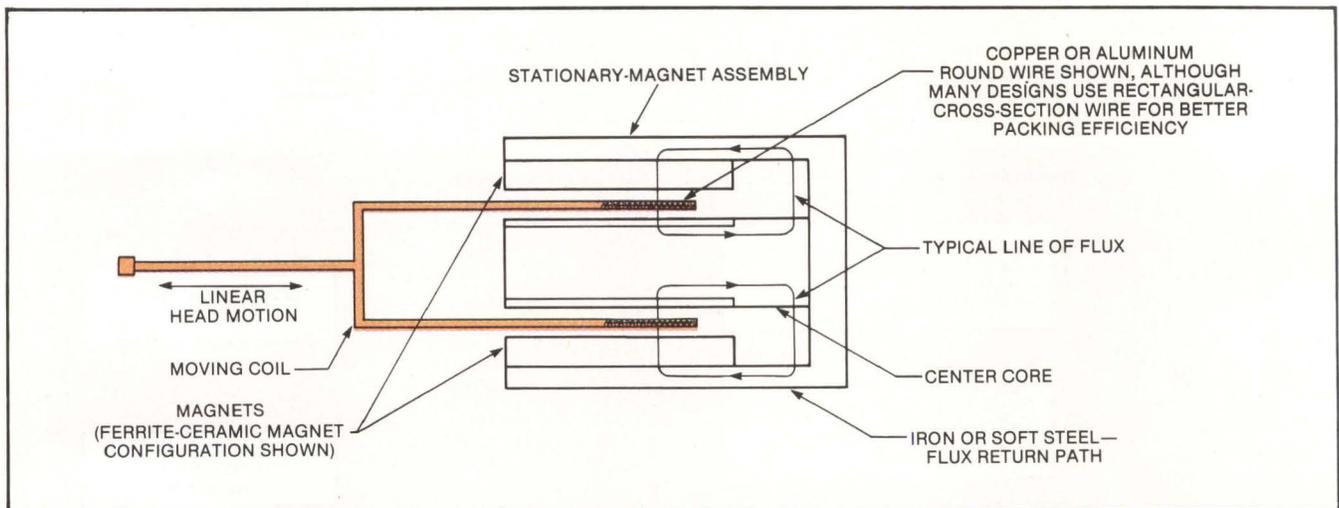


Fig. 5. A typical voice-coil motor works on principles derived from speaker technology. Just as in a standard acoustic speaker, current in the moving coil produces a magnetic field, which pushes against a permanent field in the stationary magnet assembly. Because the moving force is proportional to the amount of current in the coil, a smooth, easily controlled linear movement is produced.

TYPICAL 8-INCH WINCHESTER DISK DRIVES

Manufacturer	Model	Actuator type	Capacity (Mbytes)	Latency (milliseconds)	Average access time (milliseconds)	Price (\$)
Shugart Corp.	SA1004	stepper motor	10.67	9.6	70	1,400
Quantum Corp.	Q2040	linear, torque coil	42.66	10	65	2,450
Priam Corp.	DISKOS 7050	linear, voice coil	70.49	8.3	42	3,240
MegaVault	MV116	rotary, voice coil	116.14	8.3	45	3,450

Prices are U.S. OEM prices for 100 units.

Source: 1982 Disk/Trend Report

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Drive dimensions are 1.625" high by 5.75" wide by 8" deep.

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(ACTUAL SIZE)

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COGITO
SYSTEMS

revolution. Final positioning accuracy is still limited by the motor's step size, and the process is fairly slow, but performance is superior to that obtainable with other stepper methods.

Trade-offs in voice-coil designs

As with stepper designs, voice-coil-based hard disk drives entail trade-offs. The price paid for the speed and precision these drives provide is the expense of implementing a good feedback loop. While steppers automatically stop at a required position on a disk, voice-coil systems depend wholly on feedback to determine the correct stopping point. A voice coil's precision therefore depends entirely on the accuracy of its feedback loop. In controlling the drive head, these loops normally take into consideration position, velocity and acceleration—factors that can be ignored in stepper designs.

High-performance (8- and 14-inch) Winchesters employ linear or rotary voice-coil actuators. The storage module drive (SMD) interface, a de facto standard created by Control Data Corp., is most often used for these drives, but the American National Standards

Institute (ANSI) 8-inch standard is also used. While the ANSI version permits a higher data-transfer rate (1.5M bytes per second) than the SMD (1.2M bytes per second), the ANSI interface has so many options that it is difficult to implement as a standard. Another

Buffered seek can dramatically reduce average access times in stepper-based systems.

interface gaining in popularity is the small computer system interface (SCSI) specification created by Shugart Corp. Use of the SCSI simplifies standardization between computers.

Rotary vs. linear positioners

The voice-coil motors used in rotary and linear positioner systems are powerful, accurate devices developed from audio-speaker technology (Fig. 5). Three configurations are available: balanced rotary actuators, unbalanced rotary actuators and linear positioners (Fig. 6). Both the linear and the rotary designs are closed-loop systems that employ the same type of voice-coil motor but with different methods of translating the motor's force into head movement.

Linear positioners offer an advantage over rotary devices in that the moving force can be applied directly to the carriage's center of mass if the carriage is properly designed. This arrangement promotes higher track densities because it doesn't put any twist into the carriage. For this reason, it is theoretically possible to achieve better performance from a linear than from a rotary actuator. However, linear positioners require at

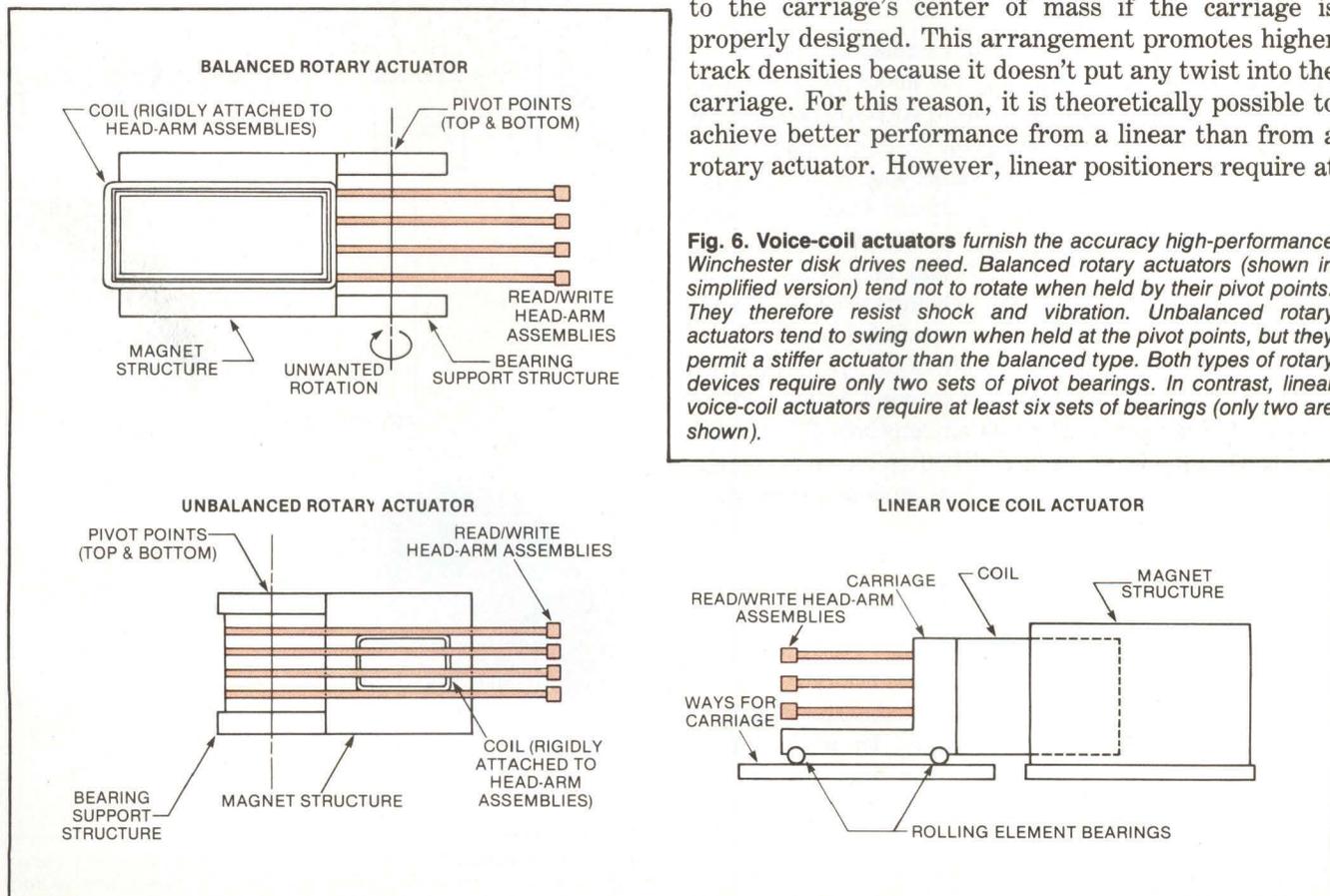


Fig. 6. Voice-coil actuators furnish the accuracy high-performance Winchester disk drives need. Balanced rotary actuators (shown in simplified version) tend not to rotate when held by their pivot points. They therefore resist shock and vibration. Unbalanced rotary actuators tend to swing down when held at the pivot points, but they permit a stiffer actuator than the balanced type. Both types of rotary devices require only two sets of pivot bearings. In contrast, linear voice-coil actuators require at least six sets of bearings (only two are shown).

least six sets of ball bearings (four to guide the mechanism and two for anti-rotation), compared with the two bearings that rotary devices use.

Bearings have a limiting effect on actuator performance for which it is difficult to compensate, so the more bearings a drive has, the lower its ultimate accuracy. And, because bearings are never perfectly round, carriage movement varies slightly, causing the heads to

As track densities advance to around 1,000 tpi, bearing variations in linear actuators can cause serious problems in head-positioning accuracy.

follow a slightly non-concentric path that changes from movement to movement.

Another bearing problem that can be especially troublesome in linear actuators involves the steel rods, or "ways," on which the bearings roll. Ways are difficult to machine and align, but they must be as straight as possible to prevent the carriage from rolling, pitching and yawing.

In fixed-media drives that have relatively low track densities (less than 200 tpi), linear-actuator bearing limitations don't cause significant problems because the accuracy required is fairly low and most head-positioning errors occur the same way each time the carriage moves. Therefore, a track that is written non-concentrically is adequately separated from its neighbors and is consistently read in the same non-concentric manner. If the ball bearings precess (change the direction of their axis of rotation) too much, however, carriage misalignments occur. In removable-media drives, this variation can prevent a disk written on one system from being read on another. When track densities advance to around 1,000 tpi, bearing variations in linear actuators can cause serious problems in head-positioning accuracy.

Servo design holds the key

Regardless of the actuator mechanism employed, the key to maximizing head-positioning accuracy in a Winchester disk drive is the type of servo design used. The two common servo types are dedicated-surface—the most popular—and embedded. In a dedicated-surface design, a signal pattern on one surface of a multiplatter drive tells the actuator when it has found the correct track position for each of the other disks. A head on the servo surface reads the pattern for the velocity, clocking and signal-peaking information that

determines how the carriage should move.

Dedicated-surface servo performance is limited by the requirement that one disk set the position standard for the others. However, when imperfections in spindle bearings come into play, the platters begin to move in relation to each other. Thus, even if one surface is correctly positioned, the others may be far enough off to cause off-track errors—especially when a few millionths of an inch are crucial.

Embedded servos, on the other hand, require hard-sectored disks, coding servo information at the beginning of each data sector and freeing all the disks for data (Fig. 7). However, most computer operating systems do not accept such fixed-length sectors. And, because this approach embeds a tracking pattern in the header of each sector, it entails considerable overhead. Compensating for this overhead is the fact that drive capacities increase dramatically as a result of improved track densities.

Handling high track densities

A servo's performance limits a Winchester drive's ultimate track density. Despite the disadvantages, using embedded servos is probably the only way to handle densities greater than 1,000 tpi on multiplatter drives. At this track density, transient thermal differ-

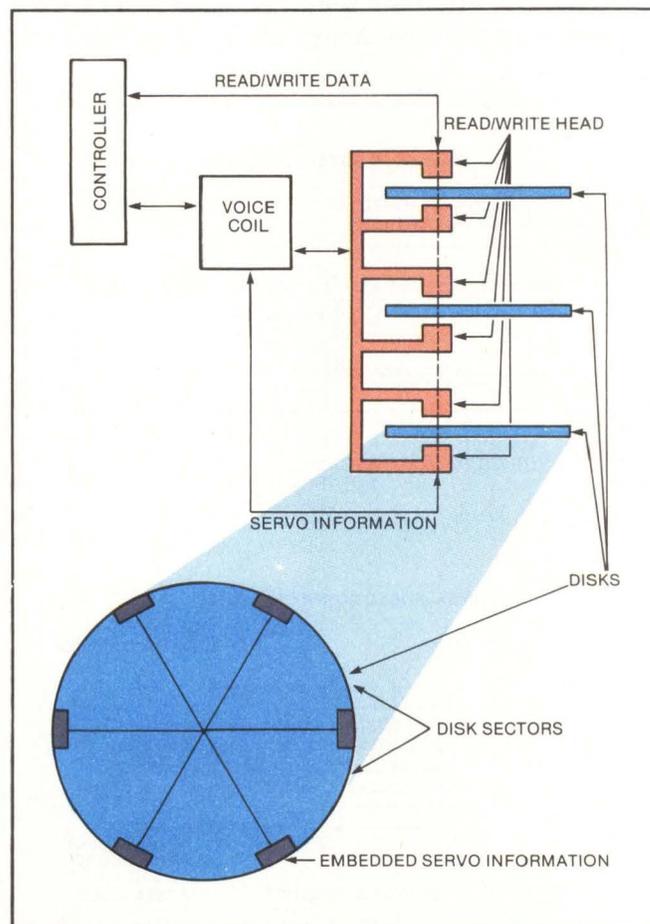


Fig. 7. An embedded closed-loop servo system codes servo information at the beginning of each Winchester disk's data sector, freeing all of the disks for data.

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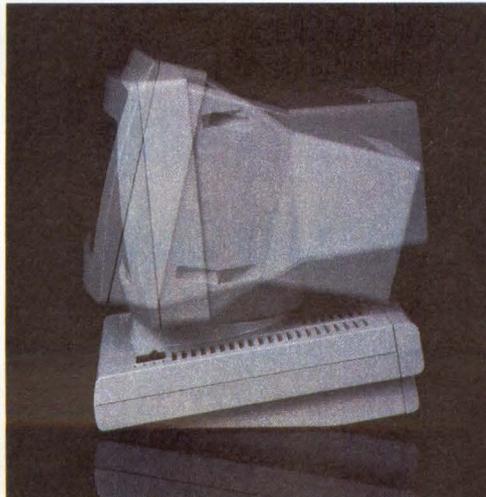
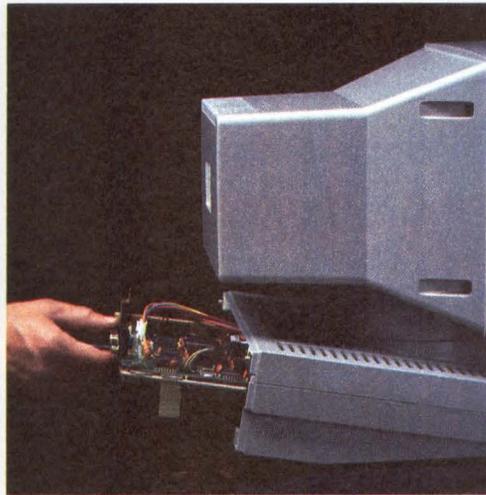
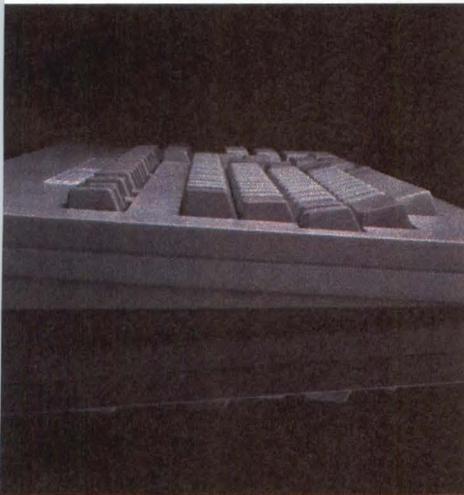
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HEAD POSITIONING

ential expansion effects could have a devastating effect on head-positioning accuracy. For example, when a drive is started, one platter usually heats faster than

Dedicated-surface-servo performance is limited by the requirement that one disk set the position standard for the others.

the others as heat rises through the system. Such isolated heating causes uneven expansion in the drive mechanism. A multiplatter drive with a dedicated-servo disk, therefore, experiences off-track errors because of the disks' movement relative to each other. With an embedded servo, on the other hand, head positioning for each disk is separately controlled by its servo information.

Looking to future devices

A knowledge of the characteristics and limitations of today's actuator systems can help predict the shape of

tomorrow's devices. What is the ultimate upper limit on Winchester drive bit and track density? The theoretical upper boundary for bit density is 80,000 bits per inch, but it's doubtful whether Winchesters will ever approach that limit. The track-density limit for plated media is probably between 1,500 and 2,000 tpi, but even these levels will take some time to achieve with any reliability. Also, the actuators that could conceivably reach these density levels are not available.

One way of attaining 1,500- to 2,000-tpi track densities is to use digitally-controlled adaptive servo systems. Drives using this technique can adapt to a system's characteristics at any moment, compensating for factors such as ambient temperature. The drive's actuator receives feedback on how each seek is performed and compensates accordingly, thus determining the optimal loop gain to achieve the fastest access times.

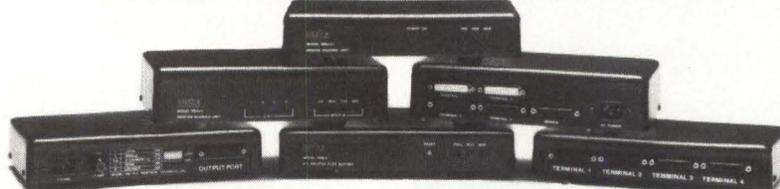
Adaptive performance could be implemented using the same types of position and velocity feedback now available in today's servo systems. While the amplifiers used in feedback loops are all analog devices, future systems could probably use all-digital systems with output amplifiers employing pulse-width-modulation techniques. □

Clyde Czernek is president of MegaVault, Woodland Hills, Calif.



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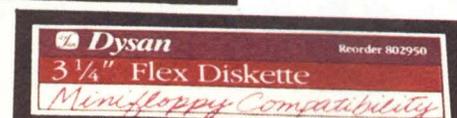


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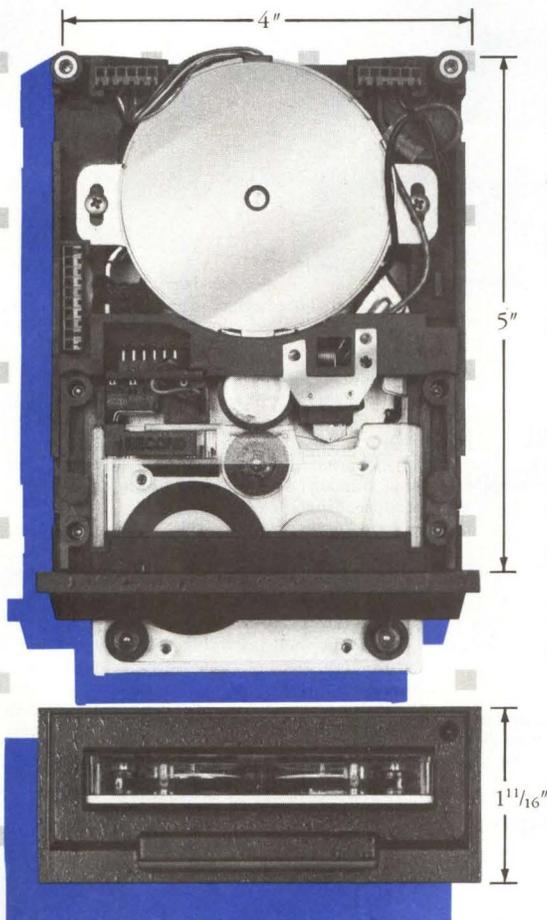
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How to select jumper options for floppy disk drives

By changing connections, system integrators can reconfigure disk drives for end-user applications

Mark Simmons, Shugart Corp.

Floppy disk drives offer various electrical connections, called jumper options, which allow a system integrator to reconfigure a disk drive to meet a wide range of user requirements and cost considerations. To select the correct floppy disk drive for a system, however, system integrators must understand the functions and trade-offs of the common drive jumper options. Among the most important are control of the head-load, spindle-motor and head-select operations.

Head-load control affects access time

Head-load control refers to the electrical method used to load heads onto the media before reading or writing. On some disk drives, heads are loaded whenever a disk is inserted into the drive and remain in contact with the media until the disk is removed. Many drives allow head loading to be performed independently of disk insertion. In this case, system integrators have three options: head-load control from drive-select

line, head-load control from head-load line and head-load control from drive-select *and* head-load lines. The method chosen can significantly affect data-access time, media life, acoustic noise and electromagnetic interference (EMI).

Head-load control from the drive-select line is the simplest of the three head-load options. It assures head contact with the media during read or write operations because the controller always selects a drive before sending or receiving data. This option also eliminates the need for a separate head-load command, reducing the complexity of the controller by at least one output gate. The simplicity of the arrangement can create difficulties because a drive can be selected for reasons other than reading or writing. Some controllers can periodically scan the drive's status signals and report changes. If status-checking occurs often or the system always has a drive selected, the head and media will be in contact more often than necessary for reading and writing. Besides increasing wear on head and media, if status-checking occurs often enough, the constant

repositioning of the head-load mechanism is likely to produce indeterminate head position and unacceptable levels of EMI.

Access time requirements should also be considered. Each time heads are loaded, the mechanical movement of the head-load mechanism and of the heads themselves introduces a 30- to 60-msec. delay. Using head-load control from drive select causes a delay each time a drive is selected. The added delay time is minor if a drive is used infrequently or transfers large blocks of data during each selection cycle, but it can be substantial if the disk subsystem is heavily used or performs many multiple-drive operations, such as disk-copying.

Head-load mechanisms make noise when engaged and disengaged. Minimizing load/unload cycles increases the amount of time the heads are in contact with the media. The system integrator must thus find a compromise between noise level and media life.

With the **head-load control from the head-load line** option, head-load control is independent of drive selection, allowing the system to check the status of a drive without loading the heads. However, this option means that the heads on all drives activate together, reducing media life in multiple-drive systems, in which diskettes are inserted into more than one drive at a time.

Head-load control from the drive-select and head-load lines represents a compromise between the first two options. By requiring *both* the drive-select and head-load lines to be asserted before the heads will load, status-checking can be accomplished with the heads unloaded. Also, the heads on one drive can be loaded without loading the heads on other drives. When the disk subsystem performs frequent multiple-drive operations, such as during a disk copy, the heads must be loaded each time one of the drives is selected. This increases both access time and noise level.

Newer motors require greater control

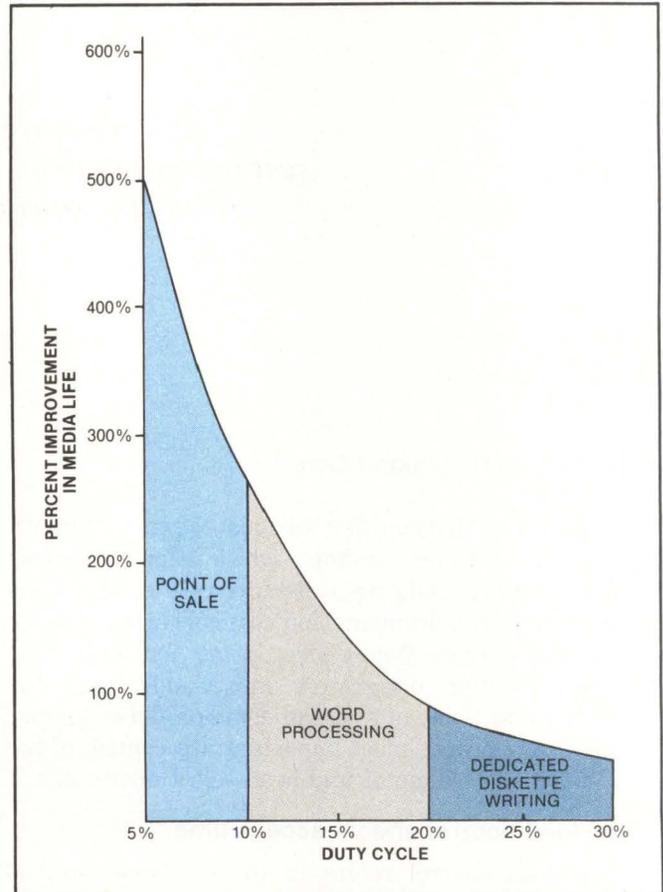
Spindle motors have undergone extensive changes since IBM Corp. invented the floppy disk drive in the late 1960s. The first floppy disk drives used large AC motors, which required about 2 seconds to reach full speed. Because of slow start times, spindle motors were usually hard-wired to run whenever system power was applied.

With the emergence of desktop microcomputers, the size, power consumption and cost of floppy disk drives became critical issues. Shugart Corp.'s introduction of the 5¼-inch Minifloppy drive in 1976 addressed these issues. Minifloppies use small, inexpensive DC spindle motors and incorporate spindle-motor control to length-

en motor life. Motor start times were 0.5 to 1 second—faster than the large AC motors but still too slow. The motor was generally left running whenever a diskette was inserted.

Today's designs are taking this motor evolution one step further with the advent of fast-start motors (less than 500 msec.) on Shugart's 455/465 half-height, 5¼-inch drives. Many drive manufacturers have discovered that, by including fast-start spindle motors and eliminating head-load mechanisms, they can double media life (see Figure, below), reduce heat dissipation, achieve quieter operation, lessen EMI and reduce costs. Proper selection of spindle-motor control options is essential to realizing these benefits. The major control options are drive select, motor on, drive select *or* motor on and drive select *and* motor on.

In spindle-motor control from drive select, a drive's motor is activated whenever the drive is selected, eliminating the need for a separate motor-on line. Power consumption is lower because only one drive motor in a daisy chain is activated at once. This option is similar to head-load control from drive select in raising access time and shortening media life.



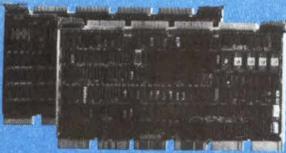
Media-life improvement using a fast-start motor rather than a head-load mechanism depends on the disk drive duty cycle (percent of system time that a drive is reading or writing). The lower the duty cycle, the greater the improvement in media life, but all applications benefit from some improvement. The data shown are based on the assumption that heads contact six tracks at a time when loaded and that contact with the most-frequently-accessed track occurs 50 percent of the time.

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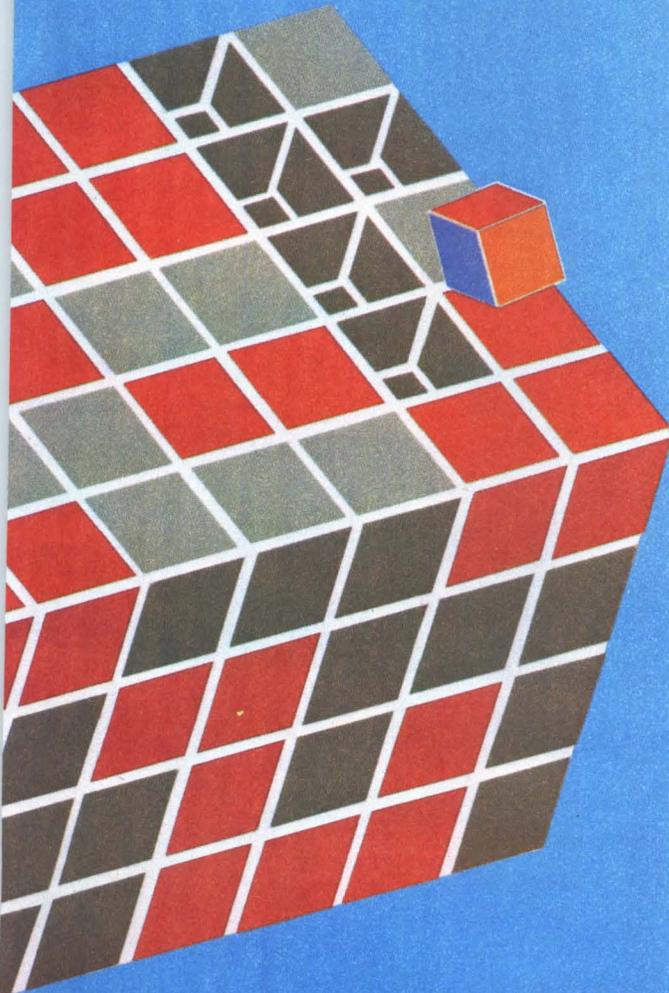
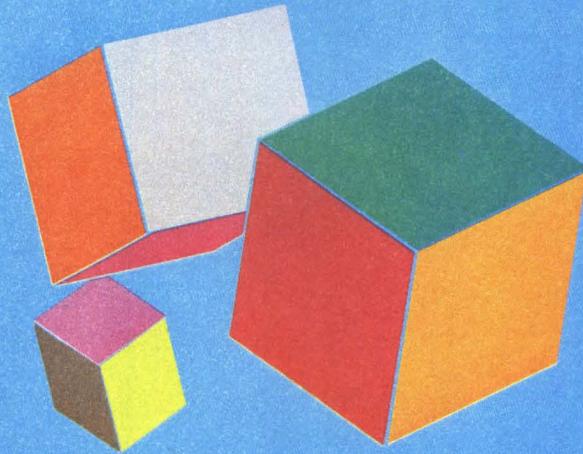
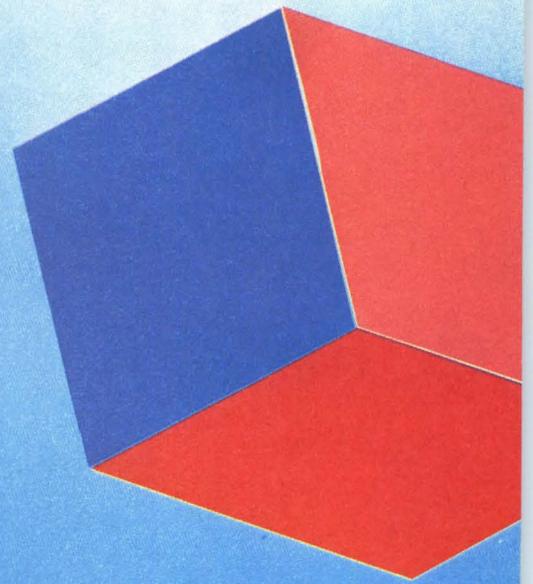
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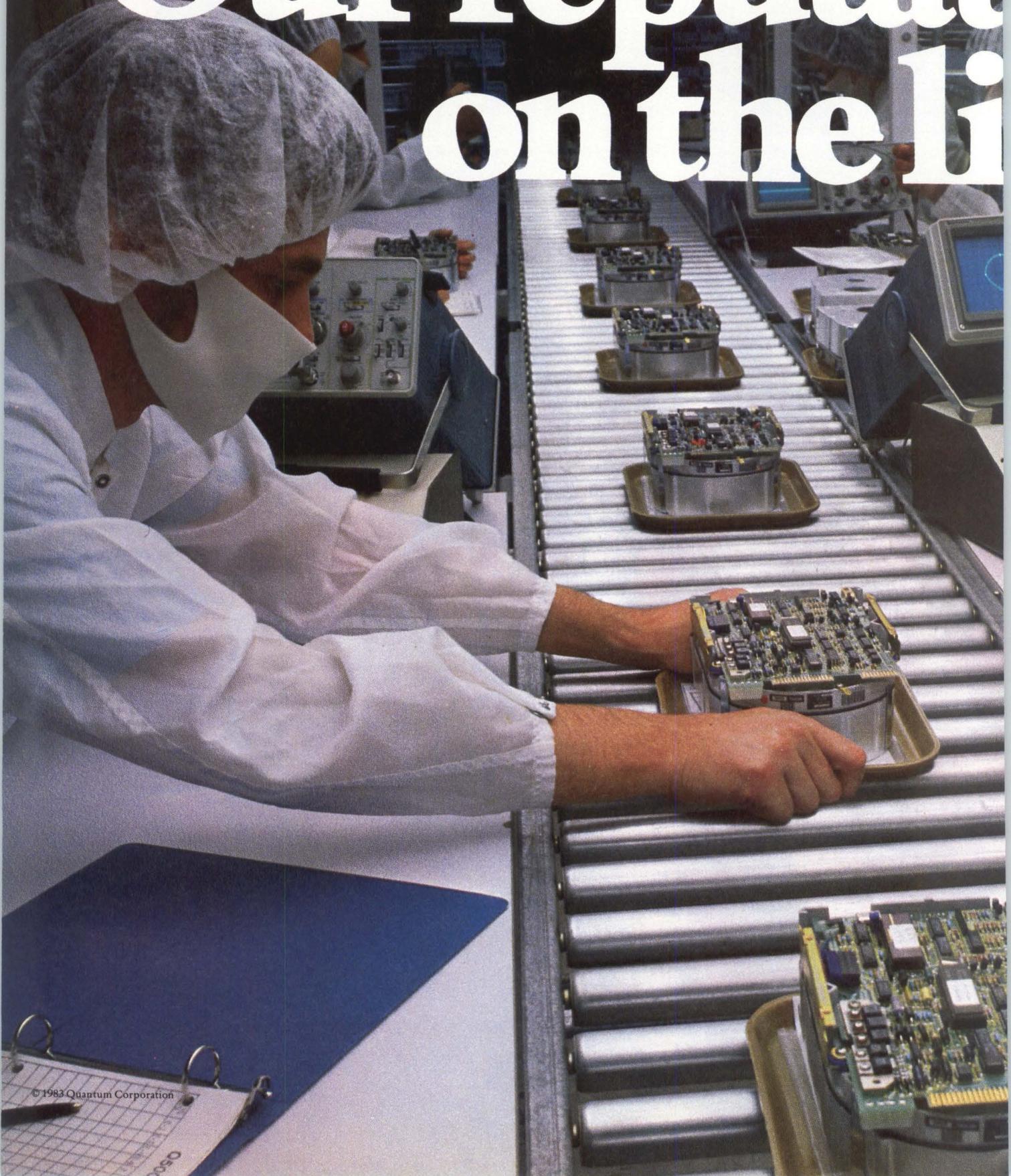
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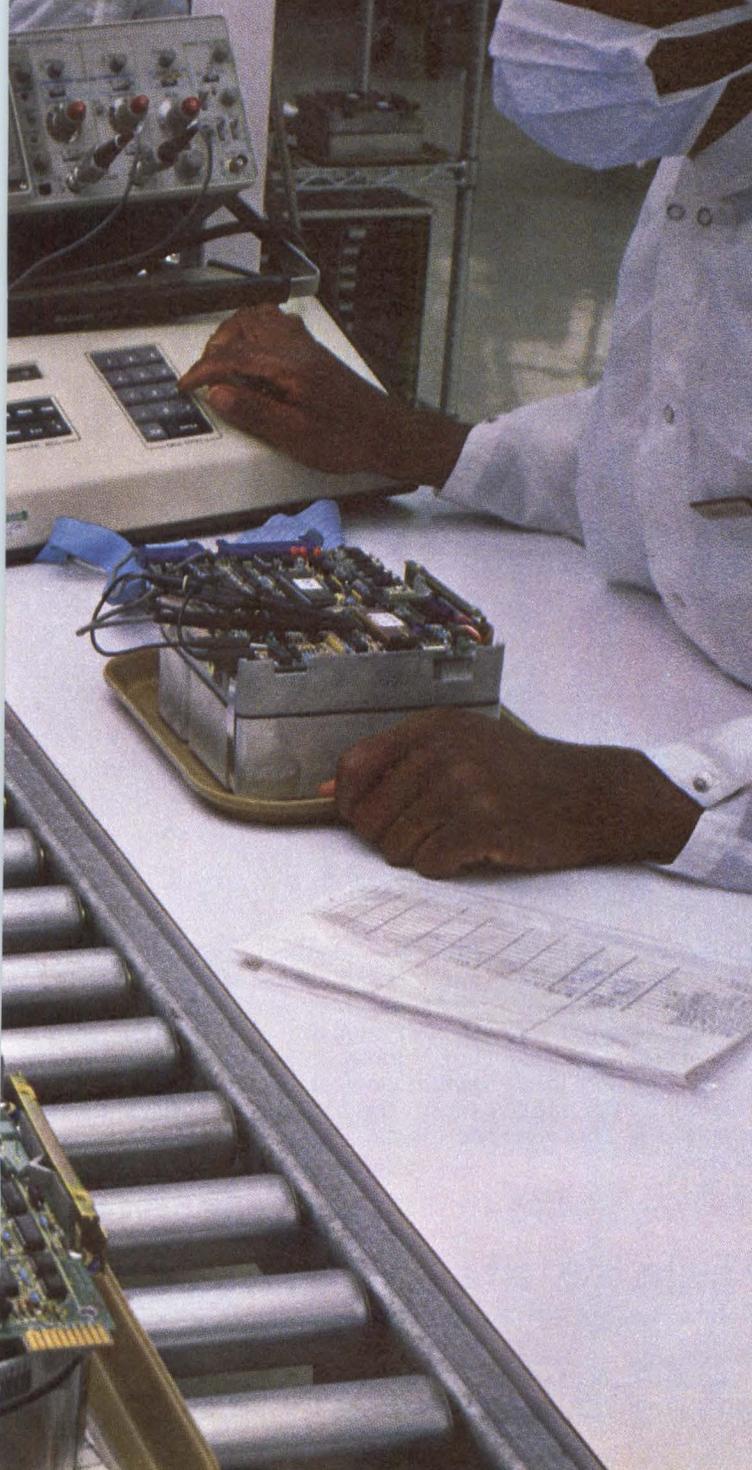
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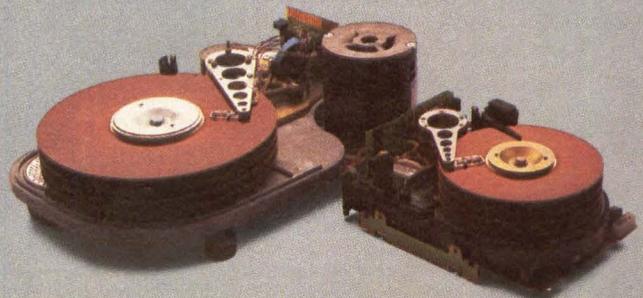
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CIRCLE NO. 133 ON INQUIRY CARD

Created by Dayner/Hall, Inc., Winter Park, Florida

DISK DRIVES

With **spindle-motor control from motor on**, the spindle motor is activated only when the motor-on line is asserted and is independent of other interface lines. This eliminates the need to activate the spindle motor while status-checking. This option yields excellent access times when multiple-drive functions are used frequently because there is no motor-start delay between drive selections as long as the motor-on line stays active. However, these advantages can be offset because the spindle motors on all drives must be activated whenever any drive is reading or writing. This requires higher peak power because all motors are starting at once. Finally, inserting diskettes into more than one drive at a time normally shortens media life.

In **spindle-motor control from drive select or motor on**, the spindle motor is turned on whenever the drive-select line or the motor-on line is active. When the drive-select line is active without the motor-on line, this option has all the advantages and disadvantages of

controlling the spindle motor from drive select. When the motor-on line is active, it has all the ramifications of control from motor on. In practice, the option is used to improve access time relative to drive-select control while improving diskette life relative to motor-on control.

The advantages of **spindle-motor control from drive select and motor on** are low power dissipation and maximum media life. The one disadvantage is high access time. An on-board drive timer for motor-off delay can reduce access times. The controller traditionally has delayed the transition of the drive-select or motor-on lines to the inactive state, but some drive manufacturers are beginning to offer on-board drive timers as a standard feature. On-board drive timers can be used with any of the previously mentioned spindle-motor options, but they improve performance only in control options using drive select.

Head select handles double-sided drives

Head-select control is necessary to indicate to the drive which side of a double-sided disk will be read or written. Common jumper options are head select from side select, head select via direction line and head select via drive select.

Most controllers use the option of **head select from**

	8-in., full height	8-in., half height	5¼-in., full height	5¼-in., half height	3½-in.
Head-load control from drive select	X	O	O	O	O
Head-load control from head load	X	O	O	O	O
Head-load control from drive select and head load	X				
Spindle-motor control from drive select		O	O	O	O
Spindle-motor control from motor on		O	X	X	X
Spindle-motor control from drive select and motor on		O			
Motor-off delay		O		O	O
*Head select from side select	X	X	X	X	X
*Head select via direction line	X	O	X	X	X
*Head select via drive select	X	O			
I/O line continuously enabled			X	X	X
Door-open detection			O	O	O
Diskette-in-place status	X	X	O	O	O
Spindle motor up-to-speed status		O		O	O
Write-protect disable	X	X	X	X	X
Internal write-current switching		O			
Double-sided diskette status	O	O			
Radial ready	X	O			
Jumper-selectable stepper enable	X	O			
True data separation (IBM 3740)	O	O			

Applies to double-sided drives only

Usually available

Available on some drives

Usually not available

Some common jumper options for 8-, 5¼- and 3½-inch floppy disk drives, such as write-protect disable, are widely available in all categories of drives; others, such as internal write-current switching, are offered only on some 8-inch, half-height drives.

side select, as it requires only one output driver to connect the dedicated, side-select signal generated by today's LSI controller chips. This option ties up an interface line but, unless the line is required for another option, it represents the simplest head-select design.

Head select via the direction line is an attractive alternative when the number of interface lines available is limited or an output driver for side selection is not provided because it eliminates the need for a separate side-select line. Normally, the direction line is active only when the head carriage is seeking (moving from track to track). Head selection is necessary only when the head carriage is stationary because data transfer cannot occur while the heads are moving. Therefore, one interface line can be timeshared to perform both the direction-line and head-select functions. This option is most commonly used with single-sided drive controllers that are being upgraded to accommodate double-sided drives. With some controllers, the upgrade can be accomplished without hardware changes.

Head select via drive select, another common method of upgrading single-sided controller boards, can make a double-sided drive look like two single-sided drives. With this option, each drive-select line specifies not only the drive, but also the head to be addressed. While it limits the number of double-sided drives that

can be daisy-chained to two, no hardware changes are needed. The only requirement is to keep the controller's track counters synchronized.

Other options aid system integrators

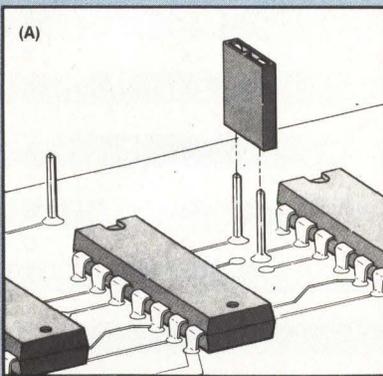
There are many common drive options besides the ones already described (see Table, Page 259). Buffered seek and on-board diagnostics are two capabilities offered on some of the newer drives, such as Shugart's 300/350 3½-inch microflops.

Buffered seek (also found on some Winchester disk drives) allows the host system to send step pulses to the drive at a rate as high as a few microseconds per pulse. Pulses are stored in a buffer that then issues step commands to the drive at the appropriate rate. The major advantage of this feature is that the controller is no longer a slave to a specific drive when performing a seek. With buffering, the controller can quickly issue a burst of pulses, de-select the drive and then perform a function with another drive. Because the seek function typically takes up about half the average access time, it can double throughput.

On-board diagnostics, though far from standardized, hold great promise—especially for field technicians. Today's system problems are difficult to isolate without special equipment, which is often bulky and expensive. On-board diagnostics can be used with alignment diskettes to verify many of the drive alignments and specifications. These capabilities are usually sufficient to help a field service technician determine whether a drive is the suspect assembly.

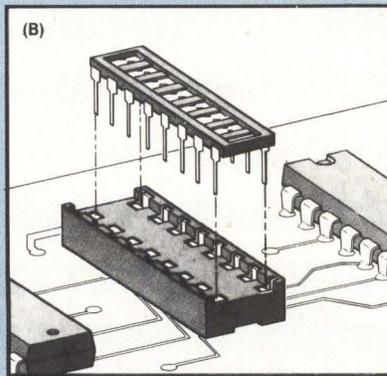
The **I/O-line-continuously-enabled** option allows all drive output lines to be monitored whenever DC power

HOW TO IMPLEMENT JUMPER OPTIONS



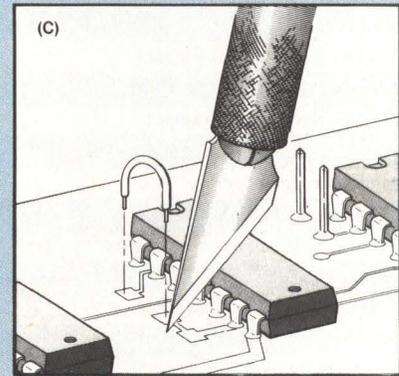
The physical implementation of jumper options affects the ease of reconfiguring a disk drive. Three kinds of implementations are common: a shorting plug, a shunt pack and a cut/jump trace.

A shorting plug (A) is a small plastic case with an innerspring clip that slides onto a two-pin post. It can be installed or removed in a few seconds,



making it the most convenient way for a system integrator to reconfigure a drive.

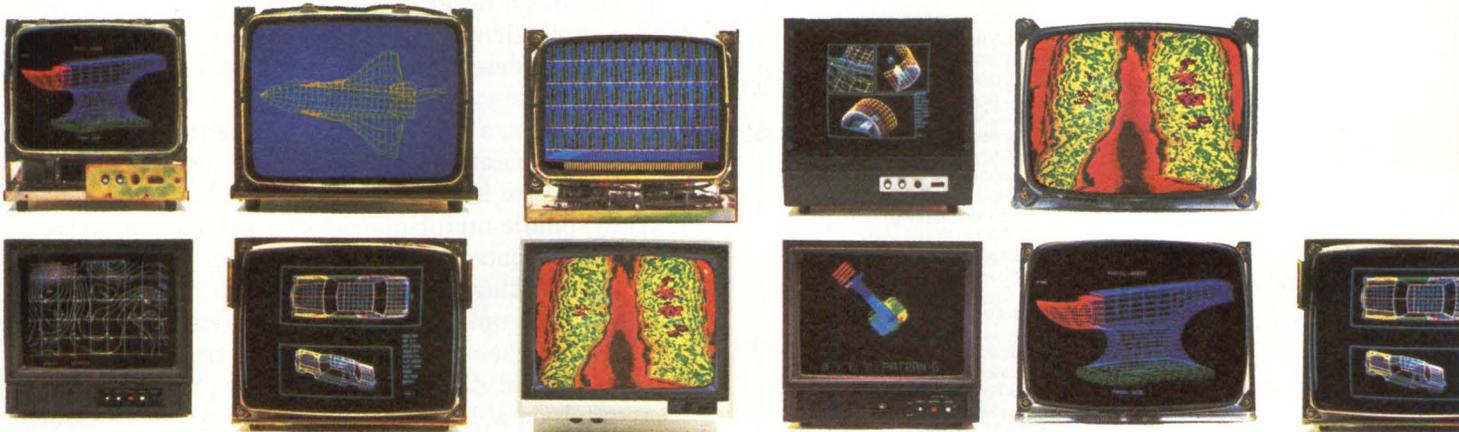
A shunt pack (B) is generally mounted on a 14- or 16-pin IC socket. The drive manufacturer shorts each connection. The shunt can easily be opened by the system integrator with a punch. Shunts are one-way changes; a shunt pack that is



mounted on an IC socket can easily be removed and replaced.

Cut/jump trace (C) is the most cumbersome implementation for a system integrator because it requires a knife to cut traces and soldering equipment to create a short. This common method is the least expensive for drive manufacturers.

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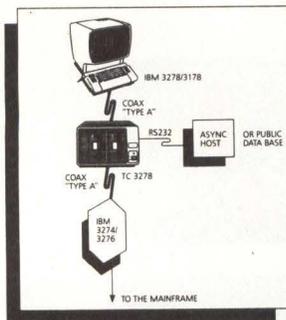
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DISK DRIVES

is applied, regardless of the state of any input signal. This option can never be used in a system configured with multiple drives.

Door-open detection permits the operating system to prompt a user when this condition occurs. **Diskette-in-place status**, a related option, enables the operating system to generate an understandable error message when a diskette is not properly inserted.

With **spindle-motor-to-speed status**, the drive signals the controller when the motor reaches full speed, eliminating the need for controller timers. This improves performance because the system can monitor actual rather than worst-case start-up time.

Write-protect disable overrides the physical write-protect tab on a diskette, letting a software manufacturer write software to write-protected disks without inserting or removing tabs.

Internal write-current switching relieves the controller of responsibility for switching between high and low write currents. A disk's outer tracks have more space between bits than its inner tracks. The outer tracks receive a high write current to increase the likelihood that bits can be properly read. The inner tracks receive a low write current to reduce the chance that a bit will "spill over" into its neighbor. When the controller handles write-current switching, an interface line is needed to specify the track on the disk, but this line is not necessary with internal switching.

Two-sided diskette status signals the system whenever a double-sided diskette is installed. (The drive can determine a double-sided diskette by the position of the index hole.) Without this option, a system must use trial and error (assume single-sided; if this doesn't work, assume double-sided) or read the disk-header data located on track 0 of a disk that has already been written.

The **radial-ready** option enables a system to monitor the Ready signal for each drive, whether or not it is selected. This option requires n-1 additional interface lines for an n-drive system.

Jumper-selectable stepper enable allows the stepper motor to operate only when specified input lines are active. Proper use of this option can increase motor life.

True data separation is useful on drives with on-board frequency-modulation data separators. It inserts the missing clock bits to prevent data loss in the industry-standard IBM 3740 format for 8-inch drives.

Mark Simmons is a product manager at Shugart Corp., Sunnyvale, Calif.

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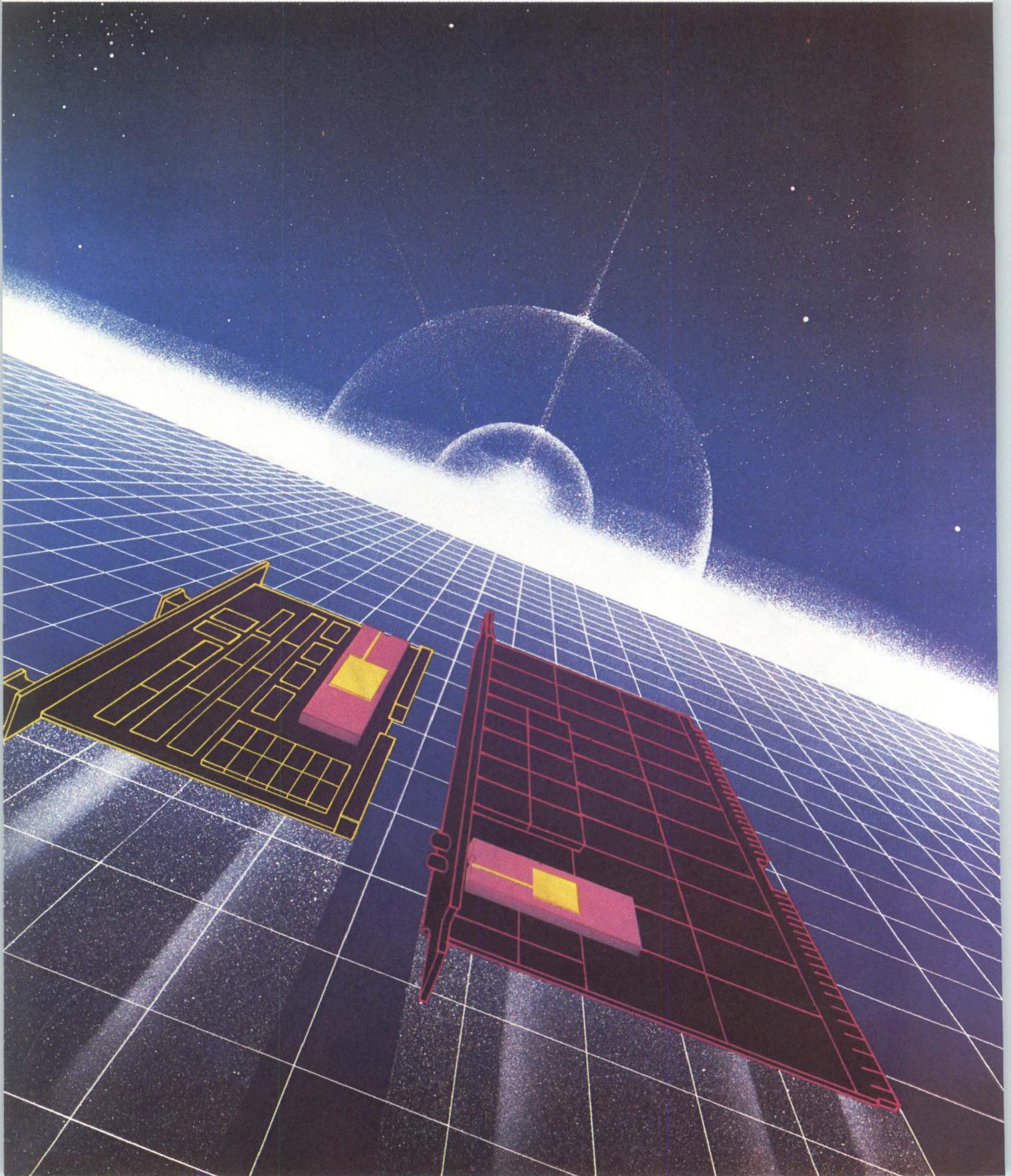
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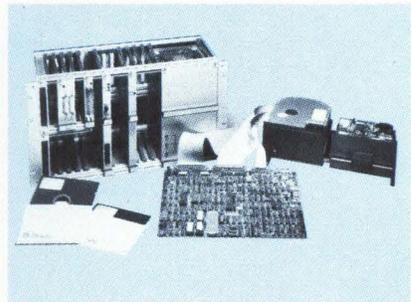
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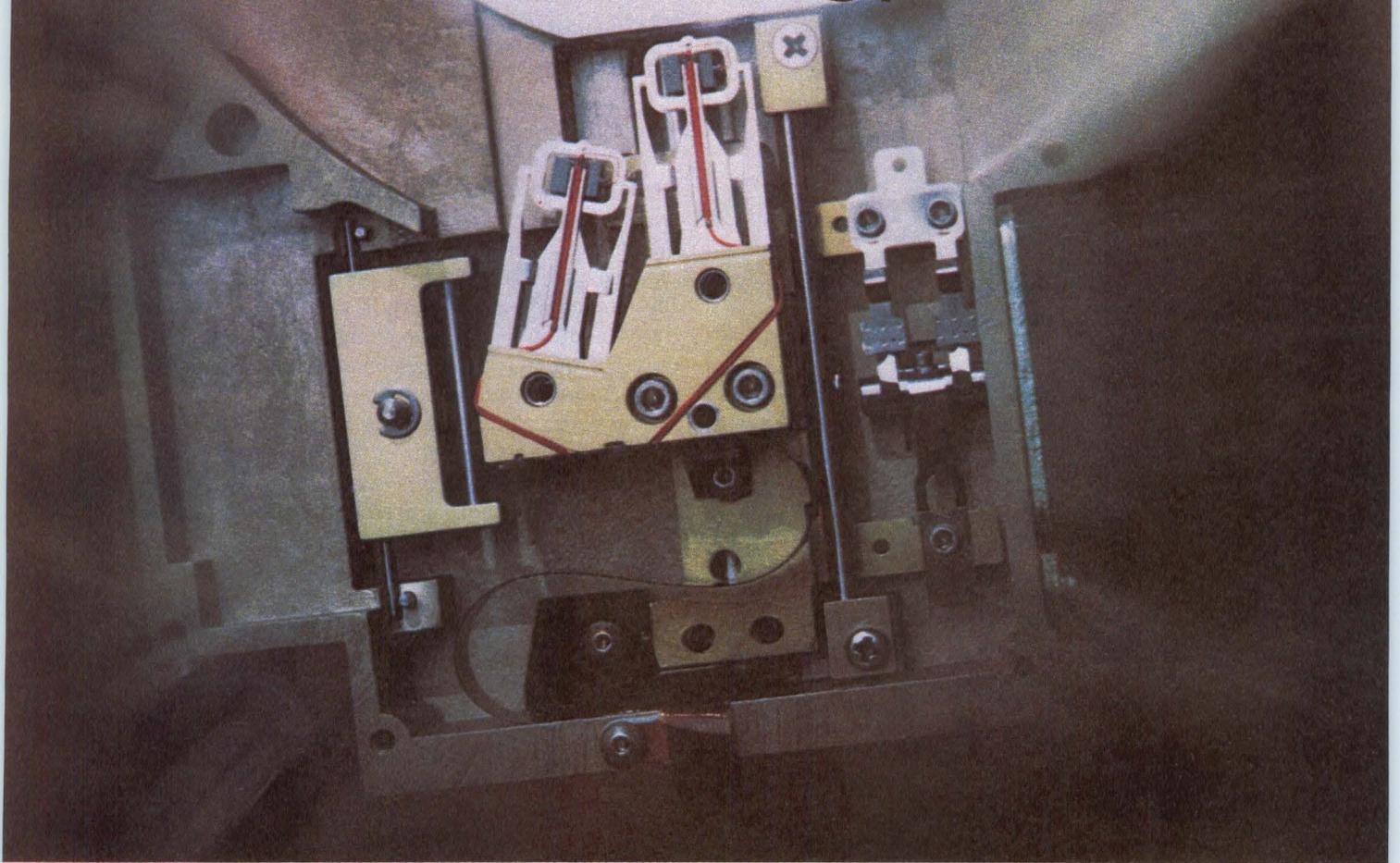
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Half-height 5¼-inch Winchester adopt large-drive technology



*Small disk drive technological advances meet
the demands of new storage applications*

Jeffrey Liu, Microscience International Corp.

Half-height 5¼-inch Winchester drives are well-suited for desktop and portable computers and for use in rugged environments. But designing them demands solving such technical problems as accurate head positioning and protection against shock, particle contamination

and temperature change. Some manufacturers have adapted large drive solutions to these problems.

Closed-loop system maintains accuracy

Most half-height 5¼-inch drives, such as those offered by Shugart Associates, Seagate Technology and Cogito Systems Inc., use open-loop servo-positioning

systems because they are easier and less expensive to manufacture than closed-loop systems. However, the accuracy of open-loop systems depends more on the mechanical tolerances of the motor/actuator components because there is no positioning information feedback from the media during operation. Off-track

In closed-loop systems, the servo writer prerecords positioning information on the disk. This information provides constant reference data to position the read/write heads. In *dedicated* closed-loop systems, one entire side of the disk is used exclusively for servo information storage, and a dedicated servo head reads the servo information. In *embedded* closed-loop systems, positioning reference information is recorded on the same surface as the stored data.

The Microscience HH-612 records the servo information in the gaps between data tracks. All positioning information is located in the servo sector. The heads function as both read/write and servo heads. In servo

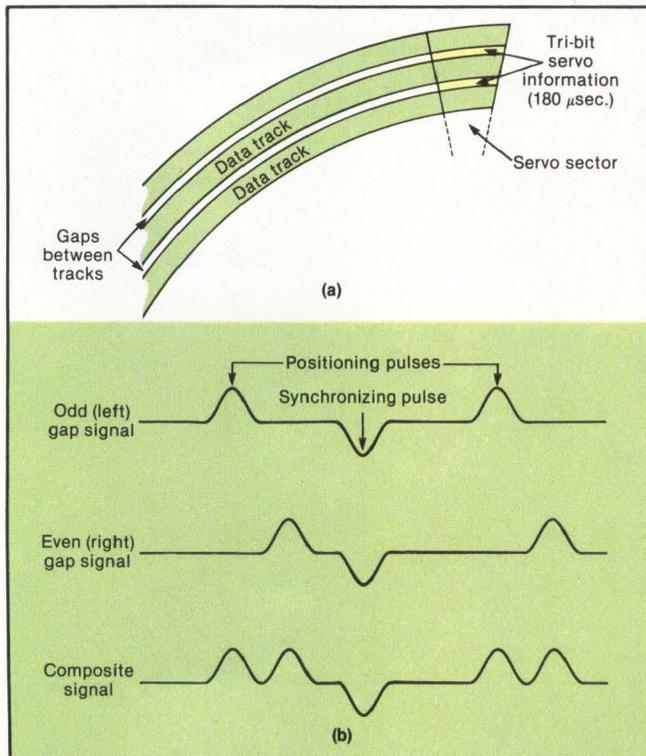


Fig. 1. Tri-bit servo information is written in the gaps between data tracks (a). All servo information is located in the disk's servo sector. The servo byte consists of a synchronizing pulse and positioning pulses. When the positioning pulses from the odd and even (left and right) servo tracks are equal (b), the read/write head is centered on a data track. When the read/write head is not centered, the head picks up unequal positioning pulses. The head actuator then adjusts the read/write head positioning accordingly.

problems such as thermal variations, stepper-motor delays and stepper settling can cause head-positioning inaccuracies. Because of these problems, open-loop systems are more often used in low-capacity Winchester drives with less than 300 tracks per inch (tpi).

Large drives, particularly 14-inch Winchester drives with track densities of more than 300 tpi, usually employ closed-loop positioning systems. This technique was introduced in 1971 with IBM Corp.'s 3330 drive and is now a standard feature of all large drives. Some of the new half-height 5¼-inch drives, such as Microscience International Corp.'s 10M-byte HH-612, have followed the lead of the large drive manufacturers.

Half-height drives use stepper, rather than voice-coil, motors.

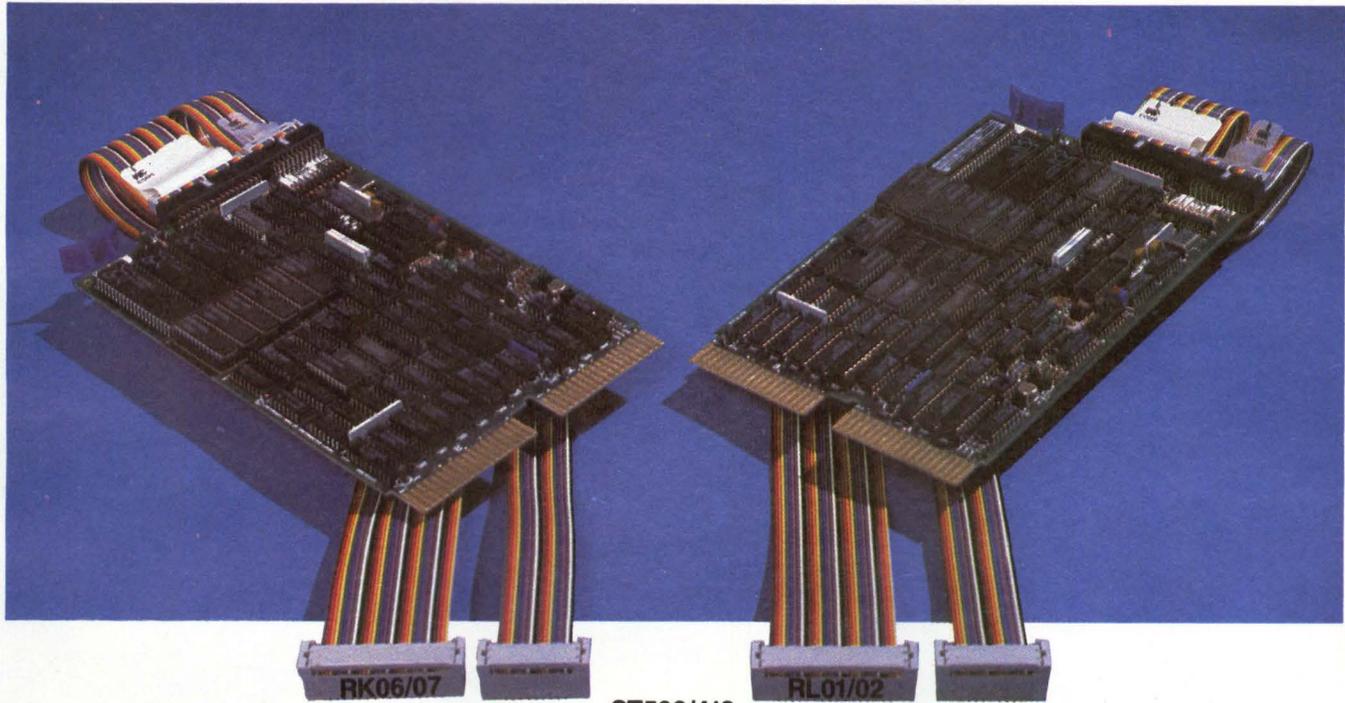
mode, a head covers the gaps on each side of the data track. The servo byte is a 180-μsec. burst of tri-bit information that indicates head position. Tri-bit servo patterns are used with large drives such as the IBM Piccolo and Memorex Corp.'s 14-inch 601. Tri-bit servo bytes contain a synchronizing pulse and positioning pulses (Fig. 1). The heads automatically are write-protected when in servo mode.

The drive samples four tracks of servo adjustment information when initialized. The microprocessor stores the results in RAM. The next stepping operation is adjusted according to a prediction made on the basis of this information before proceeding with the track-following algorithm.

The ability to gain and store tracking information from the heads (rather than from monitoring motor activity, for instance) is useful not only in assuring track-positioning accuracy but also in drive development. RAM-stored information derived from the pre-written servo information can analyze factors such as settling time and the mechanical efficiency of a stepper motor. In the production cycle, the acquisition of positioning offset information from each drive could lead to changes in assembly methods if a pattern of anomalies was detected.

The Microscience drive uses plated media, as do most larger drives, which offers better resolution of servo and stored data. Higher bit and track densities are possible because of the better resolution. The HH-612, for example, has a recording density of 9,680 bits per inch (bpi) and a track density of 648 tpi. This can be compared to Cogito Systems' 10M-byte, half-height Winchester, which uses oxide-coated media and has a 345-tpi track density and an 8,800-bpi linear density. All half-height drives use stepper, rather than voice coil, motors because voice-coil motors occupy more space.

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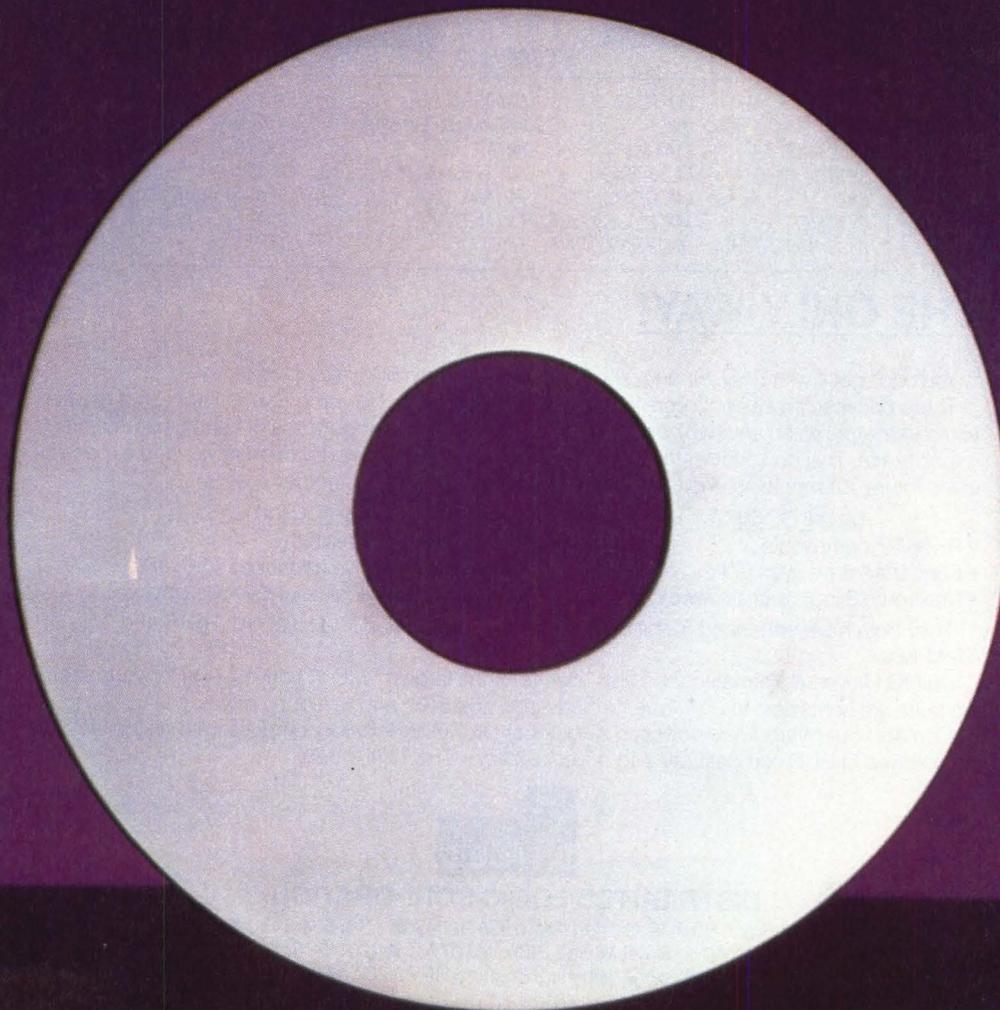


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Actuator bands reduce torque

The stepper motor moves the head/carriage assembly to the desired track. Actuator bands link the stepper motor to the carriage. The bands maintain accurate movement under stress conditions. Although some new half-height Winchester use design variations such as rack-and-pinion (Miniscribe's models 3006 and 3012) or rotary actuator techniques (Tandon Corp.), most large drives employ a linear actuator-band design.

Standard linear bands are especially subject to torque stress. The Microscience drive employs a simple

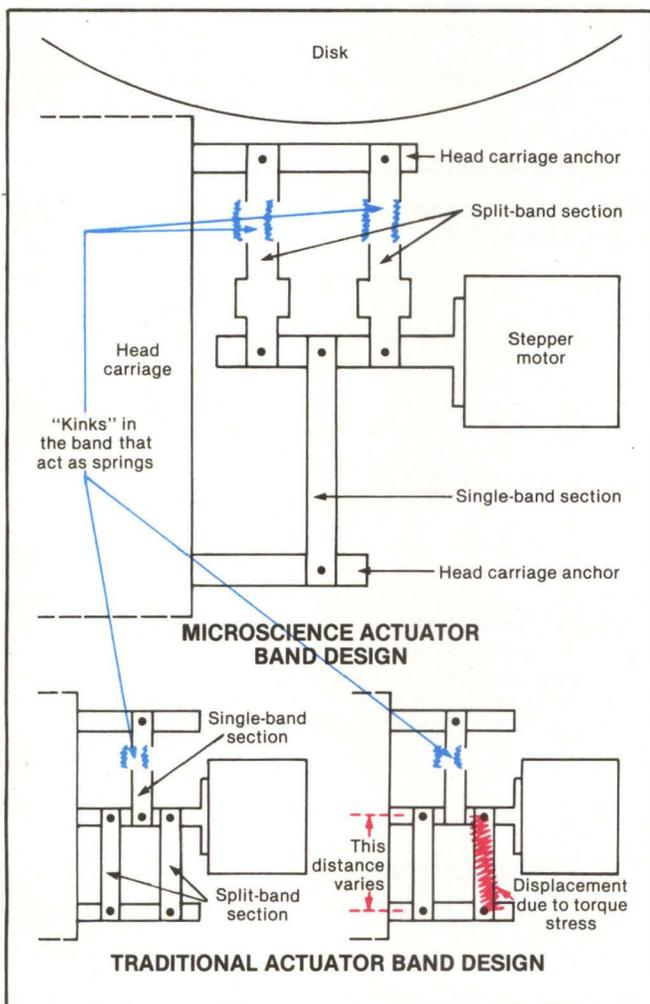


Fig. 2. Two approaches to actuator-band arrangement. The Microscience HH-612 locates the split-band section on the side of the head carriage nearer to the center of the disk. This arrangement ensures that, even under torque stress, the distance between the motor shaft and the carriage anchors remains the same. In traditional actuator band designs, the location of the split-band section and single-band section are reversed. Shaft/anchor displacement can occur when the assembly is under heavy torque stress. This can result in head-positioning inaccuracy and a greater chance of actuator-band breakage.

variation on this approach. In traditional actuator-band drives, such as those in Seagate units, the split-band section is located on the back side of the head/carriage assembly (the side farther from the center of the media). The Microscience drive reverses this arrangement, locating the single band section toward the back side of the head/carriage assembly (Fig. 2.) This

The HH-612 records servo information in the gaps between tracks.

maintains a constant distance between motor shaft and carriage anchor, whereas the traditional approach, when torqued, varies in distance. This can result in head-positioning inaccuracy and a greater chance of actuator-band breakage. The Microscience version places the primary stress on the single, stronger element of the band.

The HH-612's carriage assembly differs from many other half-height small Winchester in that it is mounted on one carriage rod rather than on two rods (Fig. 3). The carriage moves along the rod on four ball-bearing-supported offset wheels. Heads are center-mounted; that is, they move in a straight line toward the center of the disk, as in the IBM 3350 Winchester design. One head-bearing arm reads and writes from the outer edge of the disk to the mid-point; the other reads from mid-point to the inner tracks, resulting in fast seek times. (The HH-612 has an average access time of 55 μ sec.)

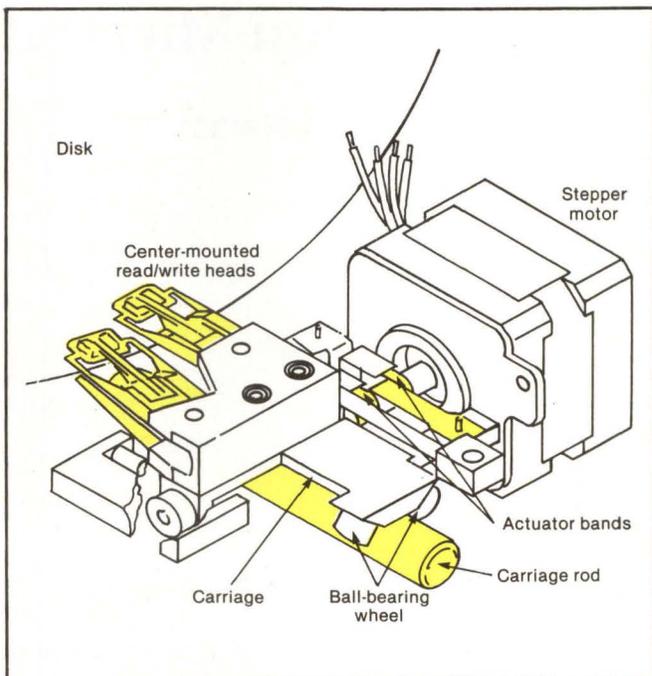
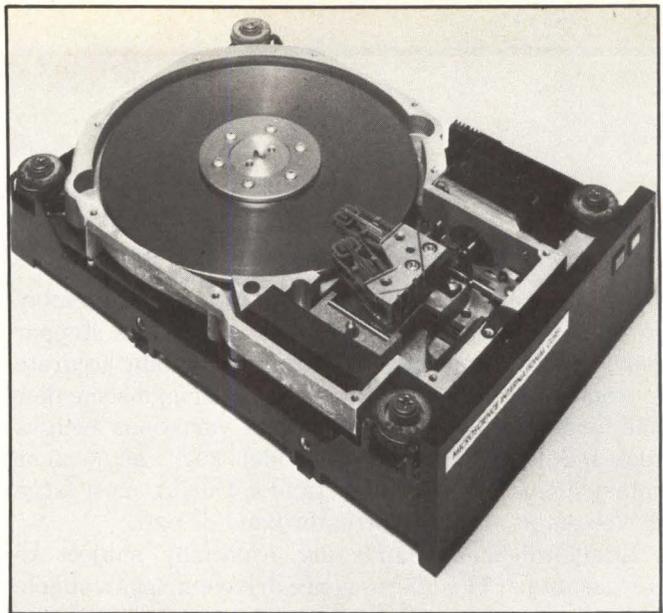


Fig. 3. The head/carriage assembly includes center-mounted read/write heads that move in a straight line toward the center of the disk. The carriage moves along one carriage rod as opposed to two rods, as in most drives.

Protecting heads and data

Given the availability of closed-loop servo-positioning circuitry, the HH-612 easily accommodates another feature usually found only in large drives. At the outer and inner edge of each disk, "guard bands" protect the head carriage from wall crashes, or the sudden jarring of the assembly against the chassis at the limits of carriage movement. The IBM 3330 is the first drive to use guard bands. The guard bands are a variation of embedded servo information that, when sensed, return the heads to track zero.

Like larger drives, half-height Winchester thermally isolate the stepper motor from the head/disk assembly to minimize the effects of thermal expansion variances between motor and disk. Most of the new half-height drives also isolate the spindle motor from the head/disk assembly, as do the larger drives. Further borrowing from their larger predecessors, the new drives use microprocessors to control spindle speed. □

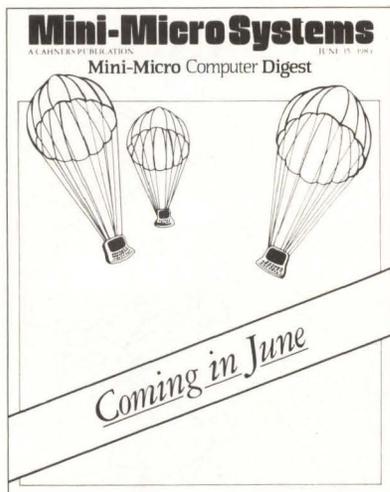


The HH-612 from Microscience International Corp. is one of the first half-height 5¼-inch Winchesters. The drive stores 10M bytes, has dual read/write heads on both sides of the disk and uses a closed-loop servo-positioning system. Price is \$580 in quantities of 2,500 to 5,000.

Jeffrey Liu is president of Microscience International Corp., Mountain View, Calif.

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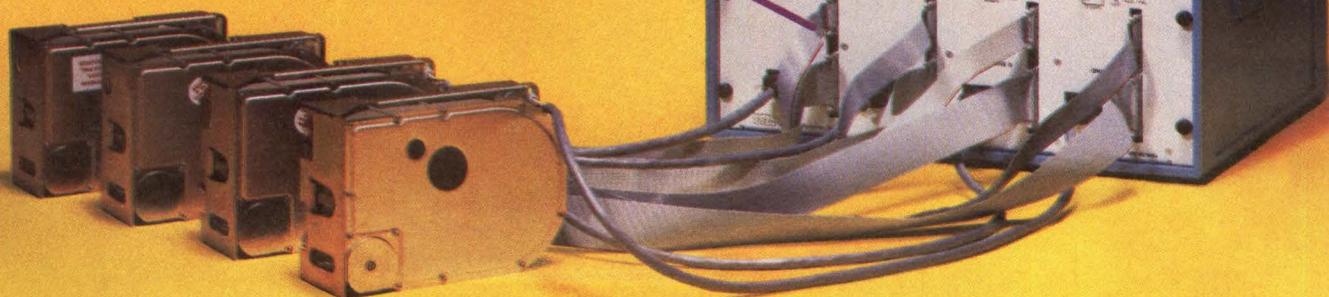
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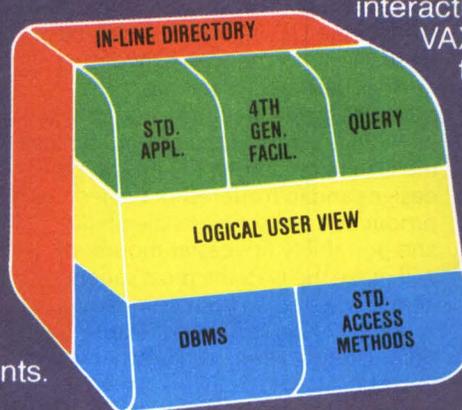
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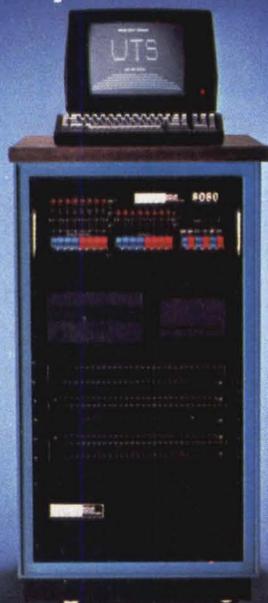
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Word-processing software for minicomputers rivals capability of turnkey systems

Programs can be differentiated by price and functions such as automatic hyphenation



The Houghton Mifflin Spelling Corrector highlights each misspelled word and displays the word most likely to be the one the user intended. The program corrected more than 99 percent of the 5,000 misspellings in Random House Inc.'s Bad Speller's Dictionary.

Roy R. Friedman, Associate Editor

Most word-processing (WP) programs for minicomputers are at least as capable as the "bundled" software of dedicated WP systems. Moreover, the industry that supplies minicomputer WP software is quite competitive. The directory of WP vendors and products, which begins on Page 291, contains programs from more than 35 independent software houses. With several choices among high-quality products, system integrators should select a WP program by focusing on price and such features as word wrap, hyphenation and spelling verification.

Which WP programs are included?

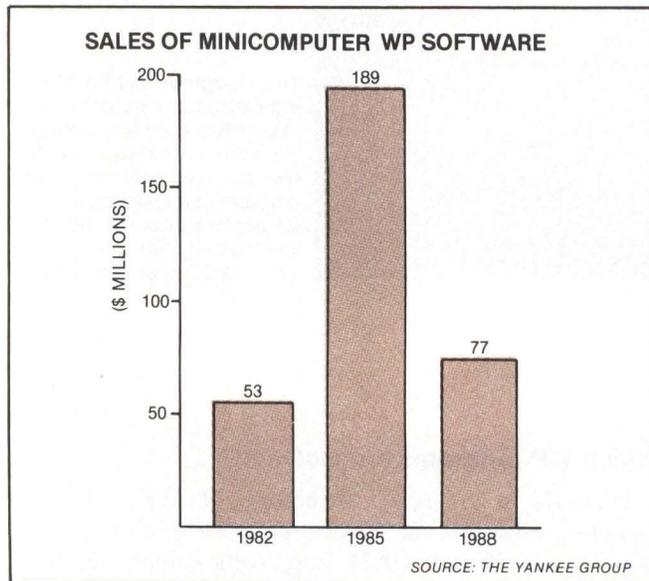
Mini-Micro Systems' directory of WP software includes programs for general-purpose minicomputers with a significant OEM and value-added market. Examples of such computers are Digital Equipment Corp.'s VAX and PDP-11, Data General Corp.'s Eclipse and Nova, Prime Computer Inc.'s minicomputers, IBM Corp.'s Series/1, Hewlett-Packard Co.'s HP3000 and Wang Laboratories Inc.'s VS. Although most minicomputer hardware manufacturers market their own WP packages and vendors of turnkey WP systems sell bundled hardware/software combinations, the *MMS*

directory includes only programs developed by independent software houses. "Program editors" designed to edit source code rather than general text, software that merges text and art for computer-aided-publishing applications and specialized programs such as mail-list generators are excluded from the survey.

Long text lines are especially useful in database and spreadsheet applications that require many fields or cells in each table.

System integrators can buy WP software from a minicomputer hardware vendor or from an independent software house. Buying from a minicomputer vendor offers the convenience of "one-stop shopping," the possibility of price discounts when hardware and software are ordered together and the likelihood of strong product support.

On the other hand, many WP programs from



The word-processing-software market for minicomputers will grow until mid-decade and then decline, according to David L. Terrie, senior analyst with the Yankee Group. "The vast growth of minicomputers will be in office-automation (OA) applications," says Terrie. By the late 1980s, most OA software for minis will be integrated packages—with average prices of \$30,000 each—that include word processing as well as electronic mail, appointment scheduling, spreadsheets, graphics, database management and voice processing. Annual sales of integrated OA packages for minis (not included in the chart) are expected to grow from less than \$10 million in 1982 to almost \$7 billion in 1988.

STEP IN PROGRAM	RESULT
au [^] tomatically	break found
au-to [^] atically	break found
au-to-ma [^] tically	no break
au-to-mat [^] ically	break found
au-to-mat-i [^] cally	break found
au-to-mat-i-ca [^] lly	no break
au-to-mat-i-cal [^] ly	break found
au-to-mat-i-cal-ly	data returned

Table 1. Scanning a word for hyphen breaks in the Orthographics Inc. program involves several steps. Each step corresponds to the space between two letters of a word (indicated by the "^^" symbol), where the program invokes its hyphenation rules to identify a valid breakpoint (see RESULT column). In the word "automatically," the first step is between the "u" and the "t"—not between the "a" and the "u"—because the program never breaks between the first two letters or the last two letters in a word. (Although such breaks might be valid, they accomplish little in terms of improved justification of text lines.) Each section of a hyphenated word must contain a syllable, and each syllable must have a vowel. Therefore, the program skips locations such as the one between the "t" and the "o" because no vowel has appeared since the previous break.

independent software houses are more capable, easier to use and more adaptable to different configurations than programs from hardware vendors. For example, Barratt Edwards International (BEI) Corp., Seattle, markets the AUTODOC program, which runs on Wang VS computers and contains a number of technical-documentation functions not found on Wang's own WP programs. BEI's largest end-user client is Wang's corporate MIS department. Another example is the COED program from Micro Metric, Woodland, Calif. The company claims that COED, which runs on DG computers, is as much as 30 percent faster than DG's text editors in a single-user, search-and-replace operation.

Packages are capable but costly

Most WP programs in the survey provide a long list of editing and formatting features, including multiple-line displays; uppercase and lowercase characters; global insert, delete, find, substitute, copy and move commands; and codes for margins, tabs, centering and indenting (see "Word-processing feature checklist," Page 287). Users of many packages can employ color, boldface and proportional spacing in screen displays and hard-copy output, provided that the underlying hardware supports these functions.

Virtually all of the programs support text lines of at least 80 columns, and many allow 132-column lines for hard-copy output. Several permit line lengths that are limited only by a user's hardware devices. Although most CRTs display only 80 columns of text at once, some programs provide "horizontal scrolling," so users can create longer lines and then view selected portions. Long text lines are especially useful in database and spreadsheet applications that require many fields or cells in each table.

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All these WP capabilities have their price, however. The more functions, the more it costs to develop and maintain them. To buyers, this implies high prices. Most minicomputer WP programs sell for at least \$1,000 each in single-unit quantities, and several programs sell for more than \$5,000 each. Just as buying a \$1,500 personal computer can mean spending three times as much for a fully-configured system, WP packages often require costly "options." Some packages need device drivers—even for standard devices—because the WP software

bypasses the operating system to communicate directly with peripherals. Software support for typesetters, letter-quality printers and non-standard CRTs is usually an extra-cost item. A WP source-code license, when available, is often the most expensive option.

Nearly all vendors of WP packages offer an annual maintenance/enhancement contract, usually for 10 percent to 20 percent of the single-unit purchase price. Even here, there are hidden costs, as some contracts cover only bug fixes and enhancements to the WP program itself, rather than changes resulting from a new release of the operating system.

OEM quantity discounts make prices much more attractive. Although many vendors negotiate OEM prices, some use a published price list. For example, Rational Data Systems Inc., New York, offers two discount plans for its \$950 to \$1,200 SCRED program

COMPRESSION CODES REDUCE STORAGE REQUIREMENTS

The word listings in an "electronic dictionary" are no different from the familiar entries of a "paper-and-ink" dictionary. The way in which they are represented is quite different, however. To preserve valuable disk space, words are coded and compressed into as few bits as possible. Because the codes are critical to the dictionary's operation, few vendors will discuss details of their proprietary implementations.

A few general techniques for compressing words are well-known, however. One method is to code a common letter sequence such as "ing" as though it were an individual letter. Another approach is to take advantage of alphabetical order. Because words in a dictionary are alphabetized, each word typically has several initial letters in common with the preceding word. Therefore, a compression code can *count* the common initial letters instead of listing them.

Shown is a compression code that uses each of the above methods. To simplify the analysis, the code includes only lowercase English letters. Most commercially-used codes also represent uppercase letters, hyphens and apostrophes.

The code for each word begins with two 3-bit numerical fields. The first field stores the number (0 to 7) of common initial letters relative to the previous word in the dictionary; the second 3-bit field holds the number (1 to 8) of letters following the common initial letters. After the 3-bit fields are one or more 5-bit fields that store codes for individual letters and selected letter sequences. Five bits

can represent as many as 32 items ($2^5 = 32$), so each 5-bit field contains one of the 26 English letters or six letter sequences listed in Table A.

Table B shows the compression codes of four typical words: "com-

(A) FIVE-BIT FIELD FOR INDIVIDUAL LETTERS AND SELECTED LETTER SEQUENCES

Letter or sequence	Decimal value	Binary value
a	0	00000
b	1	00001
.	.	.
.	.	.
z	25	11001
ing	26	11010
ment	27	11011
ly	28	11100
tion	29	11101
ed	30	11110
ous	31	11111

pute," "computer," "computerese" and "computing." The table assumes that the word just before "compute" is "computation." "Compute" and "computation" each begin with "comput," which has six letters, so the first 3-bit field for "compute" contains a "6". The rest of the word "compute" consists of only the letter "e", so the second 3-bit field stores a "1", and the 5-bit field represents "e". The word "computer" is coded in the same manner. The code for "computerese" is not quite so simple. Although there are eight common initial letters between "computerese" and "computer," the first 3-bit field holds only values between 0 and 7. Therefore, the "r" must be coded explicitly along with the "e", the "s" and the "e". Finally, in the code for "computing," the second 3-bit field contains a "1" because "ing" is one of the representable letter sequences.

The total storage requirement for the four words shown is 64 bits, or 8 bytes. In ASCII code (with one numerical count field per word) the words would require 39 bytes—almost five times as much storage.

(B) COMPRESSION CODES FOR TYPICAL WORDS

Word	First 3-bit field	Second 3-bit field	Five-bit fields	Total number of bits to represent word
compute	6	1	"e"	11
computer	7	1	"r"	11
computerese	7	4	"r" "e" "s" "e"	31
computing	6	1	"ing"	11

that runs on DG computers. SCRED OEMs can receive an 80 percent discount on orders of 100 or more units per 12-month period or, for a one-time payment of 20 times the single-unit price, a 90 percent discount on all units, with no time or volume restrictions.

Also available from some vendors are free trial periods or "try-before-you-buy" evaluation packages. Rational Data Systems offers a SCRED evaluation package that performs just like the real program, except that it doesn't update a user's file after editing.

Three key selection criteria

Word wrap, hyphenation and spelling verification are the *MMS* directory's three "functional" features. What makes these features so important is that they save time. Although it's possible to construct a finished document without them, it might take many times longer.

Word wrap describes how a program reformats text after insertions or deletions. Without it, a user can spend more time reformatting than inserting and deleting. Fortunately, most minicomputer WP packages wrap automatically or "on request." In automatic word wrap, a program reformats a paragraph each time editing extends or shortens a line, so that text always appears neatly positioned.

Hyphenation is an important function related to word wrap. A word that was originally split between two lines can sometimes fit on one line after word-wrap reformatting. However, a WP program with no provision for "unsplitting" such a word could display the word "straightforward" in the middle of a line as "straight-forward." Thus, most programs allow users to distinguish between words that *must* be hyphenated and words that are hyphenated only at line breaks.

INPUT WORD	CORRECTED WORD
milasecond	millisecond
acrew	accrue
cawshun	caution
sinnic	cynic
namonya	pneumonia
shartrus	chartreuse
crisanthemum	chrysanthemum
dackery	daiquiri

Table 2. A corrected misspelling produced by the Houghton Mifflin Spelling Corrector may appear quite unlike the original word using letter-by-letter pattern matching ("dackery" vs. "daiquiri") because the program uses word-frequency and phonetic analysis as well as pattern matching. The value of the program is not in correcting gross misspellings (few users would think "dackery" correct) but in allowing a user who is unsure of the proper spelling to input a "sound-alike" word.

A more difficult problem is hyphenating at line breaks to produce a neater "look" when reformatting. Some WP programs never hyphenate (except in "must-hyphenate" words), which can result in large blocks of blank space at the end of a line. Such programs are listed as "manual" in the "hyphenation-during-reformatting" column of the *MMS* directory. Other WP programs can decide *when* to hyphenate but not *how*. These are listed as "user prompted" because they prompt a user for breakpoints at the end of a line.

Automatic hyphenation using an "electronic dictionary" stored on disk is another option. This approach requires that the WP software access and search the dictionary each time a word must be split, reducing throughput by as much as 30 percent. Further, having

Just as buying a \$1,500 personal computer can mean spending three times that for a fully-configured system, WP packages often require costly 'options.'

a dictionary does no good if it doesn't contain the word that needs to be hyphenated.

A novel approach to automatic hyphenation is to find word breakpoints by using an algorithm that incorporates many of the de facto hyphenation rules of English. Orthographics Inc., New York, markets a hyphenation program for OEMs that supplies the host WP software with word breakpoints from which to choose (see Table 1, Page 278). The Orthographics program occupies 16K bytes of RAM and does not need disk space for either code or data. The program employs 37 hyphenation rules to locate breakpoints. However, this number is somewhat misleading because rules that find splits before common suffixes, after common prefixes and between doubled consonants are tested first, so that fewer than five rules are invoked for most words. The remaining rules are designed to handle the many quirks of English. For example, "photog-rapher" is hyphenated differently from "photo-graph." Also, because the final "e" in words such as "state" is silent, it does not contribute an additional syllable or potential breakpoint.

Spelling verification, unlike hyphenation, always uses an electronic dictionary on disk. The utility of a spelling checker depends on the size of its dictionary, which typically stores 60,000 to 80,000 words. However, spelling checkers use proprietary algorithms that "compress" words, so that even a large dictionary occupies relatively little disk space (see "Compression codes reduce storage requirements," Page 281).

Most spelling checkers merely flag words not found in the electronic dictionary, leaving the user to determine

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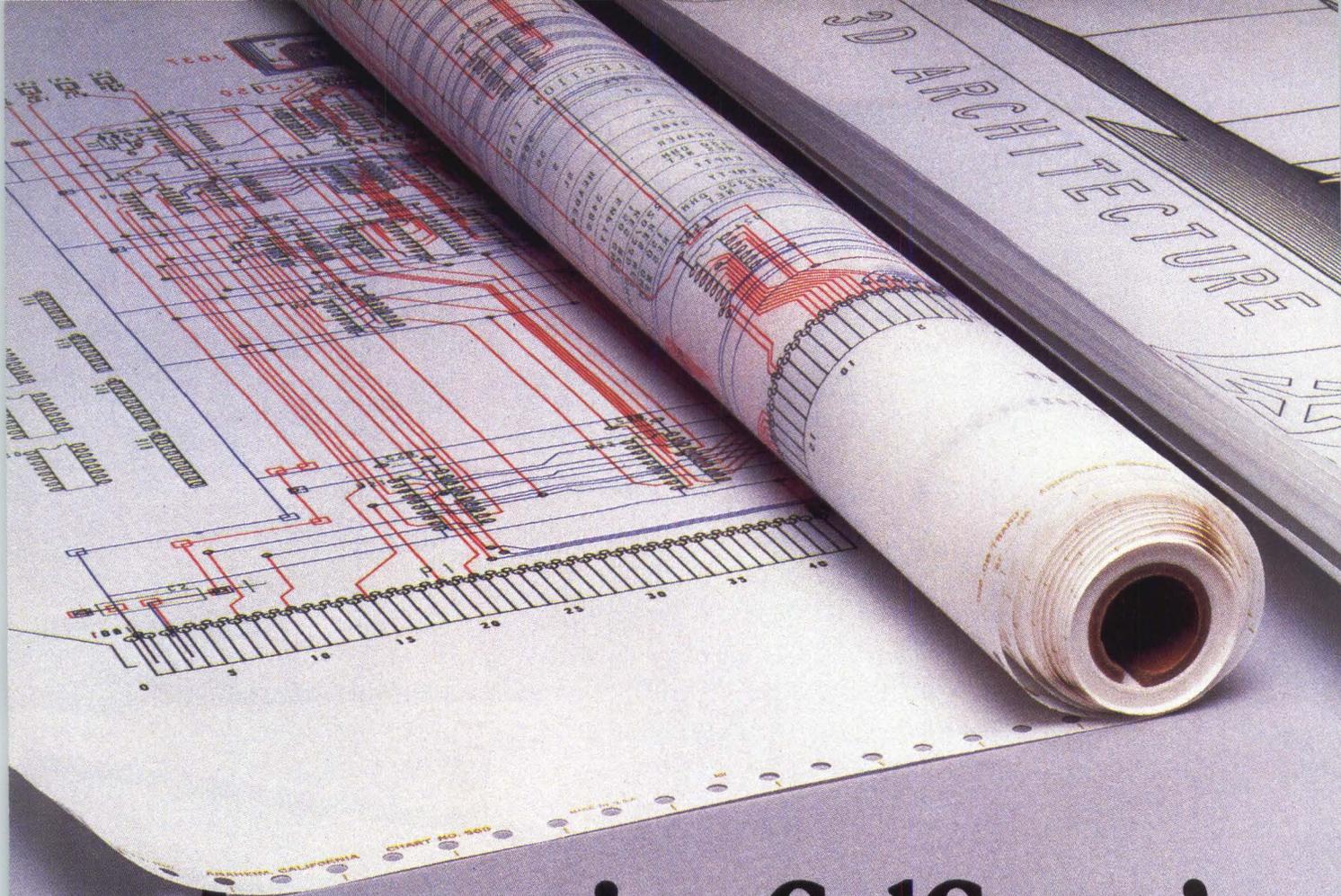
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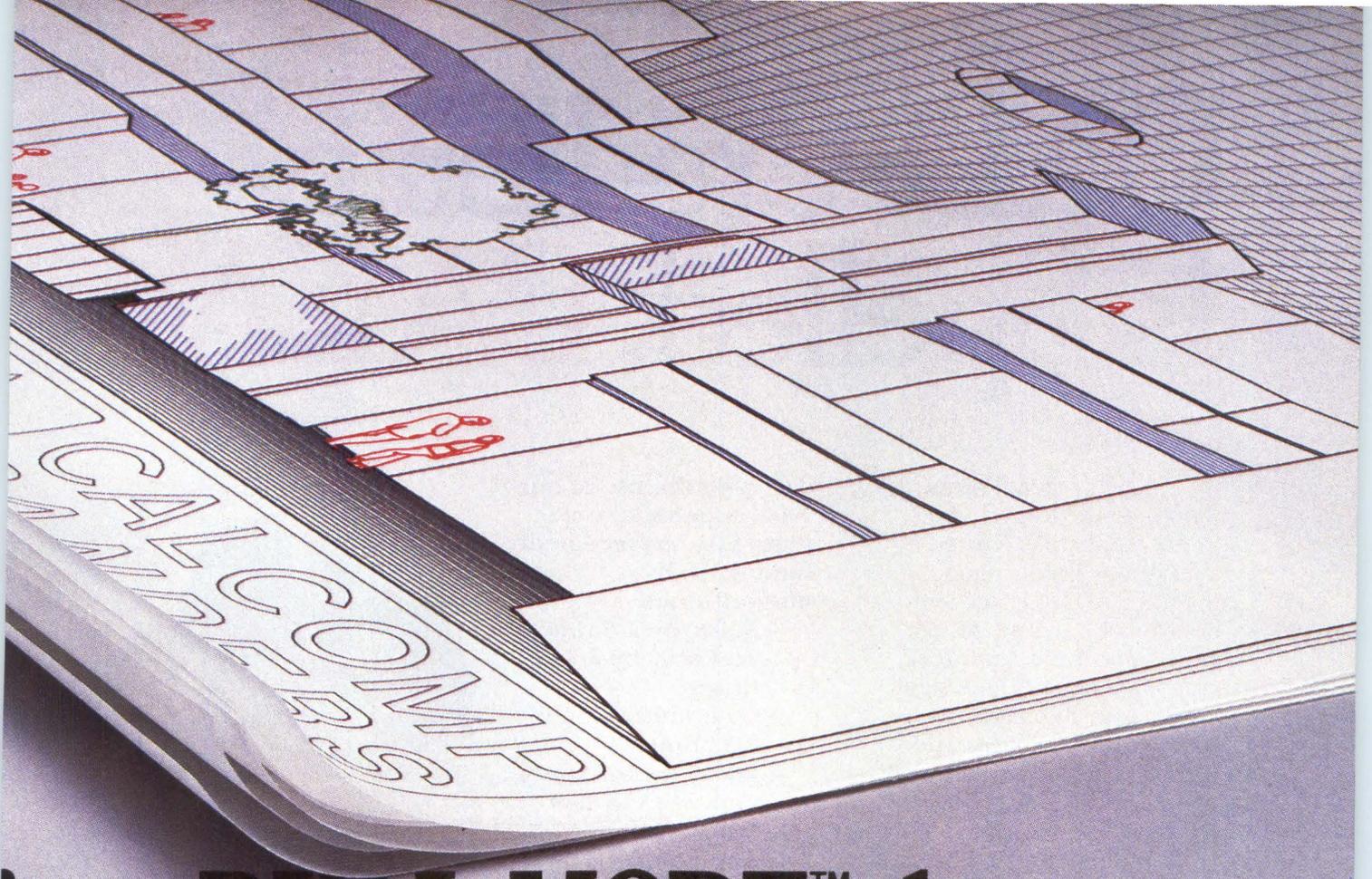
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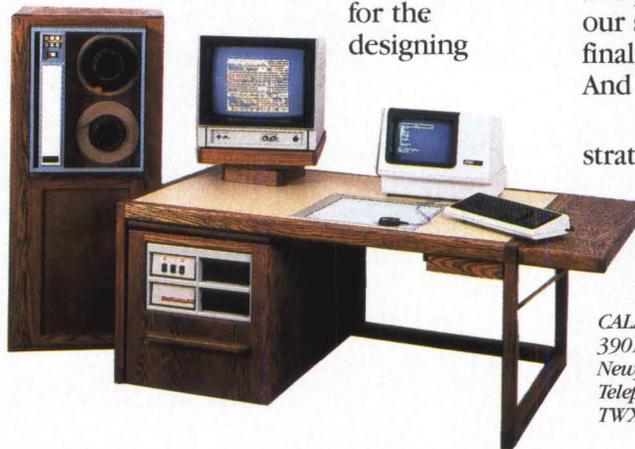
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which word was intended. However, some programs are sophisticated enough to *correct* misspellings. "Brute-force" correction programs attempt to match an

unidentified word with a dictionary entry by adding, deleting or transposing letters. These programs then generate lists of words that are likely to include the word the user intended. But, because the programs must test many letter permutations, they tend to be slow, and they generate long lists that can make it difficult for a user to select the correct entry.

Another approach to spelling correction is applying word-frequency and phonetic analysis to identify the

WORD-PROCESSING FEATURE CHECKLIST

This checklist contains many—but not all—of the editing, formatting and miscellaneous features offered by minicomputer WP packages. Be-

cause of the large number of features, prospective buyers should first consult *MMS's* product directory to focus on perhaps two or three products and

then use the checklist to study the products in more detail.

Cursor movement

- move cursor left and right by character/word
- move cursor to left and right of a line
- move cursor up and down one line
- move cursor to top of screen (1st character of 1st line)
- move cursor to bottom of screen
- move cursor to beginning/end of document
- move cursor to next screen
- move cursor to start of next line
- move cursor to a specified page

Scrolling

- scroll text up and down one line
- scroll text up and down one screen
- horizontal scrolling

Screen formatting

- set/clear tabs
- set left and right margins
- margin release
- automatic page breaks
- "what you see is what you get"

Insertion and deletion

- insert character
- delete character/next character
- delete preceding character
- delete next word
- delete remainder of line
- delete preceding part of line
- delete entire line
- delete to end of document
- delete through specified character
- delete paragraph

Block operations

- copy block (of text)
- move block
- delete block
- erase all block markers

Search and replace operations

- find string
- find string and replace
- find string and replace n times
- global find and replace
- repeat last find operation
- ignore a specific string occurrence when searching
- match only whole words
- search and replace operations using "wild cards"
- search and delete

Page layout

- set top, bottom, left, right margins
- insert page headings
- insert page footings
- set heading margin
- set footing margin
- set physical page length
- set number of characters per inch
- set number of lines per inch
- temporary left margin offset
- indent first lines of paragraphs
- outdent first lines of paragraphs
- number paragraphs
- insert <LF> between paragraphs
- suppress headings and footings
- page numbering
- page number suppression
- force new page
- two-column printing

Justification

- right justify
- center
- hard (unsplittable) spaces
- automatic alignment of decimal data

Character attributes

- underline
- boldface
- italics
- color
- shadowed (double strike)
- proportional spacing
- superscript
- subscript
- overprint

Printer control

- print a specified page
- print starting from a specified page
- print through a specified page
- print starting from cursor position
- print multiple copies
- display/change print format
- pause for paper insertion
- typesetter

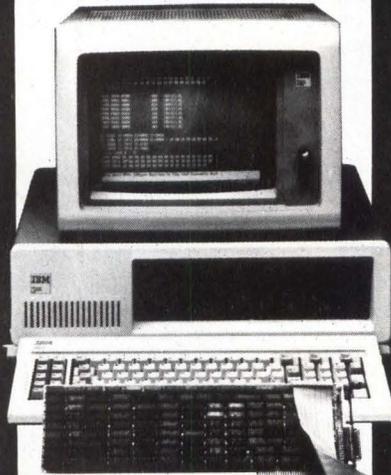
Document/file operations

- link/merge WP documents and non-WP documents (i.e. VisiCalc)
- move text blocks from document to document
- copy text blocks from document to document

Miscellaneous

- columnar math
- automatic table of contents
- automatic index

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SOFTWARE PROFILE

dictionary entry most likely to be the word the user intended. Houghton Mifflin Co. uses this approach in the Spelling Corrector program it markets to software houses and OEMs (including DEC and NEC Information Systems Inc.) that incorporate it in their own WP software packages. According to Andrea O'Shaughnessy, marketing manager for electronic products at Houghton Mifflin, the company's program can identify the intended word on the first try in 80 percent of misspellings (see Table 2, Page 282); the other 20 percent are ambiguous. For example, "fisical" could

Some WP programs never hyphenate, which can result in large blocks of blank space at the end of a line.

be a misspelling of "physical" or "fiscal." If a word is ambiguous, Houghton Mifflin's program displays possible corrections in "probability sequence," beginning with the most likely candidate. The program occupies 11K bytes of RAM, and its dictionary stores as many as 71,000 words in 383K bytes of disk space. The dictionary can also be customized for specific industries such as medicine, law and electronics.

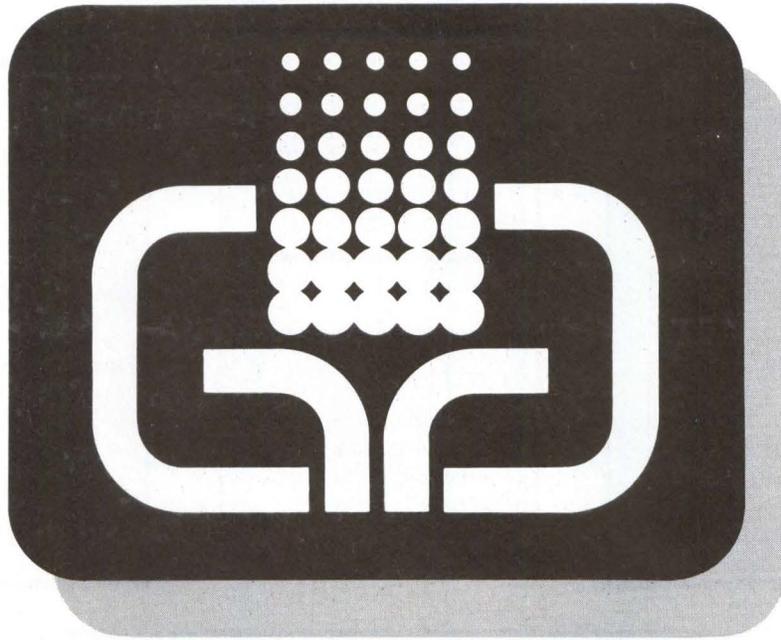
Vendor-specific programs still dominate

The "computers supported" column in the *MMS* directory highlights a major difference between mini-computers and microcomputers. Although many micro-computer application programs can run on computers from several different manufacturers, exactly the opposite is true of WP packages for minis. More than 90 percent of the products listed in the directory run on machines from only one hardware vendor, demonstrating that proprietary operating systems such as DEC's VMS and DG's AOS still dominate the minicomputer software industry. Few vendors are porting their WP programs to AT&T's UNIX because it is usually a lengthy task (*MMS*, January, Page 237). Moreover, UNIX's original application was text processing, so it has powerful editing, formatting and typesetting utilities. Creating a competitive WP package that runs under UNIX is an ambitious undertaking. □

LOOKING AHEAD IN MMS

The coming year brings a third special issue. Slated for publication in mid-June, the Mini-Micro Computer Digest will prove an indispensable selection guide to minicomputers and microcomputers.

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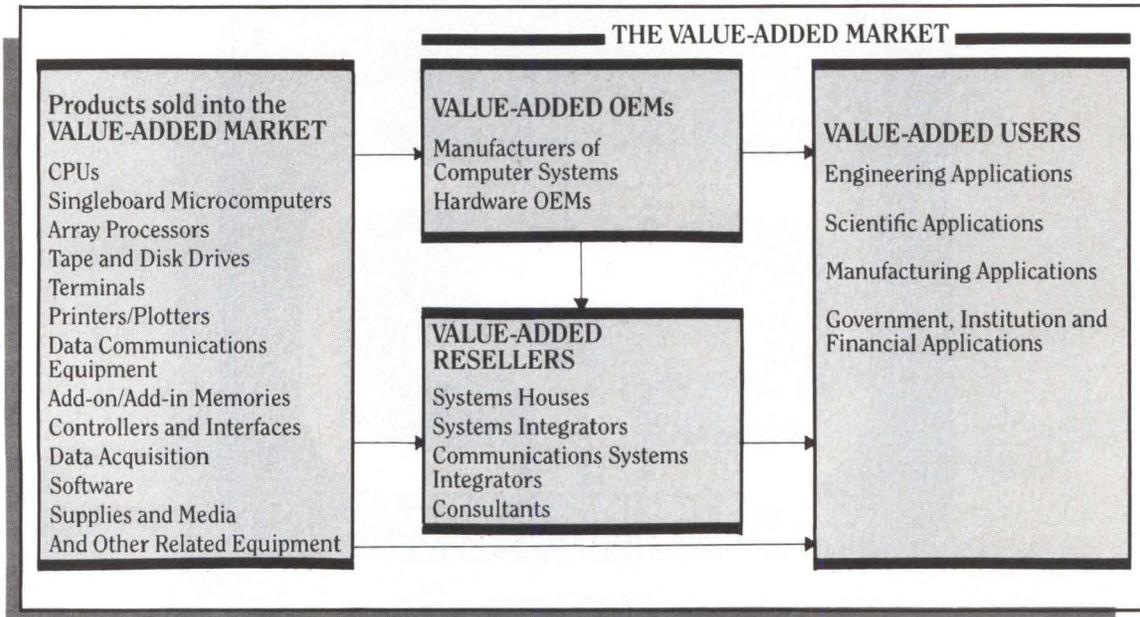
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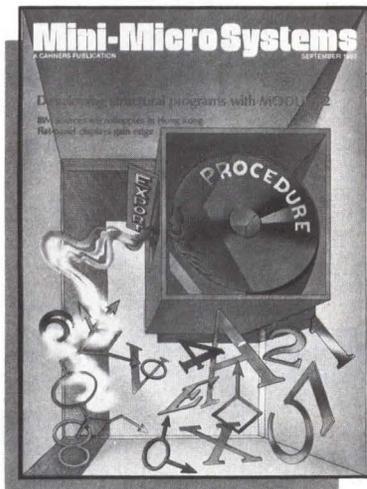
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WORD-PROCESSING SOFTWARE FOR MINICOMPUTERS

Supplier Product	Computers supported	Operating systems supported	Memory required (K bytes)	Implementation language	Year introduced	Number sold	CRT	Maximum characters per line:	Word wrap	Hyphenation during reformatting	Spelling check	Purchase price	Annual maintenance fee	Comments
ALPS 190 W. 800 North Provo, UT 84601 (801) 375-0090 Circle No. 828														
ALPSWriter	Eclipse MV	AOS, AOS/VS	64	DGL	1982	50	132	132	automatic	manual	optional	3,500	420	multilingual character set; files can be created and written in 130 languages
ANDROMEDA SYSTEMS 9000 Eton Ave. Canoga Park, CA 91304 (213) 709-7600 Circle No. 829														
VEDIT	LSI-11	RT-11	64	TECO	1980	N/A	80	132	automatic	manual	optional	200	none	
APEX DATA GROUP 1161 N. El Dorado Pl., Suite 100 Tucson, AZ 85715 (602) 886-8401 Circle No. 830														
Apex Textwriter	Prime	PRIMOS	264	FORTRAN	1980	200	132	132	automatic	automatic	yes	10,000	1,000	multiuser design; mail list capabilities
BARRATT EDWARDS INT'L CORP. 1836 Westlake N., Suite 204 Seattle, WA 98109 (206) 282-2014 Circle No. 831														
AUTODOC	Wang VS	VS/OS	N/A	COBOL	1978	250	132	132	automatic	manual	no	6,000	600	highlights document revisions in hard-copy output; Wang word-processing emulation mode
CALIFORNIA SYSTEMS ASSOCIATES 2845 Mesa Verde Dr. E., Suite 4 Costa Mesa, CA 92626 (714) 546-9716 Circle No. 832														
WORDWRIGHT	PDP-11	RT-11, TSX +	40	Macro-11, DIBOL	1978	200	66	132	automatic	manual	optional	2,595	300	includes DMBS, report generator
COMPU-TOME INC. 234 E. Colorado Blvd. Pasadena, CA 91101 (213) 796-9371 Circle No. 833														
CT-OS Word Processing	VAX, PDP-11, Professional	VMS, RSTS, RSX-11M+, RT-11, TSX+, P/OS	64	Macro-11	1978	1350	132	132	automatic	user-prompted	yes	950-6,500	100-650	87,000-word spelling corrector available for \$175-500
COMPUTER CORP. OF AMERICA 4 Cambridge Center Cambridge, MA 02139 (617) 492-8860 Circle No. 834														
CCA EMACS	VAX	VMS, UNIX	512	C	1983	70	no limit	no limit	on request	manual	yes (UNIX version only)	850 (UNIX); 1,900 (VMS)	300 per update	UNIX version includes source code and interactive spelling correction; source code (VMS) is \$2,400
CONTEL CORP. 416 W. Fifth Ave. Naperville, IL 60540 (312) 355-8188 Circle No. 835														
Starwriter	Nova, Point 4	Iris	16	Business BASIC	1979	250	80	250	automatic	automatic	yes	2,400-3,500	1,200	Star Technology microprocessor-equipped CRT required
CORPORATE COMPUTER SYSTEMS INC. 33 W. Main St. Holmdel, NJ 07733 (201) 946-3800 Circle No. 836														
TFORM	HP 1000, HP 3000	MPE-3000, RTE	27	FORTRAN	1981	50	no limit	132	automatic	automatic	optional	4,000	420	\$5,000 for program with letter-quality printer support; \$10,000 for typesetter support
D. H. MINICOM INC. 1636 Wilshire Blvd. Los Angeles, CA 90017 (213) 483-2400 Circle No. 837														
SCRIPTOR	Nova	Iris	64	Business BASIC	1978	50	79	132	on request	manual	yes	2,500	500	uses CRT memory to edit, freeing CPU for other operations

WORD-PROCESSING SOFTWARE FOR MINICOMPUTERS

Supplier Product	Computers supported	Operating systems supported	Memory required (K bytes)	Implementation language	Year introduced	Number sold	CRT	Maximum characters per line	Word wrap	Hyphenation during reformatting	Spelling check	Purchase price	Annual maintenance fee	Comments
DACOR INC. 13330 Bishop Rd. Bowling Green, OH 43412 (419) 352-3568														
Circle No. 838														
EDOC	Eclipse	AOS/VS, AOS, RDOS	256-512	Extended BASIC	1977	80	132	132	no	manual	no	1,700	170	text formatter to be used with a Data General editor
DATA PROCESSING DESIGN 181 W. Orangethorpe, Suite F Placentia, CA 92670 (714) 970-1515														
Circle No. 839														
WORD-11	VAX, PDP-11, Professional	VMS, RSTS/E, RSX-11M +	10-60	Macro-32, Macro-11	1977	1,500	132	132	automatic	user-prompted	yes	595-9,500	450-1,200	supports Xerox 2700 laser printer; scientific character set for VT100 CRT and Diablo 630 ECS printer
DATA SERVICES COMPANY 32 E. Main St., Box 450 Avon, CT 06001 (203) 678-1888														
Circle No. 840														
Datashare Word Processor	Datapoint	DOS	24-48	Databus	1982	10	79	80	on request	manual	no	800	80	runs in 4K-word overlays
DAWN COMPUTER 4019 Tujunga Studio City, CA 91604 (213) 376-7235														
Circle No. 841														
QTEXT	VAX, PDP-11	VMS, RSX-11, RSTS, TSX +, RT-11	64	Macro-11	1975	400	245	245	on request	automatic	no	995-3,500	200	stores 26 one-line math programs; communications capabilities
EEC SYSTEMS INC. 327 E. Boston Post Rd. Sudbury, MA 01776 (617) 443-5106														
Circle No. 842														
LEX-11	VAX, PDP-11, Professional	VMS, RSX +, RSTS, RT-11, UNIX	64	D	1979	200	132	132	on request	automatic	optional	1,000-7,500	500-900	"what you see is what you get" screen; available in 9 foreign languages
ENTERPRISE SYSTEMS INC. 2975 Trent Blvd., Suite D-7 Concord, CA 94518 (415) 827-1823														
Circle No. 843														
JOT	Eclipse, Nova	AOS, RDOS, DOS	22	FORTTRAN	1978	12	80	132	automatic	manual	yes	6,500	500	help menus; word indexing and page numbering
HANDLE CORP. P.O. Box 7018, 140 Makinaw Tahoe City, CA 95730 (916) 583-7283														
Circle No. 844														
HandleWriter	HP 1000 or any system running UNIX	RTE, UNIX		C	1983	100	320	320	automatic	automatic (optional)	optional	2,500 (HP 1000); 595 (UNIX)	50	integrated with optional spreadsheet, list-generation pkgs.
INTERACTIVE DATA SYSTEMS 1212 Seventh St. Santa Monica, CA 90401 (213) 450-8363														
Circle No. 845														
INword	VAX, PDP-11	VMS, UNIX	64	C	1979	500	no limit	no limit	automatic	automatic	yes	5,000-7,000	1,500	"proof-it" capability to view documents before printing
IPT CORP. 1096 E. Meadow Circle Palo Alto, CA 94303 (415) 494-7500														
Circle No. 846														
TIPS	Eclipse, Nova, MicroEclipse, MicroNova, Desktop Generation	AOS/VS, AOS, RDOS, DOS	64	Assembly	1981	400	80	132	automatic	manual	yes	700-4,800	400	Greek letter option; works with all Data General CRTs plus many others

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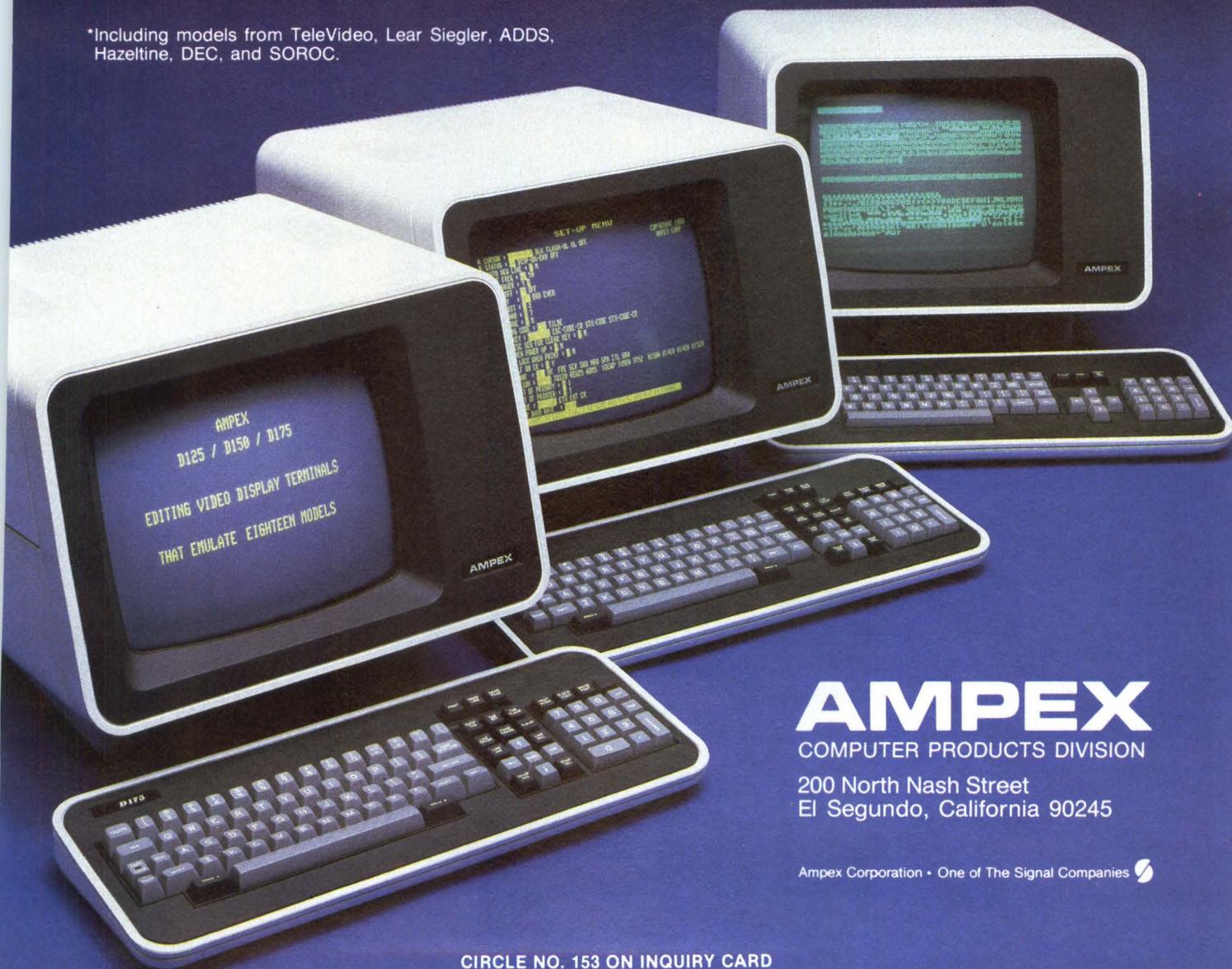
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WORD-PROCESSING SOFTWARE FOR MINICOMPUTERS

Supplier Product	Computers supported	Operating systems supported	Memory required (K bytes)	Implementation language	Year introduced	Number sold	CRT	Printer	Maximum characters per line	Word wrap	Hyphenation during reformatting	Spelling check	Purchase price	Annual maintenance fee	Comments
KENWOOD ASSOCIATES															
P.O. Box 11520 Chicago, IL 60611 (312) 548-4488															
Circle No. 847															
WALDO	Prime	PRIMOS	100	PL/P	1980	15	256	132	on request	manual	no	6,000	600		block-mode CRT required for full-screen editing
MARYLAND COMPUTER SERVICE															
2010 Rock Spring Rd. Forest Hill, MD 21050 (301) 879-3366															
Circle No. 848															
CP 250	HP 250	B.04, B.05	64	HP Business BASIC	1980	150	80	160	automatic	user-prompted	yes	1,500	250		utility to translate into foreign languages; interfaces to Hewlett-Packard 250 DBMS
MBA-SYSTEMS AUTOMATION															
3477 E. Livingston Columbus, OH 43227 (614) 231-2130															
Circle No. 849															
XWORD	VAX, PDP-11	VMS, RSTS/E	64	XPRESS	1978	25	80	132	on request	user-prompted	yes	3,000	300		unlimited size list-processing capability
MICRO METRIC															
P.O. Box 81 Woodland, CA 95695 (916) 662-4334															
Circle No. 850															
COED	Eclipse, Nova, MicroEclipse, MicroNova, Desktop Generation	AOS/VS, AOS, RDOS, DOS	30	Assembly	1979	200	132	132	on request	manual	no	1,000	100		supports macros, redefinable keyboard
MICROSYSTEMS ENGINEERING CORP.															
2400 Hassell Rd., Suite 400 Hoffman Estates, IL 60195 (312) 882-0111															
Circle No. 851															
MASS-11	VAX	VMS	2000	FORTRAN, Macro-11	1981	400	249	no limit	automatic	user-prompted	yes	11,500	1,150		split screens; scientific package with equation editing
MID-AMERICAN CONTROL															
U.S. 60 West Shelbyville, KY 40065 (800) 626-5518															
Circle No. 852															
PROMPT Word Processing	IBM Series/1	EDX	32	EDL	1976	400	80	132	automatic	manual	no	2,000	none		integrated with PROMPT DataFiles DBMS
NEOTERIC SYSTEMS INC.															
320 S. Main St. Bartlett, IL 60103 (312) 289-1950															
Circle No. 853															
DPX	PDP-11, LSI-11	RSX-11M, RT-11, TSX	32	Macro-11	1980	12	256	256	no	manual	no	2,500	250		automatic table of contents; formats text into shapes such as circles
PULSAR SYSTEMS INC.															
1259 Route 46, Building #2 Parsippany, NJ 07054 (201) 335-5600															
Circle No. 854															
MUSE	Prime, DEC, Harris	PRIMOS, VMS, VOS	350	FORTRAN	1980	500	163	163	automatic	automatic	yes	5,000-12,500	750-1,800		foreign languages; glossary, Greek/math character set
QAX INTERNATIONAL SYSTEMS CORP.															
59 E. Cunningham Palatine, IL 60067 (312) 358-3783															
Circle No. 855															
3-16 Word Processor	Eclipse, Nova, MicroNova, Desktop Generation	AOS, RDOS, DOS	15	Business BASIC	1982		131	131	on request	manual	yes	750-1,650	none		undo, redo commands; stored phrases; chapter and page numbering

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At last, you have a small choice for back-up in the 9-track world.

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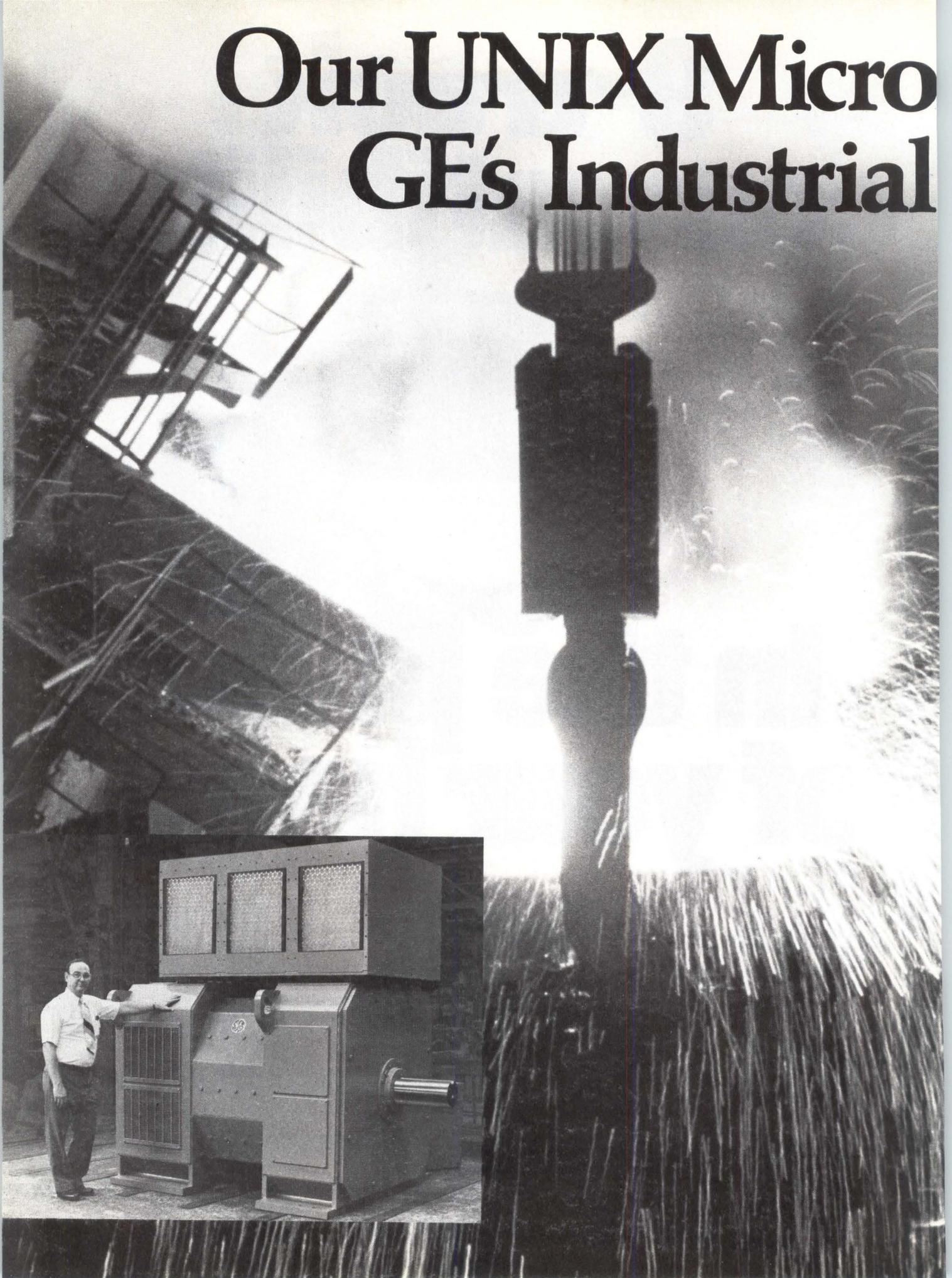
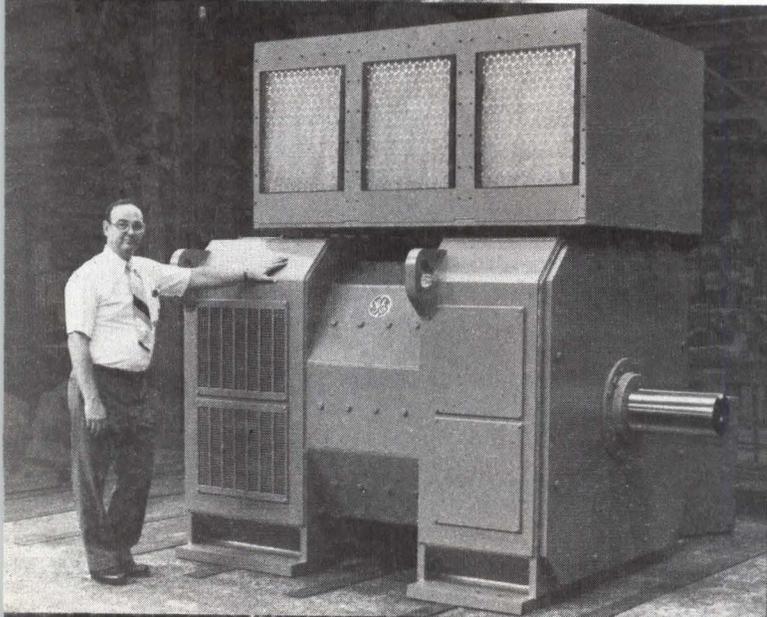
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In addition, you'll find our 83/80 delivers increased performance through its Dual ported full-track disk buffer and proprietary controller circuiting. More users can access with better response time.

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The C programming language comes standard with UNIX, of course. Other optional languages include FORTRAN-77, PASCAL, RM/COBOL®, LISP and BASIC. And that's just for starters. Optional software includes data base and administrative packages like INGRES and UNIFY.

And the sticker price? Quantity 10 at \$14,693.

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57.5 mm

MODELS MDD 423 & 413

33.5 mm

MODELS MDD 221 & 211



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The choices:

- Standard half-height panels — or panels 20% thinner than half height: 33.5 mm.
- 96 TPI — or 48 TPI.
- Single drive — or double drive.
- Double drive with two stepper motors.

The reasons a Canon floppy drive should be your choice:

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The single drives weigh 1.2 Kg, the double drives 1.9.

The single drives use 0.8A (12V and 5V); the double drives 0.9A (5V) and 1.3A (12V). As you can see, our double drives use 25% less power than two separate single drives — even ours!

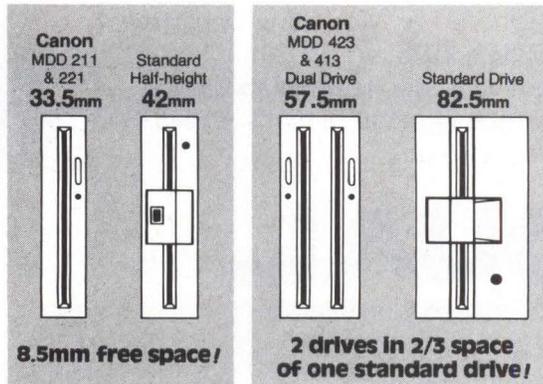
Single-pushbutton media locking and ejection, and anti-crunch mechanism to prevent damage to improperly inserted media. Pushbutton is locked while heads are loaded, automatically.

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Canon

WORD-PROCESSING SOFTWARE FOR MINICOMPUTERS

Supplier Product	Computers supported	Operating systems supported	Memory required (K bytes)	Implementation language	Year introduced	Number sold	CRT	Printer	Maximum characters per line	Word wrap	Hyphenation during reformatting	Spelling check	Purchase price	Annual maintenance fee	Comments
RATIONAL DATA SYSTEMS INC.															
205 E. 42nd St. New York, NY 10017 (212) 697-5855															
Circle No. 856															
SCRED	Eclipse, Nova, MicroNova, Desktop Generation	AOS/VS, AOS, RDOS, DOS	42	Pascal	1982	100	80	80	on request	manual	no	950-1,200	200-250		supports any cursor-addressable CRT; includes installation program
RUF CORP.															
1533 E. Spruce Olathe, KS 66061 (913) 782-8544															
Circle No. 857															
RNI	PDP-11	RSTS	20	Basic	1982	30	256	256	on request	user-prompted	yes	1,500	150		interfaces to IMPRS DBMS
SATELLITE SOFTWARE INTERNATIONAL															
288 W. Center Orem, UT 84057 (801) 224-8554															
Circle No. 858															
WordPerfect	Eclipse, Nova, Desktop Generation	AOS, AOS/VS, RDOS, DOS	32	Assembly	1979	750	250	250	automatic	user-prompted	yes	500-5,000	N/A		math, foreign language capabilities
SATURN SYSTEMS INC.															
6875 Washington Ave. S., Suite 218 Minneapolis, MN 55435 (612) 944-2452															
Circle No. 859															
WP SATURN	VAX, PDP-11	VMS, RSTS, RSX, RT-11, TSX+	42	Macro-11, FORTRAN	1979	1000	no limit	no limit	automatic	automatic	optional	2,500	200-400		RT-11 version available for \$1,400
SHIRLEY SOFTWARE SYSTEMS															
1936 Huntington Dr., Suite 208 South Pasadena, CA 91030 (213) 441-5121															
Circle No. 860															
DirectED	Prime	PRIMOS	64	FORTRAN	1983	20	no limit	no limit	on request	user-prompted	no	4,000	200		lease terms available
SYSTAR CORP.															
1762 Technology Dr., Suite 208 San Jose, CA 95110 (408) 280-7066															
Circle No. 861															
WP/1	IBM Series/1	EDX	30	EDL	1982	20	75	80	no	manual	optional	1,400	none		supports models 4978 and 3101 display terminals; \$500 for spelling checker
TRIDENT DATA SYSTEMS															
8929 S. Sepulveda Blvd., Suite 200 Los Angeles, CA 90045 (213) 645-6483															
Circle No. 862															
LASTWORD	HP 3000	MPE	28	FORTRAN	1981	2	80	132	on request	automatic	no	2,500	500		supports block-mode Hewlett-Packard display terminals
UNIVERSITY SOFTWARE ASSOCIATES															
R.F.D. 1, P.O. Box 6 Fitchville, CT 06334 (203) 889-5641															
Circle No. 863															
Master Word-processor	HP 9845	HP BASIC 2.0	187	BASIC, Pascal, Assembly	1981	125	78	78	automatic	manual	no	495	free up-dates		supports superscripts, subscripts, and user-defined characters on printers
VENTURCOM INC.															
139 Main St. Cambridge, MA 02142 (617) 661-1230															
Circle No. 864															
The FinalWord	any system running VENIX	VENIX (enhanced UNIX)	64	C	1980		no limit	no limit	automatic	automatic	no	950	none		split screen; automatic index and table of contents



THE MAINFRAME INDUSTRY

Ever since the Sixties, it's been the same old story. The DP department needs more mainframe power. So they get a grown-up version of their old model. And a lot of requests for new applications.

Of course, for every job your people take care of, three more spring up to take its place.

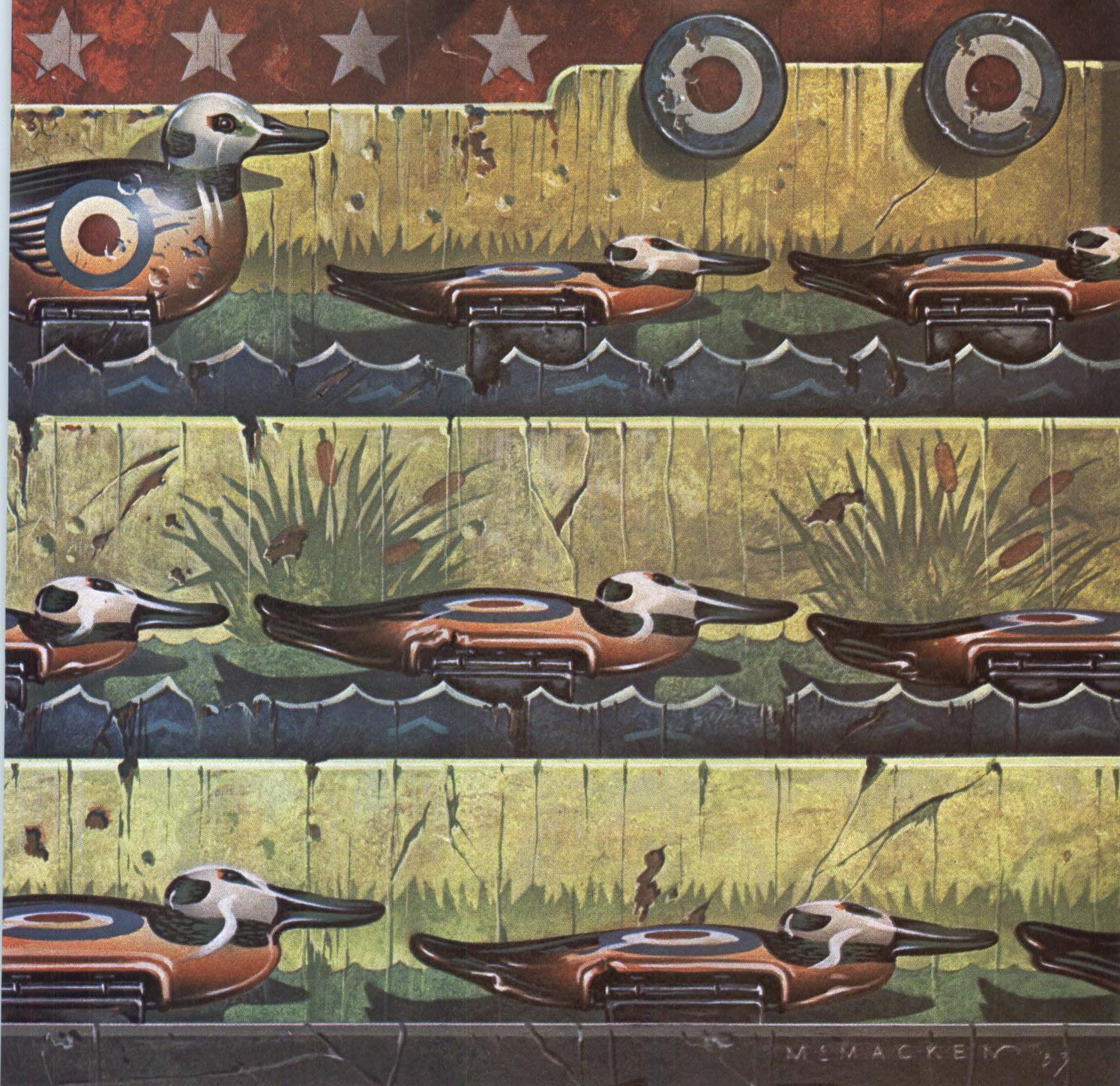
So they work harder than ever. And all of a sudden, it's time for another mainframe.

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endless parade of grown-up mainframes has cost you too much already. So we've developed the first generation of grown-down mainframes.

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MOVES INTO THE EIGHTIES.

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The grown-down mainframes.

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The Terminal/System Architects Present New Ergonomics

Eye Fidelity



It's Music To Your Eyes

Bring new harmony to your office with the ergonomics of Beehive's ATL-004 ANSI standard smart terminal. This ANSI standard, with a monitor featuring a Beehive unique "dual dynamic focus" capability, delivers perfect reproduction, displaying crisp, precisely formed characters on a large 7x9 matrix all housed within an attractive package. A special anti-glare nylon filter provides a further feast for your eyes.

The P31 green screen clearly reveals 27 lines in

a choice of 80 or 132 column formats. Beehive's 14" diagonal screen displays as much data as a bulky, costly, 15" unit.

The ATL-004 is VT52/VT100 compatible and plays to convenience, tilting and swiveling for viewing comfort. The detachable DIN profile keyboard rests easy on lap or desk. And its full-travel key switches feel just right.

Experience the advantage of eye fidelity soon. To find out more, write or call Beehive, 4910 Amelia Earhart Drive, Salt Lake City, Utah 84125. Toll Free: 1-800-453-9454.



BEEHIVE™
Terminal/System Architecture
in Data Processing

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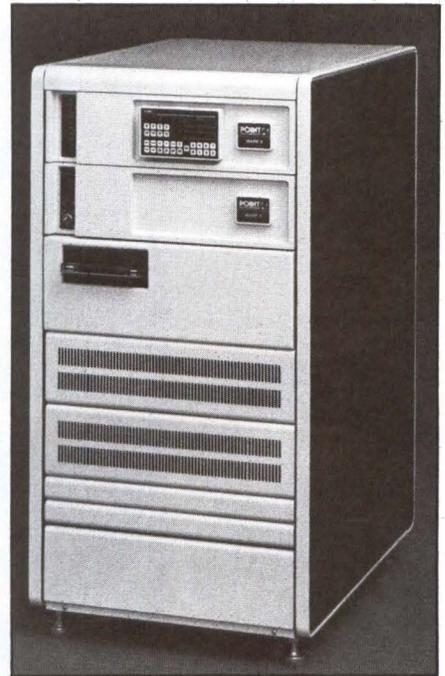
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WASHINGTON, DC (VA) Falls Church 703/573-1261

CIRCLE NO. 158 ON INQUIRY CARD

New Products

SYSTEMS

Point 4 extends multiuser computer line



Point 4 Data Corp.'s low-end Mark 2T (left) and high-end Mark 9 minicomputers serve the multiuser, small business system market. The computers run the company's time-sharing IRIS operating system that uses the Business BASIC language.

Point 4 Data Corp. has introduced two computer systems for the multiuser, small business system market. They are the Mark 2T, an entry-level minicomputer system with prices starting at less than \$10,000, and the Mark 9, a top-of-the-line system that supports more than 64 users and is priced from \$30,000.

The Mark 2T computer employs bit-slice technology with a microsequencer to effect a 600-nsec. instruction-execution cycle time and a 200-nsec. RAM access time. Using a direct-memory-access (DMA) multiplexer, the Mark 2T handles as many as seven users. The computer incorporates a 5¼-inch Winchester disk drive with the ST-506 interface in capacities ranging from 19M to 46M bytes. A 20M-byte streaming cartridge-tape subsystem provides backup and program loading. The system is compatible with industry-standard terminals and printers.

The Mark 9 16-bit general-purpose minicomputer offers selectable operational modes including a Nova 3-compatible mode and an extended instruction set. The Mark 9's CPU has a 300-nsec. internal cycle time. Hardware multiplication/division and floating-point hardware enhance system speed. For the value-added reseller, the Mark 9

is available at several levels of integration from CPU/memory board to complete system. As a complete system, the Mark 9 offers a 35M- to 84M-byte Winchester disk subsystem, a streaming cartridge-tape drive subsystem and DMA multiplexers to support more than 64 users. An entry-level Mark 9

Package provides industrial graphics system

The Classicmate II hardware/software package provides an industrial graphics system for programmable controllers. The on-line system consists of a color monitor, a 105-key development keyboard and an IDT-2200 video processor that addresses 512 by 512 dots on the monitor. The video processor employs bubble memory for storing data and picture files. With the graphics-development package, which contains a 10M-byte Winchester disk drive, plant personnel can build process displays and tie them to the programmable-controller system within a few hours. An operator can also monitor and change process variables through the IDT keyboard and display without programming or adjusting the program-

configuration with a 256K-byte CPU board, eight ports, a 35M-byte Winchester disk drive and controller and a 20M-byte streaming cartridge-tape drive and controller is priced at \$30,000. **Point 4 Data Corp.**, 2569 McCabe Way, Irvine, Calif. 92714, (714) 863-1111.

Circle No 300



mable controller. Classicmate II contains a simulation program that checks the animation of any configured picture before going on-line with the programmable controller. On-line system: \$22,000, graphics-development package: \$9,495. **Industrial Data Terminals Corp.**, 173 Heatherdown Dr., Westerville, Ohio 43081, (614) 882-3282.

Circle No 301

ISOs RESERVE THESE DATES...APRIL 5, 6, 7, 1984



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New Products

SYSTEMS

MS-DOS-based micros are host-specific terminals

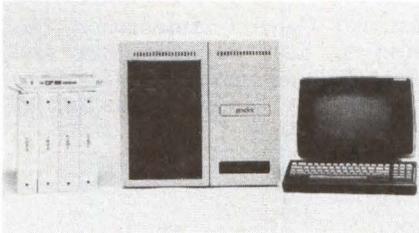
The Series 1600 systems operate as both MS-DOS-based, 16-bit microcomputers and as full-function, host-specific terminals, allowing users to transfer data between the host and the personal computer. The Intel 8088 microprocessor-based systems have 128K bytes of dynamic memory, 64K bytes of terminal display memory, two 5¼-inch, 320K-byte floppy disk drives and two RS232C asynchronous communications ports for



connection to the host or a printer. The model 1625 is host-compatible with the HP 3000. It has an application-specific keyboard and provides an HP terminal personality with block-mode capabilities. The model 1631 has a DEC VT100 terminal personality and complies with the ANSI X3.64 standard. \$3,995 each. Delivery is 60 days after receipt of order. **Direct Inc.**, 4201 Burton Dr., Santa Clara, Calif. 95051, (408) 980-1414. **Circle No 302**

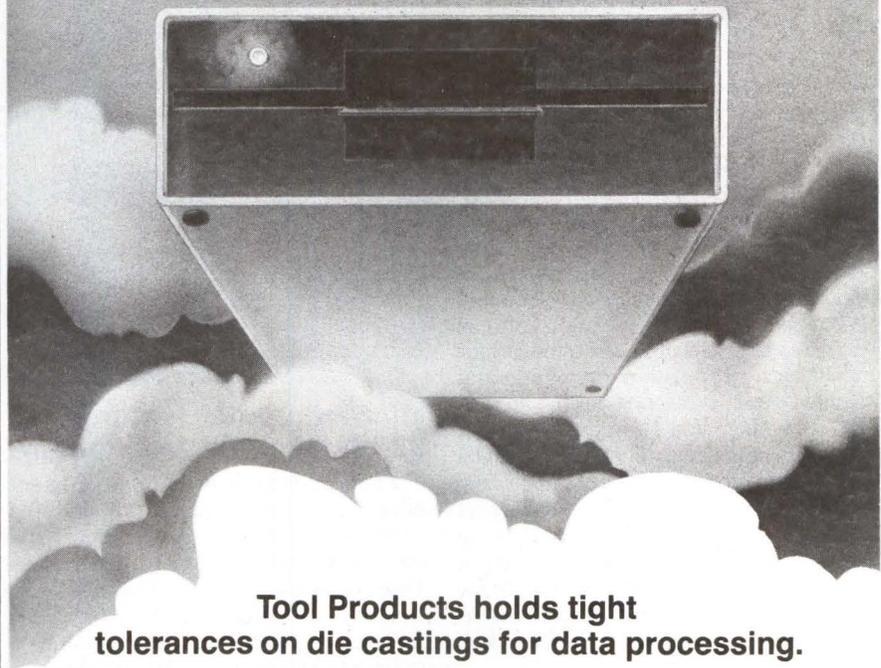
CP/M-86 microcomputers offer configuration options

The model 95/36A CP/M development system offers flexibility and versatility to engineers who need Multibus capabilities and want the ease of use and small RAM requirements of CP/M-86. The systems are housed in an integrated chassis that provides three 8-inch peripheral slots and nine Multibus card slots or in a two-part modular chassis, one with two 8-inch peripheral slots and a second with nine Multibus card slots. Both chassis can be used in a standard 19-inch rack or as tabletop units. The systems include an 8086-based ZX-86 CPU board that comes with CP/M-86 and any of three single-board disk controllers. The 95/36A supports a dual-serial port on the ZX-86 board with I/O drivers for CP/M-86. Users have a choice of 128K,



256K or 512K bytes of RAM with parity or 512K bytes of RAM with ECC. Drive options comprise one or two half-height, 1M-byte floppy disk drives and 10M-, 20M- or 40M-byte Winchester disk drives. Prices start at \$8,545. **Zendex Corp.**, 6644 Sierra Lane, Dublin, Calif. 94568, (415) 828-3000. **Circle No 303**

THE DRIVE TO SUCCEED.



Tool Products holds tight tolerances on die castings for data processing.

They may be called floppies, but there's nothing loose about the tolerances required on castings for 5¼ and 8-inch disk drive units. That's why Tool Products gets the call for close tolerance parts like base castings, head arms and motor mounts.

We're tackling castings for Winchester drives, too. And there's nothing easy about casting hard disk components. But we're providing the same kind of consistent quality, meeting the most demanding specifications you can imagine. For example, we deliver a motor mount that's bored to an accuracy of $\pm .001$ ". We supply a head arm that consistently meets a flatness requirement of $.0005$ ". And we deliver both parts in volume.

A lot of people said this kind of accuracy was impossible at this high level of production. But we delivered because we have the state of the art facilities and equipment to provide the precision required. We have the experienced people it takes to find innovative solutions to tough casting and finishing problems. And we have the drive to succeed. Got a tough one? Call Tool Products and put that kind of drive to work for you.



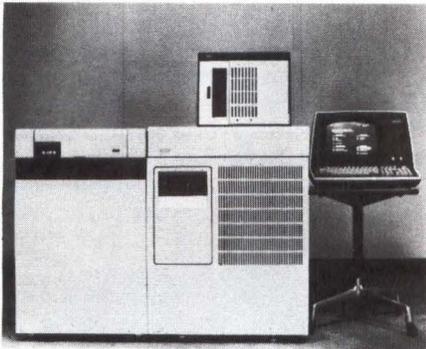
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CIRCLE NO. 160 ON INQUIRY CARD

New Products

SYSTEMS



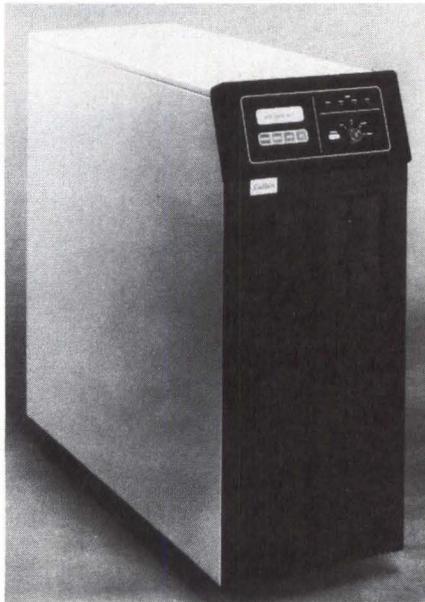
Wang expands VS family with 32-bit VS 85

Featuring the Wang VS family's 32-bit architecture, the VS 85 minicomputer is packaged for small- to medium-sized office environments to meet their word-processing, document-transfer, graphics, program-development, database-management, data-entry and file-maintenance needs. The VS 85 offers graphics, as much as 4G bytes of standard disk-storage capacity, support of 32 concurrent users and optional WangNet and other telecommunications capabilities. Programming languages include COBOL, FORTRAN, BASIC, RPG II, PL/I, assembler and Procedure. A basic VS 85 encompassing a 32-bit CPU, 1M byte of main memory, the VS operating system, assembler language, a 16-port serial I/O processor, an archiving workstation and a compiler is priced at \$63,000. **Wang Laboratories Inc.**, One Industrial Ave., Lowell, Mass. 01851, (617) 459-5000. **Circle No 304**

16-bit microcomputer runs Pick operating system

The Zebra 2500 microcomputer uses the 68000 microprocessor and the Pick operating system. The operating system provides database-management facilities and virtual-memory operations and features Access, an information-management and -retrieval language that employs English phrases and statements. The computer also includes software packages for word processing, spreadsheet analysis and business graphics. The basic hardware configuration comprises 256K bytes of RAM, a Multibus controller for as many as 10 asynchronous ports, a 35M-byte Winchester disk drive and a 1/4-inch streaming magnetic-tape drive.

\$21,425. **General Automation Inc.**, 1045 S. East St., P.O. Box 4883, Anaheim, Calif. 92803, (714) 778-4800. **Circle No 305**



Microcomputer features 32-bit machine architecture

The Unistar 300, a 68010-based microcomputer, features 32-bit architecture that supports virtual memory and the UNIX System V operating system. User benefits of UNIX System V are faster C compiler execution and new features such as inter-task communications via shared memory, semaphores and messages. The product can be used as a single workstation for CAD/CAM or other computation-intensive applications or in multiuser office-automation systems. The computer also offers as much as 2M bytes of memory with parity checking and no wait states. Its 5 1/4-inch Winchester mass-storage system accommodates one to four drives with one or more DMA-based controllers. Hard disk capacities range from 40M to 160M bytes; 5 1/4-inch floppy disks can also be used. Streaming-tape backup provides image or selective file restoration on 45M-byte tape cartridges. The computer supports Ada, BASIC Plus, COBOL, FORTRAN 77, Pascal and assembler languages. Prices start at \$20,000. **Callan Data Systems**, 2645 Townsgate Rd., Westlake Village, Calif. 91361, (213) 991-9156. **Circle No 306**

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MINI-MICRO SYSTEMS/February 1984

DON'T PAY MORE FOR A PRINTER THAT DELIVERS LESS.

COMPARISON CHART

	Printing speed (cps)	Avg. hours before repair*	User-changeable multiple interfaces	Mfr's suggested retail price
Diablo 630 API	40	4,000	YES	\$2340
NEC 7700 Series	55	2,000	NO	\$2595
Qume SPRINT 11/55 PLUS	55	5,500	YES	\$1990

Qume's
SPRINT 11/55 PLUS™
 outperforms NEC**
 and Diablo† for a
 lot less money.

A simple comparison tells the whole story. Qume's new SPRINT 11/55 PLUS™ daisywheel printer is tops in performance, with a steady speed of 55 characters per second. Print quality that's second to none. And the industry's best reliability rating—equal to almost three years of all-day, five-day-a-week business use without a single repair.

That's nearly a year longer than its closest rival.

And the SPRINT 11/55 PLUS is a perfect fit for most popular business computers, via our inexpensive plug-in interface modules.

That means you won't have to change printers when you upgrade your current system.

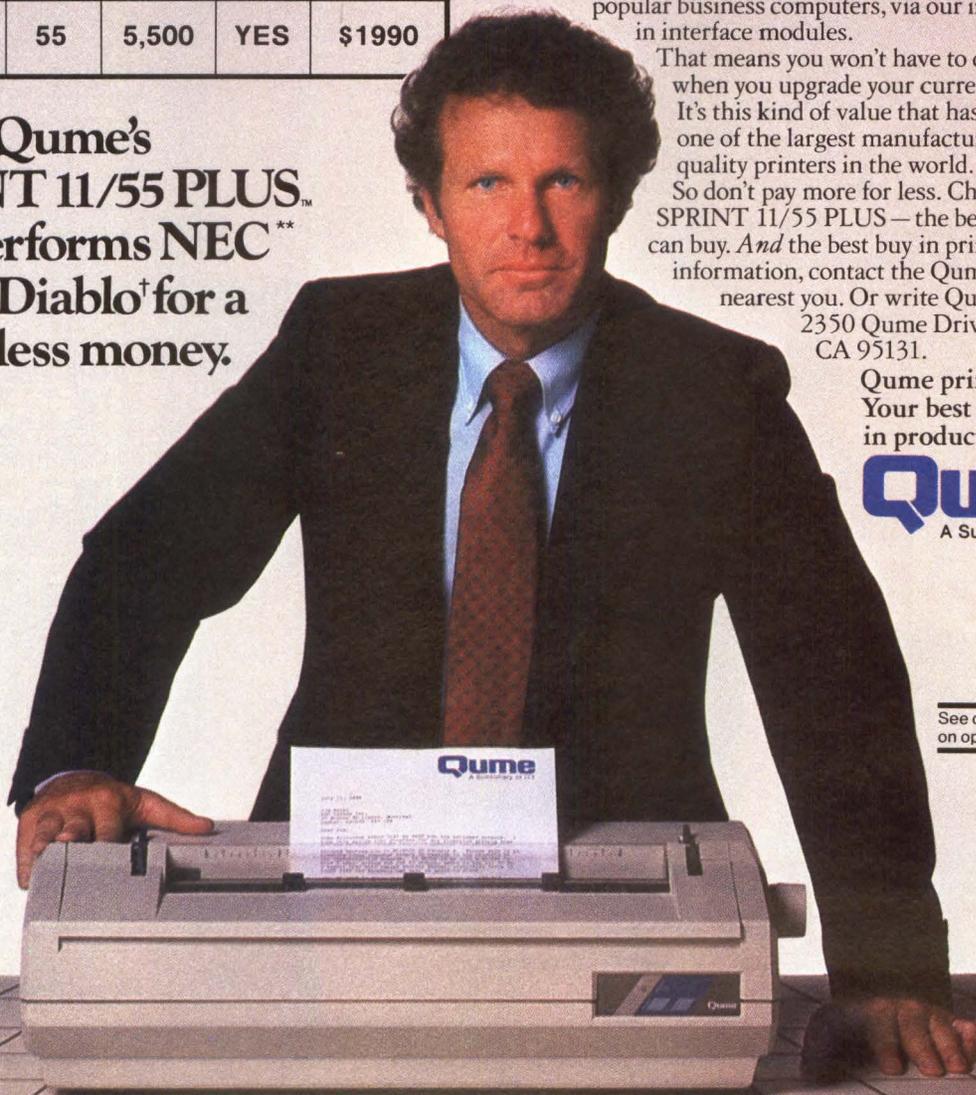
It's this kind of value that has made Qume one of the largest manufacturers of letter-quality printers in the world.

So don't pay more for less. Choose Qume's SPRINT 11/55 PLUS—the best printer you can buy. And the best buy in printers. For more information, contact the Qume distributor nearest you. Or write Qume Corporation, 2350 Qume Drive, San Jose, CA 95131.

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See distributor listing
 on opposite page.



*Mean Time Before Failure at 25% duty (manufacturer's published data)

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CIRCLE NO. 161 ON INQUIRY CARD

FACIT

TWIST The Facit Twist Video Terminal can be viewed from an entirely new angle: a real multipurpose workstation with a large, dual display monitor that can be tilted, lifted and even twisted, to suit any operator's convenience.

The Twist capability means that you can use the conventional landscape format (24 lines by 80 characters) to display large detailed characters – or you can Twist the monitor to portrait format (72 lines by 80 characters) to display the information in full-page layout.

The flickerfree screen with superb video quality allows any number of positioning possibilities. Added features include a super-slim, ergonomically designed keyboard and a strikingly small footprint.

When comparing terminals, think professionally. Contact Facit – we'll introduce you to our whole family of video terminals.



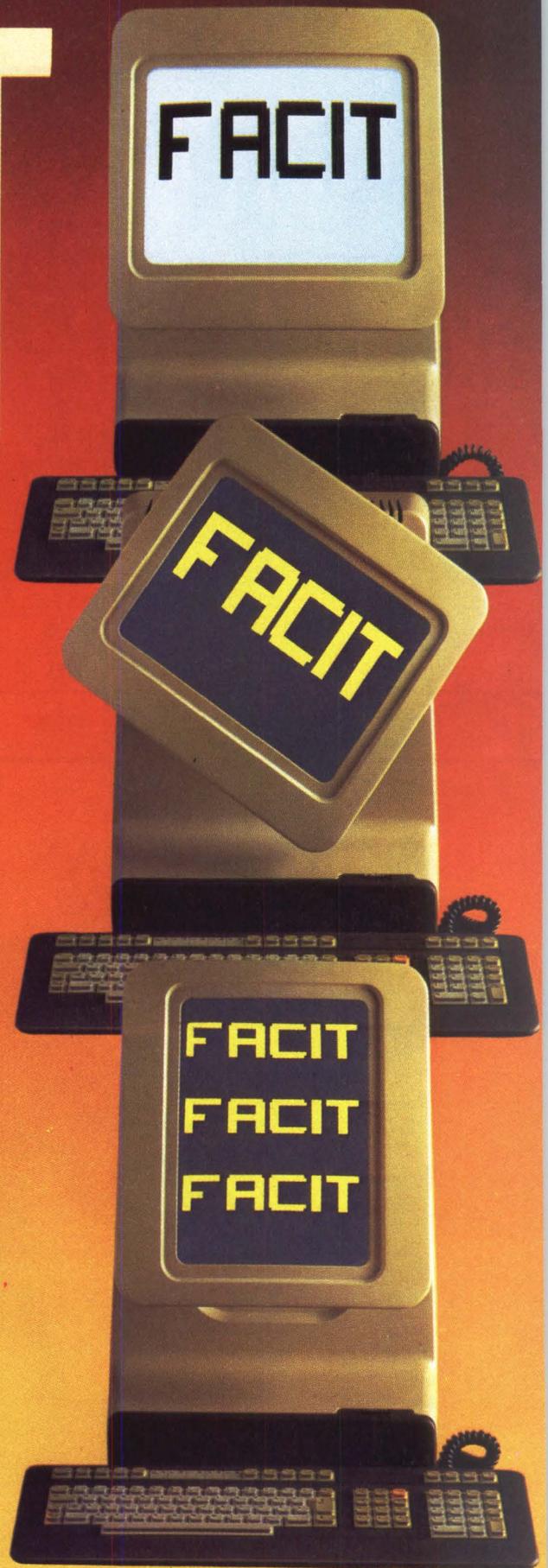
Facit 4420 and Facit 4431 Smart Video Terminals are other Facit VDT alternatives with numerous user-oriented features for optimum operator comfort.

CIRCLE NO. 162 ON INQUIRY CARD

FACIT

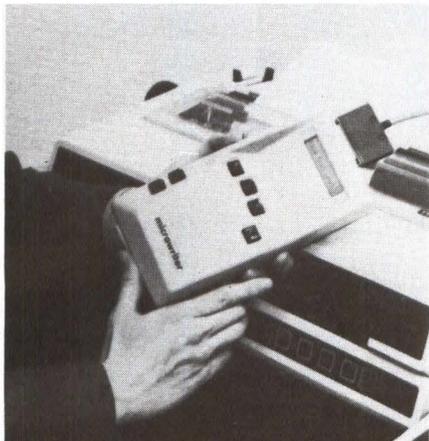
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USA: 235 Main Dunstable Road. P.O. Box 828, Nashua, N.H. 03061. Phone: (603) 883-4157.



New Products

SYSTEMS



Hand-held word processor has 8K-byte memory

With the Microwriter, a 2-pound, six-key, hand-held word-processing system, users can build characters by pressing key combinations with one hand. The vendor claims that the time to learn the system is 1 hour. The unit has 8K bytes of non-volatile memory and a one-line LCD. An RS232C port connects the system to a printer or a CRT terminal. The Microwriter also includes a cassette interface. The system measures 9 by 9 by 2 inches and uses nickel-cadmium batteries with a 30-hour life. Text-editing features include review, delete, insert and formatting. \$499. **Microwriter Inc.**, 17 E. 71st St., New York, N.Y. 10021, (212) 288-8863.

Circle No 309



Transportable computer is Q-bus based

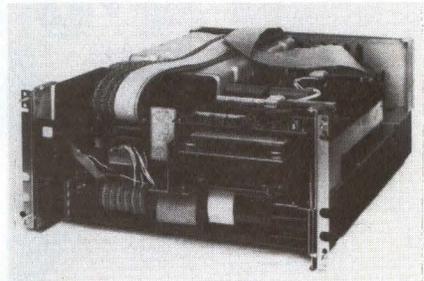
The Andromeda 11/M12 transportable computer features an LSI-11/23 CPU with memory management, 256K bytes of RAM, a half-height, 10M-byte Winchester disk drive, a half-height, 512K-byte floppy disk drive and four serial ports offering RS232C and 20-mA

current loop. The compact package also contains a spare card slot, operator controls and a power supply in a 13-by-15-by-4-inch envelope. The unit runs standard DEC software including RT-11, TSX-Plus or RSX-11M. It connects to any standard CRT terminal. When connected to a modem, it becomes an intelligent workstation with dial-up connection to a database or host in the home office. \$8,400. **Andromeda Systems Inc.** 9000 Eton Ave., Canoga Park, Calif. 91304, (213) 709-7600.

Circle No 310

Minicomputers execute Nova instruction set

The Dancer line of Nova-compatible minicomputers features the 16-bit Fairchild 9445 microprocessor, a 128K-byte extended bit memory and a 256K- or 512K-byte mapped memory. This line executes an extended Nova instruction set and is software compatible with RDOS, IRIS, BLIS/COBOL, BITS-



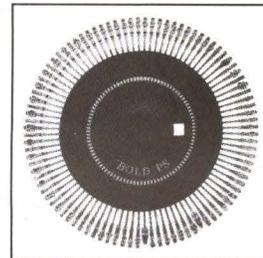
BASIC and MICOS operating systems. The computers incorporate 8-inch, SMD-type Winchester disk drives with appropriate tape backup. Five standard configurations offer 40M, 80M, 160M and 212M bytes of fixed Winchester disk storage with cartridge tape backup and a 25M-byte fixed/25M-byte removable disk drive. A nine-user system containing an 80M-byte Winchester disk drive, a 45M-byte cartridge tape drive and one parallel printer port is priced at \$10,800. **Rianda Electronics**, 2525 Via Palma, Anaheim, Calif. 92801, (714) 995-6552.

Circle No 311

Make it snappy.



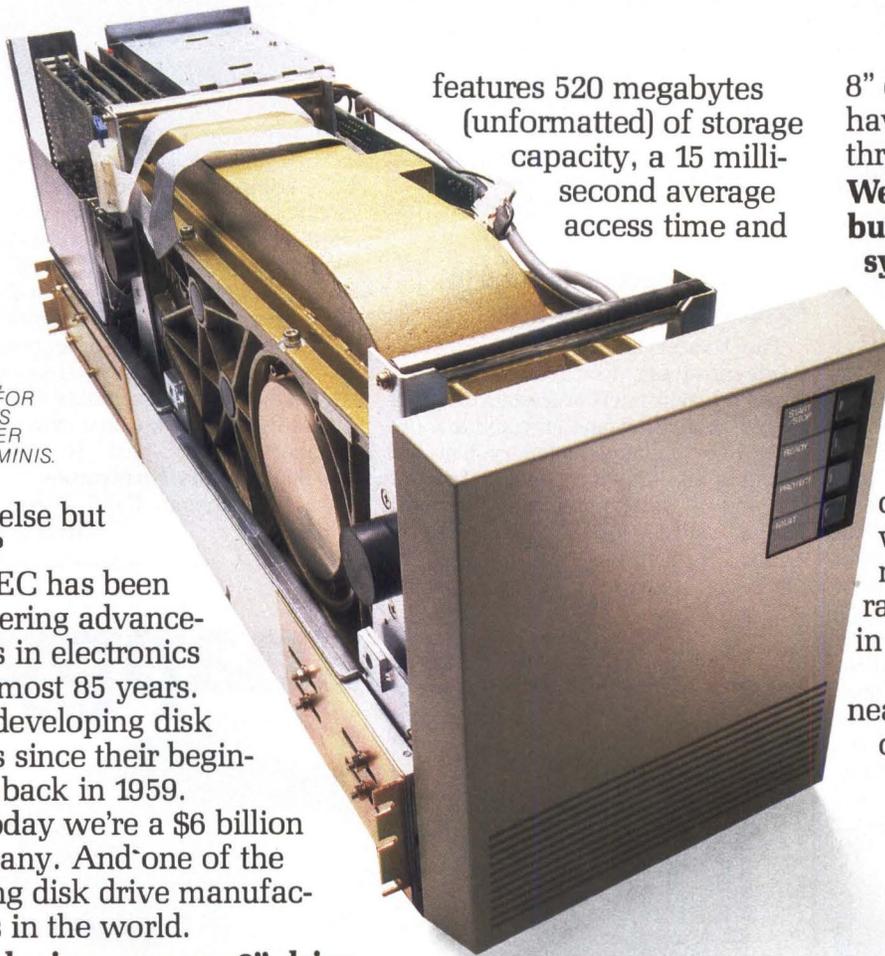
When a printed page has to represent your whole company, it'd better look sharp. Our DP-35 and DP-55 daisywheels rival the finest office typewriters for crisp clean impressions. And they zip along at just about a page a minute. Call your printer distributor. Or contact Dataproducts at (213) 887-3924, 6200 Canoga Avenue, Woodland Hills, CA 91365. In Europe, 136-138 High Street, Egham, Surrey, TW 20 9HL England.



Dataproducts Daisywheel Printers

CIRCLE NO. 163 ON INQUIRY CARD

WHO ELSE COULD FIT 520MB, 20 YEARS OF EXPERIENCE AND A \$6 BILLION COMPANY INTO A 9" DISK DRIVE?



features 520 megabytes (unformatted) of storage capacity, a 15 millisecond average access time and

8" drive that NEC customers have been using for the past three years.

We know what systems builders need. We build systems too.

That gives us an edge over other drive companies. Because it gives us a special insight into the needs of a systems builder.

The D2300 is extremely compact. At just 8½" wide, two drives can be mounted in a single 19-inch rack for a storage capacity in excess of one gigabyte.

For the name of your nearest NEC representative, call 1-800-343-4418 (In Massachusetts, call 617-264-8635). You'll discover why more and more systems builders are saying "NEC and me."

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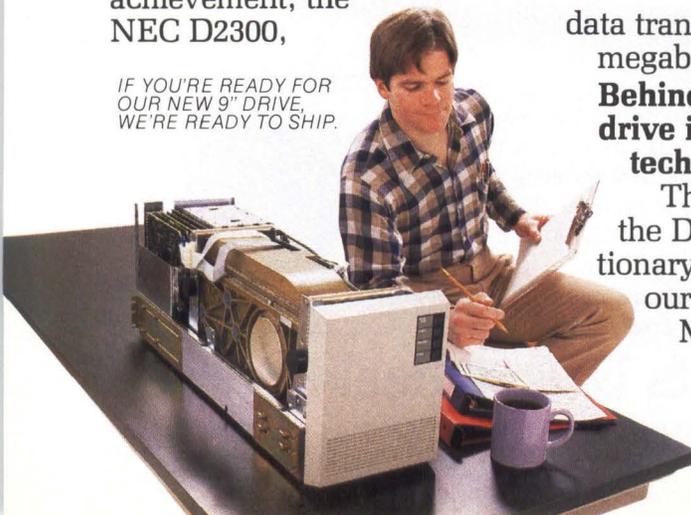
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NEC Information
Systems, Inc.
1414 Mass. Ave.
Boxborough, MA
01719



CIRCLE NO. 164 ON INQUIRY CARD

Products

SYSTEMS



System runs version of TSX-Plus

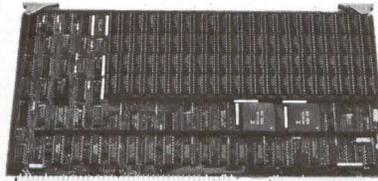
Built around the DEC LSI-11/23 CPU, the SMS Micro/TSX-plus computer accommodates three users, expandable to 16; provides 15.9M bytes of hard disk storage; and is compatible with PDP-11 software. The system runs a microcomputer version of the DEC-compatible TSX-Plus operating system. This operating system offers transparent print spooling, system administrative control, shared-file record locking, data and directory caching and a performance-analysis facility. Priced at \$11,000, the computer supports three user-supplied DEC VT100 terminals and one serial printer running at 9,600 baud. Expansion is accomplished by upgrading the Micro-TSX operating system to a full TSX-Plus software license and adding groups of four serial ports and 256K-byte memory modules. **S&H Computer Systems Inc.**, 1027 17th Ave. S., Nashville, Tenn. 37212, (615) 327-3670. **Circle No 312**

Rainbow features 10M-byte Winchester

The Digital Equipment Corp. Rainbow 100+ computer features an integrated 10M-byte Winchester disk drive and 128K bytes of system memory, expandable to 896K bytes. The computer is supported by new versions of MS-DOS and CP/M-86/80 and is compatible with more than 750 application packages including Lotus 1-2-3. Priced at \$5,475, it also comprises Z80A and 8088 microprocessors, dual 400K-byte floppy disk drives, synchronous/asynchronous communications, a built-in terminal emulator and a printer port. White, green or amber monochrome monitors and a low-profile keyboard are available. **Digital Equipment Corp.**, Maynard, Mass. 01754. **Circle No 313**

CHRISLIN MEMORY

MULTIBUS MEMORY 512KB TO 2 MB EDC

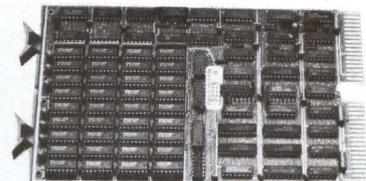


- Error Detecting and Correcting (EDC).

SINGLE QTY. PRICE:

	Without/EDC	W/EDC
512KB	\$ 895.00	\$1495.00
2MB	\$5995.00	\$6495.00

LSI 11 MEMORY 256KB TO 1 MB



- Control Status Register (CSR)
- On board parity generator checker.
- Battery back-up mode.

SINGLE QTY. PRICE:

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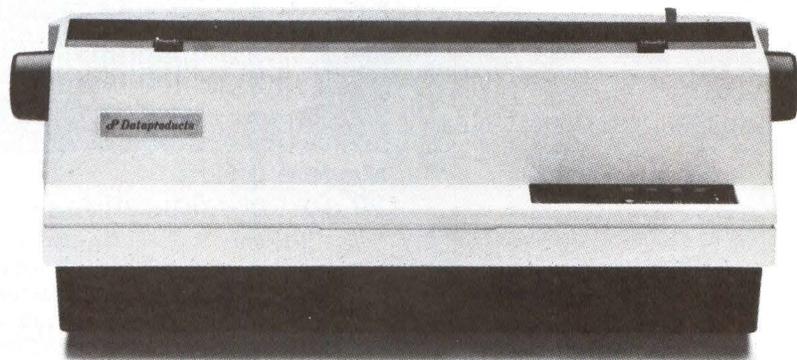
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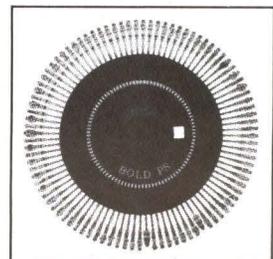
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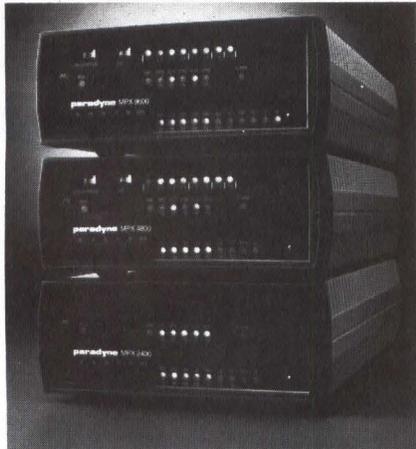


Dataproducts Daisywheel Printers

CIRCLE NO. 175 ON INQUIRY CARD

New Products

DATACOMM



Low-power modems use custom-designed chips

The MPX series of 2,400-, 4,800- and 9,600-bit-per-second synchronous modems employs a custom-designed LSI chip set constructed with NMOS and CMOS LSI technology. These modems consume 18W to 23W, weigh 5½ pounds and measure 3½ by 8½ by 18 inches. By incorporating an LSI microprocessor, they permit point-to-point or multipoint leased four-wire configurations. They operate on unconditioned phone lines and provide automatic, adaptive line equalization at all speeds. The 4,800- and 9,600-bps models have a four-port buffered multiplexer option, and the MPX family provides a CCITT V-Series compatibility mode. \$950 to \$3,400. **Paradyne Corp.**, 8550 Ulmerton Rd., P.O. Box 2826, Largo, Fla. 33540, (813) 530-2000. **Circle No 314**



Ethernet transceiver connects multiple devices

The model 2100 MultiPort Ethernet transceiver connects multiple computing devices to a coaxial-cable node or operates those devices as a standalone mini-network. It runs at 10M bits per

second and accepts as many as eight transceiver modules and one station module. Computing devices connect to transceiver modules with transceiver cables in the same manner as they connect to Ethernet transceivers. The station module connects to an Ethernet transceiver, which attaches to a network coaxial cable or to a mini-network adapter, allowing the computing devices and the MultiPort transceiver to operate as a standalone mini-network. Linking the station module to an Ethernet network via a standard transceiver permits computing devices attached to the MultiPort transceiver to become part of the network. \$441.80. **TCL Inc.**, 2066B Walsh Ave., Santa Clara, Calif. 95050, (408) 727-3800. **Circle No 315**



Modem offers 10 port configurations

The 9600/M, a 9,600-bit-per-second synchronous modem, suits network applications on domestic and international leased lines. Its nominal transmission rate can be reduced to 7,200 or 4,800 bps in the event of degraded line quality. Operating in a multipoint mode, the modem provides as many as four low-speed data channels with the same high-speed transmission path. Selectable from the modem front panel are 10 separate multipoint configurations, which can use varying port bit rates. Simulated controlled carrier operation, with different RTS-CTS delays, is provided for each port. This feature enables connection of remote 2,400- and 4,800-bps multipoint links to the central site via a multiplexed 9,600-bps link.

Loop-back tests, including analog, digital and line loop backs, can be initiated from the front panel. Prices start at \$3,650. **Kinex Corp.**, 6950 Bryan Dairy Rd., Largo, Fla. 33543, (813) 541-6464. **Circle No 316**

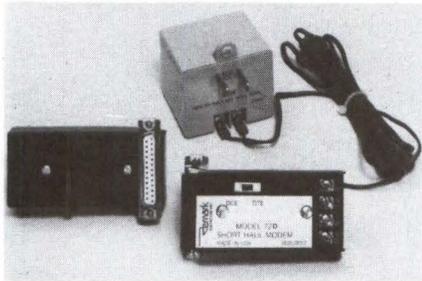


Multiplexers link workstations to copier

These video multiplexers connect multiple graphics video terminals to one video copier. The KMS 8V multiplexer connects as many as eight monochrome or color composite video terminals. Additional 8V multiplexers can be interconnected to add more video inputs in groups of eight. The KMS RGB multiplexer connects as many as four video terminals with RGB outputs. Additional RGB multiplexers can be interconnected to add more video inputs in groups of four. The multiplexers accommodate continuous, unattended operation with automatic copiers such as Tektronix video hard-copy units, the Polaroid model 4 or the Polaroid Matrix 3000. Model 8V: \$1,500, model RGB: \$1,750. **KMS Advanced Products Inc.**, 3941 Research Park Dr., Ann Arbor, Mich. 48104, (313) 769-8500. **Circle No 317**

Modems operate with DEC VT100 terminals

Usable with the Digital Equipment Corp. series of VT100 CRT terminals, the model 72D short-haul modem allows VT100-type terminals to operate at speeds to 19,200 baud and at distances as far as 1 mile from the computer. At decreased baud rates, the terminals can be placed as far as 2 miles away at 9,600 baud and 10 miles away at 1,200 baud. The modem operates asynchronously over two twisted pairs having end-to-end DC continuity. The transmission scheme features a balanced current loop. Opto-couplers provide isolation



between subsystems. A built-in switch allows interfacing with data-communications-equipment or data-terminal-equipment devices. \$130. **Telebyte Technology Inc., Remark Datacom Division**, 148 New York Ave., Halesite, N.Y. 11743, (516) 423-3237.

Circle No 318

Data concentrator multiplexes eight terminals

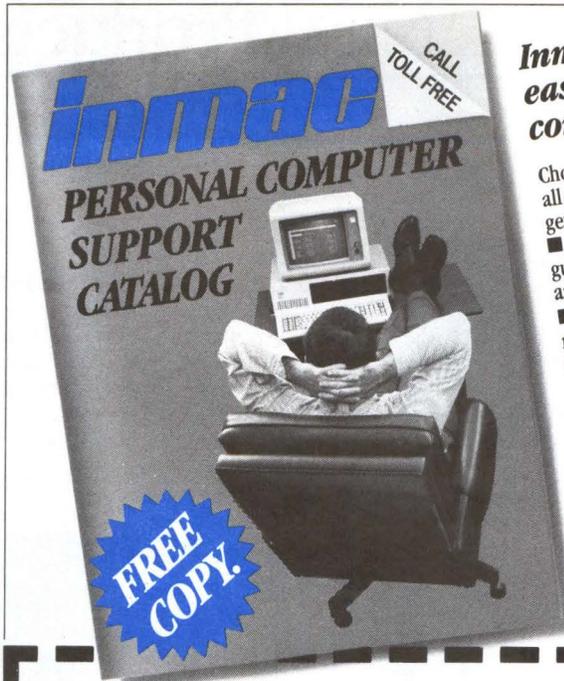
The Gen*Net 1261 data concentrator multiplexes four or eight asynchronous terminals over a single communications link with composite data rates as high as 19,200 bits per second. It also offers 15 channel data rates, down-line loading, diagnostics, CCITT compatibility and local echoplex. Four-channel model: \$1,330 (two units), eight-channel model: \$2,090 (two units). **General DataComm Industries Inc.**, 1 Kennedy Ave., Danbury, Conn. 06810, (203) 797-0711.

Circle No 319

IBM PC modem operates at 110 to 1,200 bps

The Info-Mate 212PC Bell 212A-type modem plugs directly into the IBM PC, XT or IBM-compatible personal computers such as the Eagle, Compaq or Corona. It includes a Modem-Mate data-communications software package and provides asynchronous data communications at 110, 300 or 1,200 bps. It supports auto dial, answer, speed select, parity select and tone- or pulse-dialing select and electronic call progress tone detection of dial, busy, ring-back and modem answer tone. The software allows users to transmit and receive files, transmit or receive information at full or half duplex, log modem data on a printer and maintain a 60-entry phone directory. \$495. **Cermetek Microelectronics**, 1308 Borregas Ave., Sunnyvale, Calif. 94089 (408) 734-8150.

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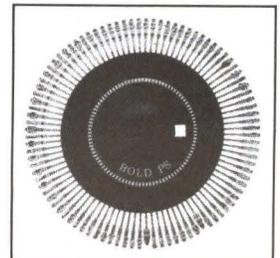
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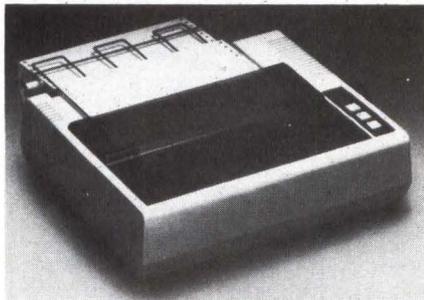


Dataproducts Daisywheel Printers

CIRCLE NO. 166 ON INQUIRY CARD

New Products

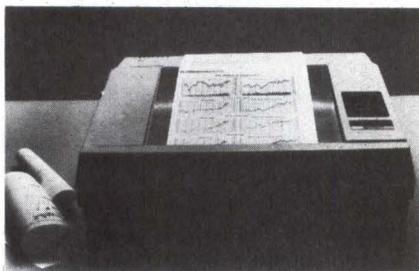
PRINTERS



100-cps printer features multiple font styles

The R series impact dot-matrix printer provides a 100-cps print rate, multiple font styles, graphics with a selectable 1:1 aspect ratio, seven text print modes with 32 character-size and pitch combinations and elite or pica character print spacing. Programmable print modes include 9 by 18 (double strike), 18 by 9 (emphasized), 18 by 18 (near letter quality) and enlarged (twice character width). Print direction is bidirectional in text mode and unidirectional in bit-image mode. Other key features include two 96-character ASCII character sets with descenders plus 11 international character sets. A Centronics-style 8-bit parallel interface is standard; IEEE 488 and RS232C interfaces are optional. \$494, RX-80. Delivery is 120 days. **Epson America Inc., Printer Product Group, OEM Products Division**, 3415 Kashiwa St., Torrance, Calif. 90505, (213) 534-0306.

Circle No 321



Plotter has IEEE-488 interface

The v-80 printer/plotter with an IEEE-488 interface serves engineering workstations. It plots an A-sized drawing in as little as 8.5 seconds and a B-sized drawing in as little as 17 seconds. It prints bills of materials, schedules and listings at speeds as high as 1,000 lpm. on roll or fan-fold paper.

The unit employs a non-impact, electrostatic writing technique. The product allows plotting of data formatted for 100 or 200 points per inch, printing of as many as 256 unique characters and character underline. Prices start at \$7,444 (OEM quantities). **Versatec**, 2710 Walsh Ave., Santa Clara, Calif. 95051, (408) 988-2800. **Circle No 322**

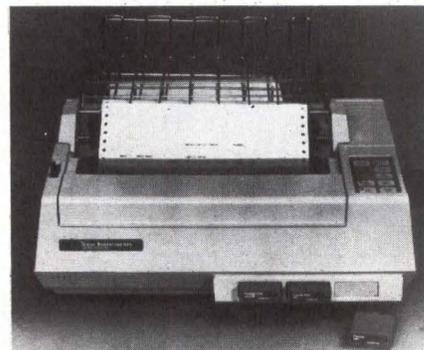


Document printer targets financial, industrial markets

The DP4 document/passbook printer is a dot-matrix impact unit that prints on documents as large as 8½ inches wide and as small as 2½ inches square. The printer automatically compensates for variable thicknesses including six-part carbon forms and 16-page passbooks. Documents are moved at 8 ips and printed at 150 cps. The unit features a 32-character alphanumeric display for operator messages, a 16-key data-input pad, an easy-loading cartridge ribbon and self-diagnostics. \$2,000 (OEM quantities). **Craden Peripherals Corp.**, 204 Cooper Center, North Park Drive, Pennsauken, N.J. 08109, (609) 488-0700. **Circle No 323**

Printer's font modules act as electronic daisy wheels

The Omni 800 model 855 dual-mode dot-matrix printer provides letter-quality printing for word-processing and draft-quality printing for data-processing applications. The printer delivers 35-cps printing using a 32-by-18-dot-matrix format in the letter-quality mode and 150-cps using a 9-by-9-dot-matrix format in the draft-quality mode. The unit is compatible with industry-standard escape codes, featuring Epson, Qume and Diablo data streams. It can print an original and two



copies and can accommodate 3- to 11-inch-wide paper. The printer accepts three cartridge font modules. Font styles include Courier, Courier italics, Prestige elite, Modern proportional space, Gothic and Orator. Friction-feed model: \$935, tractor-feed model: \$995. **Texas Instruments Inc., Data Systems Group**, P.O. Box 402430, H-669, Dallas, Texas 75240, 1(800) 527-3500.

Circle No 324



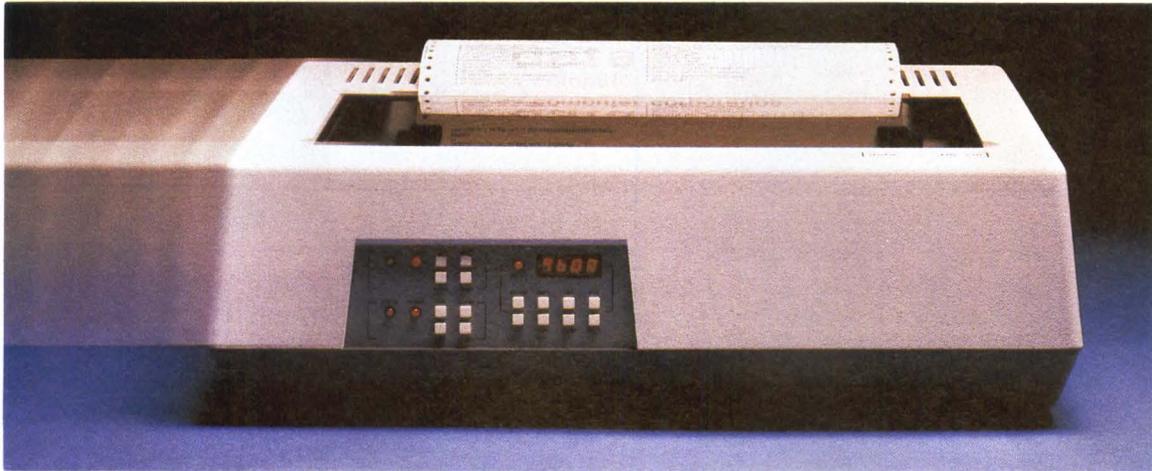
Non-impact printers output seven colors

This family of four non-impact printers provides seven-color, near-letter-quality printing with bit-mapping and addressable graphics capability. The printers use plain paper, letter-head, copier paper, envelopes or vinyl sheets. They use a technique in which ink, coated on film or paper, is melted from an 11-dot-matrix print head and transferred to the paper. Model BCT-3010 has a 10-inch-wide carriage and prints 80 characters per line at 30 cps. Model BCT-3015 has a 15-inch-wide carriage and prints 140 cpl at 30 cps. Model BCT-8010 has a 10-inch-wide carriage and prints 96 cpl at 80 cps. Model BCT-8015 has a 15-inch-wide carriage and prints 142 cpl at 80 cps. \$399 to \$899. **Blue Chip Electronics Inc.**, 7406 E. Butherus Dr., Scottsdale, Ariz. 85260, (602) 991-9833.

Circle No 325

HIGH PERFORMANCE

LONG DISTANCE RACER



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MORE CHARACTER

The printhead on a Datasouth printer is rated to live through 500 *million* characters. Even in the most demanding applications, this means years of service without an overhaul.

HEAVY DUTY CYCLE

For a Datasouth printer, "100% duty cycle" is something of an understatement. So far, over 35,000 Datasouth printers have hit the hard copy road, and so few have pulled into the garage for repairs, it's hard to say how close to forever any of them will last.

MORE THAN THE HUM OF ITS PARTS

There's less to go wrong with a Datasouth printer. With sophisticated microprocessor control and unusually

efficient design, Datasouth printers have few moving parts. They also don't need add-on "personality boards" to accommodate different computers.

TAKE YOUR CHOICE

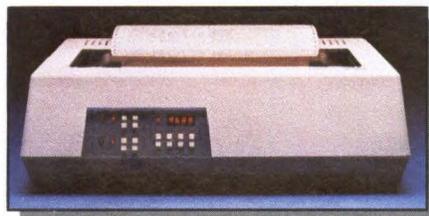
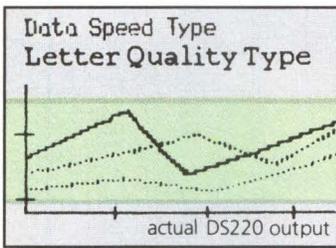
Datasouth reliability comes in two high performance models. The DS180 is a legendary workhorse that delivers crisp data quality printing at 180 CPS. The new multimode DS220 cruises at 220 CPS for high speed data printing and at 40 CPS for letter-quality word processing. Both models print precision dot-addressable graphics.

If you have a high performance printing need,

Datasouth has a high performance printer to fill it.

DRIVE ONE TO WORK

Test drive a Datasouth printer at your nearest showroom today. Then put it to work. With a Datasouth racing beside you, there's no way to lose.



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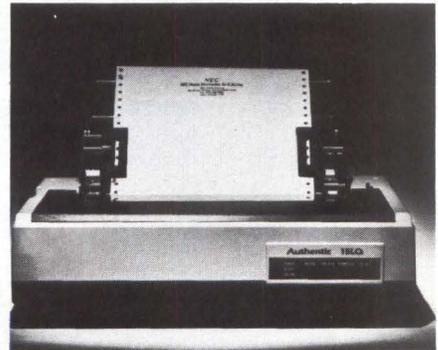
New Products

PRINTERS

Dot-matrix unit prints at 50 cps

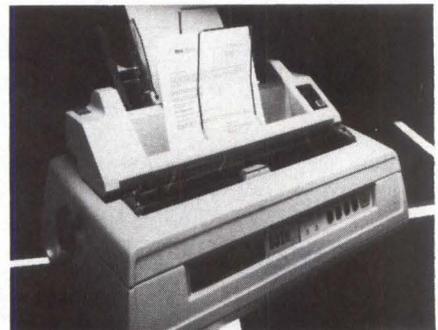
The 80-column, tractor-feed, dot-matrix Banana printer prints alphanumeric or graphics at 50 cps on fan-fold forms from 4½ to 10 inches wide. Characters are printed in a 5-by-7-

matrix. Character sets include U.S., U.K., German and Swedish. In the dot-addressable graphics mode, print density is 63 by 60 dpi. A Centronics-type parallel interface comes standard. \$249.95. **Leading Edge Products Inc.**, 225 Turnpike St., Canton, Mass. 02021, 1(800) 343-6833. **Circle No 326**



Daisy-wheel printer operates at 14 cps

The Authentic 15-LO daisy-wheel printer prints Shannon text bidirectionally at 14 cps. It prints a maximum of 101, 121 or 151 characters per line at 10, 12 or 15 cpi. With appropriate software, it supports word-processing functions such as boldface, superscript, subscript and automatic underlining. A Centronics-type parallel interface is standard. \$695 including tractor feed. **NEC Home Electronics U.S.A. Inc.**, 1401 Estes Ave., Elk Grove Village, Ill. 60007, (312) 228-5900. **Circle No 327**



Letter-quality printer fits office environment

The model 8010 bidirectional, solid-font, impact printer is plug compatible with the IBM 3270 product family and can be connected to a Trivex 8074, IBM 3274 or IBM 3276 controller. The printer can be equipped with a pin-feed continuous-forms tractor or a dual cut-sheet forms feeder. Both forms feeders accommodate forms from 3 to 16 inches wide as well as envelopes, labels and multipart forms. The printer prints as many as 99 lines per form and as many as 136 characters per line at 55 cps. \$5,235. **MDS Trivex**, 3180 Red Hill Ave., Costa Mesa, Calif. 92626, (714) 546-7781. **Circle No 328**

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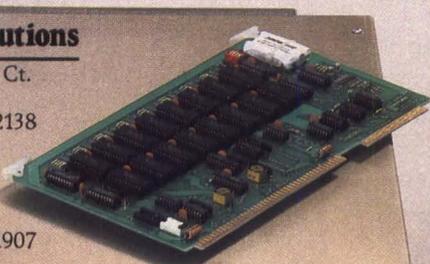
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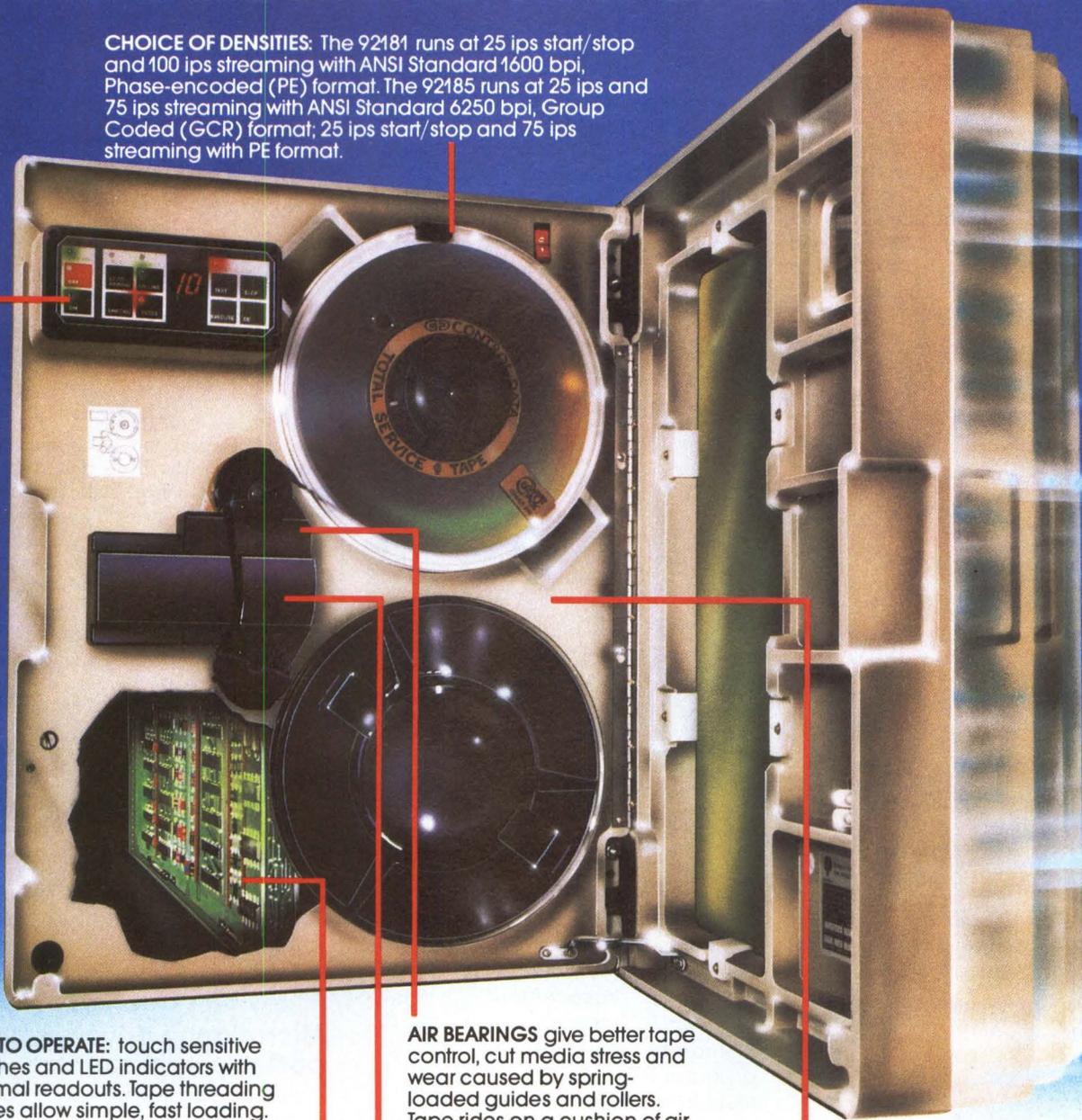


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GD CONTROL DATA

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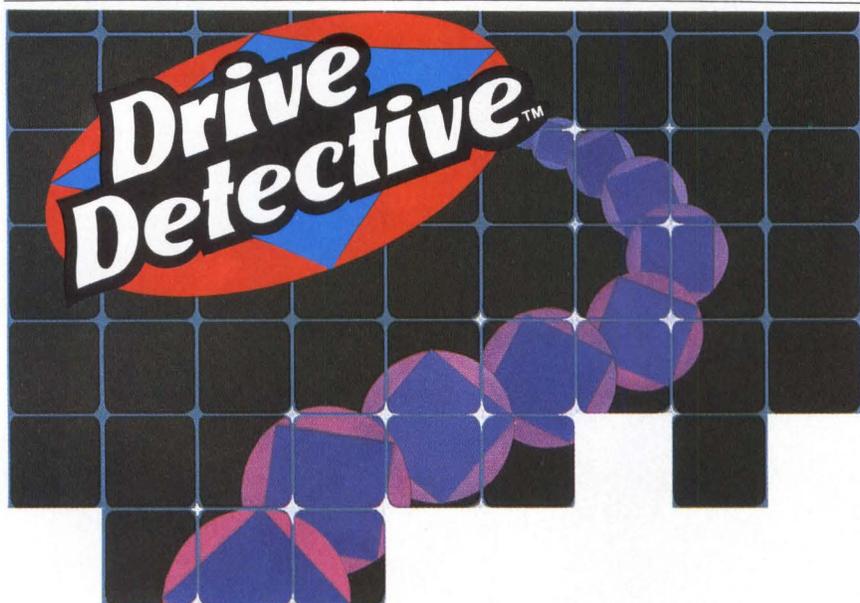
New Products

DISK/TAPE

Half-height Winchester store 31.46M bytes

Because they employ a space-saving inside hub spindle motor that enables the use of multiple platters in half the height of a standard minifloppy package, these half-height Winchester disk drives achieve formatted storage capac-

ities as high as 31.46M bytes. The one-platter model TL213 stores 10.48M bytes (formatted), the two-platter model TL226 stores 21M bytes (formatted), and the three-platter model TL240 stores 31.46 bytes (formatted). The drives feature plated media, automatic spindle brake and actuator lock, a dedicated head-landing/shipping zone,



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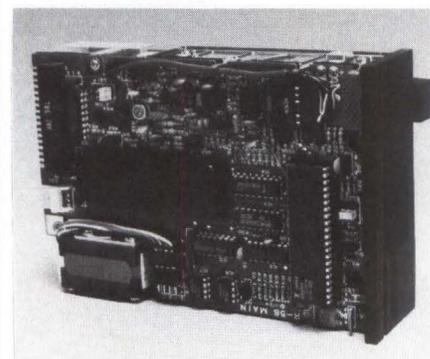
First and still foremost in media duplication and test technology

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four-point shock mounting and internal diagnostics. All three drives use the ST-506/412 interface. Data-transfer rate is 5M bits per second; average access times are 95 msec. Model TL213: \$650 (500 units), model TL226: \$850 (500 units); model TL240: \$1,055 (500 units). **Tulin Corp.**, 2393 Qume Dr., San Jose, Calif. 95131, (408) 942-9025.

Circle No 329

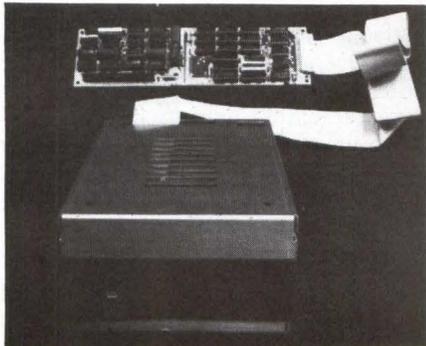


Microfloppy drives suit portable applications

Designed for use in battery-powered portable equipment, the SMD-100 series of four low-power, 3½-inch floppy disk drives consumes 0.05W during standby and 3.3W during read/write. The four models feature storage capacities ranging from 125K bytes for the SMD-150, a single-sided, single-density drive, to 1M byte for the SMD-180, a double-sided, double-density drive. The SMD-150 and SMD-160 have 6-msec. track-to-track access times and 97-msec. average access times; the SMD-170 and SMD-180 have 3-msec. track-to-track access times and 96-msec. average access times. Data-transfer rate is 125K bits per second for the single-density versions and 250K bits per second for the double-density versions. Track

density is 67.5 tpi for the SMD-150 and SMD-160 and 135 tpi for the SMD-170 and SMD-180. An industry-standard 5¼-inch interface and a Sony 3½-inch interface are offered. SMD-180: approximately \$230 (1,000 units). Delivery: 90 days after receipt of order. **Epson America Inc., OEM Products Division**, 3415 Kashiwa St., Torrance, Calif. 90505, (213) 533-8277.

Circle No 330



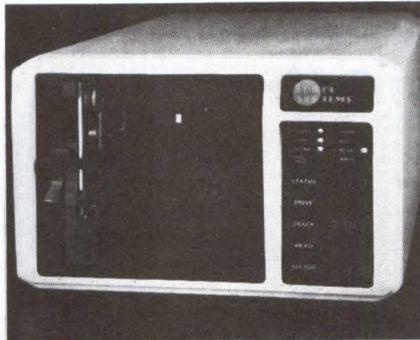
Disk system for Rainbow stores 11M bytes

This hard disk subsystem adds 11M bytes of formatted mass-storage capacity to DEC Rainbow computers. The subsystem is housed completely within the DEC Rainbow computer in the second floppy disk drive space. The host bus adapter plugs into the memory option slot and comes standard with 64K bytes of additional RAM. Data-transfer rate is 5M bits per second; average access time is 155 msec. The subsystem supports CP/M-80/86 and MS-DOS operating systems. Full backup and restore facilities are included. The RAM disk software included with the package allows use of RAM as a virtual disk to speed operation of programs. \$1,650 (five to 10 units). **Univation Inc.**, 1037 N. Fair Oaks Ave., Sunnyvale, Calif. 94089, (408) 745-0180.

Circle No 331

Winchester disk system stores 51M bytes

This 51M-byte, 5¼-inch Winchester disk drive system, a member of the vendor's Corvus-compatible universal mass-storage systems family, works with IBM, Texas Instruments, Apple and other microcomputers. The subsystem features a proprietary controller design using run-length-limited coding that allows a 7.5M-bit-per-second data-



transfer rate. As many as 64 users and seven operating systems can share a single mass-storage unit. On-line backup storage is available via a 32M-byte, ¼-inch cartridge-tape drive. \$4,595. **Sunol Systems**, P.O. Box 1777, 1072 Serpentine Lane, Pleasanton, Calif. 94566, (415) 484-3322.

Circle No 332

Mass-storage subsystem replaces 14-inch drives

The model 850 mass-storage subsystem for the vendor's Series 6600/6700 computer systems and other LSI-11/23-based computer systems stores 84M bytes on an 8-inch disk drive that is packaged in a 5¼-inch-high rack-mount chassis. The drive emulates as many as five Digital Equipment Corp. RKO6 14-inch disk drives or one RKO6 and two RKO7 14-inch disk drives. The model 850 features a 28.3-msec. average access time. Integrated control switches on the front panel include on/off, write protect and clear fault. Each switch has correspondent LEDs to indicate function activity. \$10,800 with controller. **Plessey Peripheral Systems Inc., Computer Systems Division**, 17466 Daimler Ave., P.O. Box 19616, Irvine, Calif. 92714, (714) 540-9945.

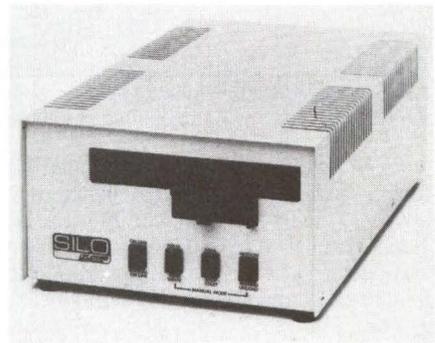
Circle No 333

GCR tape subsystems back up minicomputers

Designed to be integrated into Digital Equipment Corp., Data General, Texas Instruments, Perkin-Elmer or Hewlett-Packard Co. minicomputers, these magnetic-tape subsystems feature high-density group-coded recording (GCR). The subsystems are based on Storage Technology Corp.'s model 2920 Avalanche dual-density drive (1,600/6,250 bpi) or Kennedy Co.'s tri-density model

9400 (800/1,600/6,250 bpi). The drives are interfaced through a variety of controllers made by Emulex, Western Peripherals, Rianda, Spectra Logic Macrolink or Dylon. Using GCR recording, the tape drives can store as much as 180M bytes of data on a standard 10½-inch reel of magnetic tape. The model 2920 drive operates at 50 inches per second in start/stop mode. The model 9400 drive provides start-stop operation at 45 ips in GCR format and at 75 ips in phase-encoded and non-return-to-zero formats. 2920-based subsystem: \$11,300, 9400-based subsystem: \$12,100. **California Computer Group Inc.**, 3303 Harbor Blvd., Suite G-10, Costa Mesa, Calif. 92626, (800) 854-7488 or (714) 996-1661.

Circle No 334



Tape subsystem provides RS232 control

The UT-2320 SILO data-storage system holds 67M bytes of formatted data on 3M's DC600HC ¼-inch data cartridge. The system includes a 3M HCD-75 drive, an intelligent formatter, a buffered controller with an RS232 interface and power supply in a 9-by-5-by-15-inch cabinet. Applications include data logging, disk backup, store and forward, archival storage and data interchange. The on-line mode allows interactive RS232 commands as well as a status message and two-way data transfers to computers or modems at 15 switch-selectable asynchronous baud rates as high as 38,400 baud. Users can select between sequential and block-addressable protocols. The manual mode allows direct reading from or writing to any device with RS232 output using the sequential protocol. Less than \$3,000. **Upland Technologies Inc.**, 80 Davids Dr., Hauppauge, N.Y. 11788, (516) 231-0770.

Circle No 335

New Products

TERMINALS

Falco Data Products unveils Fame series terminals



Falco Data Products' Fame II terminal, one of four members of the Fame series, showcases the line's tilt-and-swivel adjustable screen and detachable keyboard.

Falco Data Products has unveiled its four-member Fame series of ergonomically-designed terminals: the models II, III, 100 and I. Although similar in basic structure, each terminal offers features geared to a specific market segment.

The Fame II features 22 user-programmable function keys and two independently configurable communications ports that support baud rates as high as 19.2K. The standard ports provide RS232C interfaces, and RS422

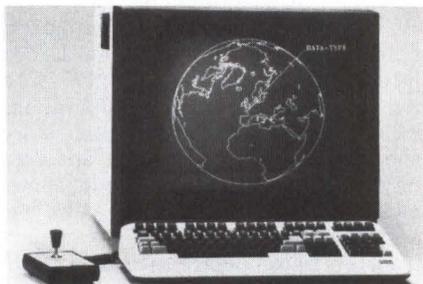
and current-loop options are available. The Fame II shares its standard 12-inch tilt-and-swivel, adjustable green monitor and detachable keyboard with other members of the Fame series. (A 14-inch monitor and amber and white phosphors are optional.) The monitor displays 24 lines by 80 columns and a 25th status information line. The terminal offers split-screen and smooth-scrolling capabilities and underline, reverse video, blinking and blanking video attributes.

The Fame III, a low-cost, general-purpose ASCII terminal, has a micro-processor-controlled logic board and a CRT control circuit for a separate synch/video CRT monitor. It has two bidirectional RS232C ports that offer user-selectable baud rates ranging from 300 to 9,600 baud. The first is an EIA standard data-terminal-equipment port for host communications; the second is a data-communications-equipment port for local printer communication.

The Fame 100 is the company's entry in the high-end, smart terminal market, offering DEC emulation and features not found on the DEC VT100 and VT52 terminals. It features 18 user-programmable, non-volatile function keys and retains screen memory when switched between 80 and 132 columns. Other features include advanced video option, conversation and block modes with DEC VT131 edit commands, a local printer port, display of control characters and a pass-through print capability. An RS232 interface is standard; RS422 or current-loop interfaces are optional.

Designed for the custom OEM market, the Fame I offers all the features of the Fame II plus four character sizes and as much as 64K bytes of RAM for multipaging. A 132-column display is optional. The Fame series is priced from \$595 to \$1,195. **Falco Data Products**, 1286 Lawrence Station Rd., Sunnyvale, Calif. 94089, (408) 745-7123.

Circle No 336



Terminal serves graphics applications

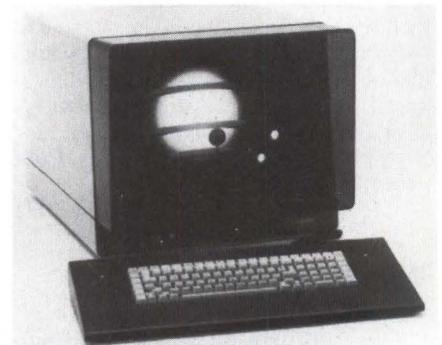
The AutoGraph XK-19 graphics terminal features a 19-inch, bit-mapped, anti-glare monochrome display with a 1024-by-780-pixel viewing window. The terminal is compatible with Tektronix 4010 and 4014 terminals. Graphics functions encompass local drawing of

lines, circles, arcs, ellipses and block fill. The terminal can also be used in a data mode as a smart ASCII terminal with user-selectable character sets. A detachable Selectric-style keyboard includes a numeric keypad, mode controls and 20 function keys. \$4,495; 90 days delivery. **Data Type, Inc.**, 2615 Miller Ave., Mountain View, Calif. 94040, (415) 949-1053.

Circle No 337

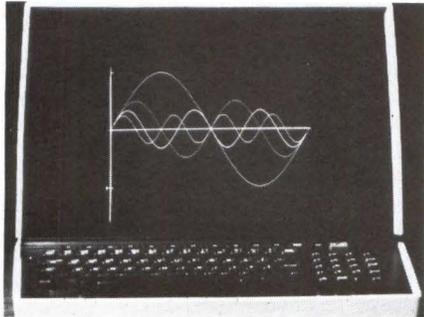
Graphics terminal displays 1024 by 780 pixels

The Jupiter 7 Plus color graphics terminal incorporates a 19-inch screen that can display 1,024 by 780 pixels. The terminal includes hardware anti-aliasing for dejagged vectors and proportionally spaced character fonts. Eight 1K-by-1K



memory planes enable the terminal to display 256 colors simultaneously from a palette of 16.7 million. Other standard features encompass graphics generation, zoom, pan, scroll and a hardware tri-level blue grid. The programmable keyboard has dual joysticks and a

built-in sound synthesizer. A pixel block-moving system can shift any operator-defined shape at 1M bits per second. \$15,200 to \$19,000. **Jupiter Systems**, 2126 Sixth St., Berkeley, Calif. 94710, (415) 644-1024, (800) 858-9309. **Circle No 338**



Graphics terminal suits process control, CAD

The GTC 224 dual-processor, color graphics terminal suits process-control and CAD applications. It displays eight colors from a palette of 4,096 and allows pixel dithering. Because the terminal changes color by palette register, color commands can be used for animation. Its alphanumeric handling capabilities include the display of an ASCII character set and two programmable character sets that can be defined in a cell size as large as 256 by 128 pixels. A programmable keyboard that includes 32 function keys controls the terminal. \$4,900 (OEM quantities). **PsiTech**, 2842-C Walnut Ave., Tustin, Calif. 92680, (714) 730-0981. **Circle No 339**



Terminal provides 28K bytes of memory

The Guru display terminal provides 28K bytes of display memory that can be scrolled or zoomed horizontally and

vertically. Line length is host-selectable to as many as 255 characters per line, and page length is selectable to as many as 250 lines. The terminal displays as many as 66 lines of 170 characters on a 15-inch non-glare green screen. Its keyboard is standard with 38 keys programmable on 60 levels with any ASCII string and with local-only,

send-only and repeat controls. Other features include smooth scroll, editing with local move capability, form-filling functions, a pause key, a Meta key and an RS232 printer interface with local and remote print and copy functions. \$2,395. **Ann Arbor Terminals Inc.**, 6175 Jackson Rd., Ann Arbor, Mich. 48103, (313) 663-8000. **Circle 340**

SEATTLE GIVES YOU AN EDGE IN S-100 SYSTEM DESIGNS

You can unlock new system capabilities with high-performance S-100 boards from Seattle Computer. All are IEEE-696 compatible. But, for innovative systems that demand performance beyond the limits of conventional S-100 boards, you'll want to know more about these Seattle Computer products. For example, with our 8 MHz 8086 CPU, you'll be able to build systems that run faster and consume less power than before. Take a closer look:

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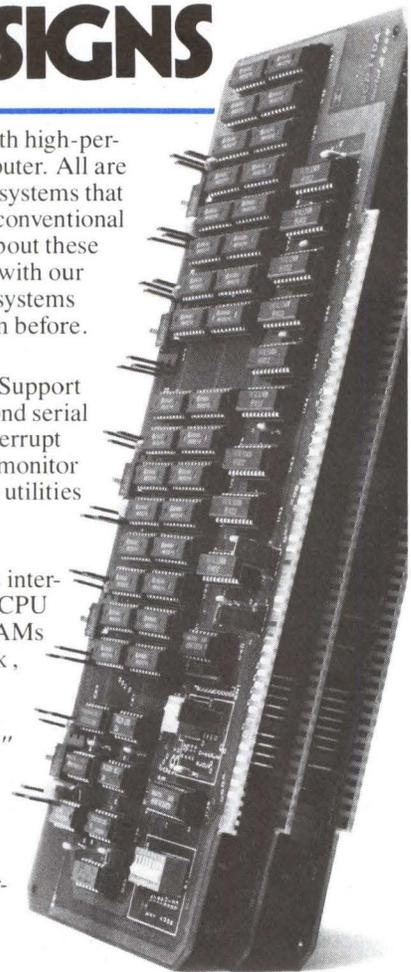
Disk Master™ Controls as many as four 8" and four 5.25" floppy disk drives simultaneously, in any combination • Uses 1793 disk controller chip • Can be used with 10 MHz CPUs • **Single Qty: \$325.00**

Multi-Port Serial Card 2- and 4-port versions are available • These RS-232 ports operate as either "data sets" or "data terminals" • 36" cables included
• **Single Qty: \$280.00 (4-port)**
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CIRCLE NO. 178 ON INQUIRY CARD

New Products

SOFTWARE

Information-management system combines DBMS software, network hardware

The 10-Base relational database-management system (RDBMS) software package is based on the Sequel (SQL) RDBMS language developed by IBM for mainframe computers. It runs on IBM PC, PC XT and PC-compatible microcomputers under the MS-DOS 2.0 operating system. The program can exchange information with Lotus 1-2-3, WordStar and MailMerge. It works with the vendor's 10-Net local-area network, which links personal computers using twisted-pair wiring.

With one English-like command,

10-Base users can create, organize tables, edit, delete, modify, query, manipulate, display and print all or part of an information file. One 10-Base query command can draw information from as many as 16 files. Users can also browse through—adding, changing and deleting—data files. The program offers a virtually unlimited number of files and records per file.

The 10-Net system has no separate network controller or server hardware. Each network interface card works with the software that governs file access and

security and performs network functions such as electronic mail and printer spooling. A "chat" features allows network users to talk to another workstation for short times without disturbing their current applications. A news function lets users create, delete and display general-interest messages on every PC screen in the network. 10-Base: \$495, 10-Net, including software, plug-in board, documentation and wiring: \$595. **Fox Research Inc.**, 7005 Corporate Way, Dayton, Ohio 45459, (513) 443-2238. **Circle No 341**

DEC system generates application programs

RIMS/MPG-Plus is an application-program-generating system for DEC PDP-11, VAX and DECSYSTEM 10/20 computers using COBOL under the TSX-Plus, RSTS/E, VMS and TOPS-10/20 operating systems. It produces data-entry, data-manipulation and data-output programs and the source code for those programs. The COBOL-based language versions of RIMS/MPG-Plus consist of seven-key software modules including a dictionary (data file definition) and six program-generating modules for creating data-entry, report, sorting, transaction-processing, graphics and menu programs. Other features include user-selectable field- and record-size maximums, multikey/multifile cross-referencing capabilities and field redefinition capabilities. \$5,750 to \$22,500. **Information and Systems Research Inc.**, Airport Office Park, Building One, 410 Rouser Rd., Coraopolis, Pa. 15108, (412) 262-5507. **Circle No 342**

Ethernet software links IBM PC, UNIX systems

Fusion 2.0 network software links MS-DOS-based IBM Personal Computers to 8086, 68000, 16032, PDP-11 and VAX processors running UNIX and UNIX-like operating systems on an Ethernet local-area network. The software incorporates an implementation of Xerox's XNS Internet Transport protocols and

provides file-transfer, virtual-terminal and network-utility programs. The file-transfer program moves groups of files or complete directory hierarchies between PC and UNIX systems with a single command. With the virtual-terminal function, an IBM-PC or UNIX system user can remotely log into another UNIX system on Ethernet. The network utilities programs provide traffic monitoring and performance analysis, mail and print service and remote command execution. Fusion is compatible with Ethernet controllers manufactured by 3COM, Interlan and Communication Machinery Corp. Prices vary, depending on CPU. **Network Research Corp.**, 1964 Westwood Blvd., Suite 200, Los Angeles, Calif. 90025, (213) 474-7717. **Circle No 343**

Software accelerator does background printing

CacheQ software increases the speed of application programs running under the CP/M 2.2 or PC-DOS operating systems. It automatically buffers data from as many as 16 mass-storage devices attached to a computer and data to as many as five attached printers. It uses as much as 590K bytes of the computer's memory for its buffer space. It buffers data from the mass-storage devices by employing a least-recently-used algorithm. For data integrity, CacheQ employs write-through whereby each sector being written to the buffer area is also written onto the mass-storage device. The product is invisible

to all user applications and requires no modification of programs or operating procedures. \$225. **Techné Software Corp.**, 3685 Mount Diablo Blvd., Suite 210, Lafayette, Calif. 94549, (415) 283-6834.

Circle No 344

File driver for PDP-11s appears as RT-11 file

The Softdrive RT-11- and TSX-plus-compatible input/output driver allows standard RT-11 disk files to be used as if the files themselves were disks. These smaller pseudo-disks, called filedisks, have the same characteristics as a disk. A user can initialize a filedisk, copy to or from it and list its directory. In addition, a filedisk appears as a standard RT-11 file on the disk that contains it. On multiuser systems such as TSX-Plus and on single-user systems that are shared by several users, Softdrive allows each user to have a disk simultaneously, regardless of the number of users. \$200. **Interactive Microware Inc.**, P.O. Box 771, State College, Pa. 16801, (814) 238-8294.

Circle No 345

Package builds application screens

FFSP, a terminal-independent package for building application screens, contains C language functions that allow a user to input various data types in a controlled manner, control program flow and standardize screens for easier

maintenance. The package runs on UNIX-based systems that have the U.C. Berkeley CURSES cursor-movement-optimization package. FFSP supports short, long, float, double, string, char, date, time, telephone and money data types. Various functions put up menus, sub-menus and prompts. Other functions read data from the screen, validate it and pass flags based on data entered. Function keys allow a user to backspace to the previous prompt, delete data or escape to end of screen. Source code: \$500. **Fargo Electronic Services Inc.**, 7150 Shady Oak Rd., Minneapolis, Minn. 55344, (612) 941-9470.

Circle No 346

Software package provides data acquisition, analysis

DT-DATS, an interactive, multiuser software package, supports data acquisition, signal processing and graphical output. This programming environment reduces user development time in applications such as acoustics, sound, vibration, speech research, fatigue and structural testing. It supports menu-driven interactive programming and batch type JOB processing as well as linkages to user-written FORTRAN programs. Each activity in DT-DATS is implemented as a separate program module that performs only one definable function, and each module produces output in a form suitable for input to other DT-DATS modules. The package runs on LSI-11, PDP-11 and VAX systems under RSX-11 or VMS operating systems. \$15,000. **Data Translation**, 100 Locke Dr., Marlboro, Mass. 01752, (617) 481-3700.

Circle No 347

Network software links dissimilar microcomputers

The PC/NOS family of networking software packages operates independently of microcomputer hardware, network and operating system. The first version of PC/NOS supports microcomputers based on the CP/M 2.2 or MS-DOS 2.0 operating systems. It works with Ethernet, Arcnet and Omnet network hardware. The package consists of four modules: the PC/NOS exploration, connection and security command language, the PC/NOS CP/M 2.2 interface package, the PC/NOS MS-DOS 2.0 interface package and a Z80-based

file-server package that can be customized to create network servers. The PC/NOS command language is a host-independent session-layer language that uses standard directory and active connection tables maintained at each node on the network. The file-server module permits CP/M 2.2 and MS-DOS 2.0

workstations to read and write files in shared directories. It also provides three levels of file- and record-locking protocols. One-time OEM license fee: \$100,000. **Applied Intelligence Inc.**, 2101 Landings Dr., Mountain View, Calif. 94043, (415) 967-3512.

Circle No 348

BABYMUX

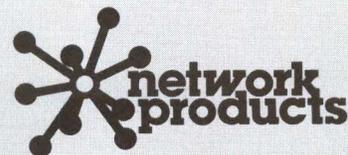


TWO, FIVE OR EIGHT LINE VERSATILITY Network Products Dependability

Babymux brings large multiplexer capabilities to the small Mux. User upgradable from two to five or eight lines in minutes. Terminal and composite line speeds up to 19,200 bps. Babymux supports a complete line of computers and terminals including DEC, Data General, Hewlett-Packard and IBM. Front panel convenience for programming configuration and statistical monitoring and no unnecessary DIP switches. Babymux - you can depend on it because it comes from Network Products.

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CIRCLE NO. 171 ON INQUIRY CARD

New Products

SUBASSEMBLIES



Monitor incorporates touch-sensitive panel

The Point-1 touch-sensitive monitor for the IBM PC and other personal computers includes a 12-inch amber or green CRT screen, an analog, resistive-type touch screen offering a 1,024-by-1,024-point resolution and an RS232 port for the communication of touch points. The monitor fits close to the keyboard and features a reclining display. Versions are offered for use

with the IBM monochrome and color graphics cards. A built-in 8-bit 65F11 microprocessor allows software-controlled data formats and calibration, and software tools allow creation of touch programs to run on-board the controller. \$850. **MicroTouch Systems Inc.**, 400 W. Cummings Park, Suite 5050, Woburn, Mass. 01801.

Circle No 349

Software turns IBM PC into COBOL workstation

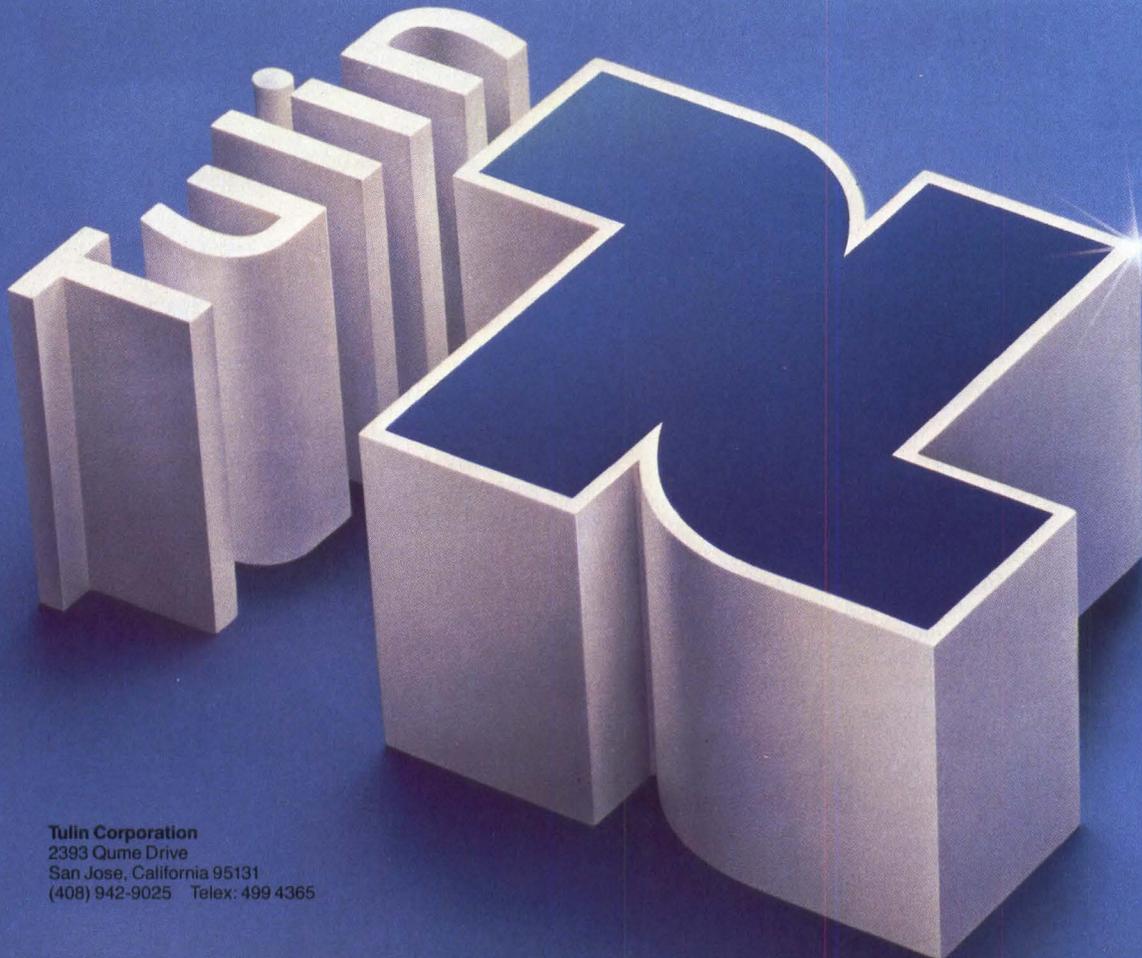
The 68000 card turns an IBM PC or XT into a 68000-based, multiuser, COBOL-oriented computer. Carrying a 68000 chip and 256K bytes of memory and running the RM/COS commercial operating system, the board supports three users. The card provides 8088-based address relocation and memory protection needed by the RM/COS operating system and business applications. The product also speeds system

execution by using the 68000 as a CPU and the 8088 as an I/O processor. \$2,495. **Sritek Inc.**, 10230 Brecksville Rd., Cleveland, Ohio 44141, (216) 526-9433.

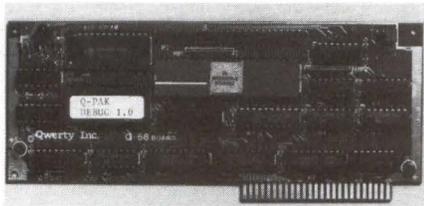
Circle No 350

Package turns Apple II into development system

The QPAK-68 add-in board and software package turns an Apple II microcomputer into a 68000 assembly language development system. The package includes the Q-68 plug-in board to run 68000 programs, a combined editor/assembler and a debugger. The board uses the 68008 microprocessor, which runs in parallel with the Apple's 6502 microprocessor, and shares the Apple's 64K-byte memory space. The board has its own 8K bytes of EPROM and 2K bytes of RAM, expandable to 32K and 8K bytes, respectively. The EPROM-resident debugger displays five screen windows to monitor or



Tulin Corporation
2393 Oume Drive
San Jose, California 95131
(408) 942-9025 Telex: 499 4365



change registers or memory. The source-code development package comes on an Apple-compatible disk and consists of a combined editor and macro-assembler. \$695. **Qwerty Inc.**, 9252 Chesapeake Dr., Suite 600, San Diego, Calif. 92123, (619) 569-5283.

Circle No 351

Monitor operates without a transformer

The RGB-1400, 14-inch color display monitor features an interface concept that allows the unit to be custom adapted to any signal format. Resolution is 700 lines horizontally by 260 lines

vertically. The monitor's design incorporates circuitry that allows operation without an isolation transformer, reducing heat, magnetic interference, weight and cost. A master heat-transfer system sends heat to the outside rear of the cabinet, thus cooling the heat-generating devices. Customized thick films incorporating resistor arrays with surface-mounted devices and chip capacitors comprise functional interface, horizontal and power modules. A user can select 32 colors from a total array of 4,096. Colors are selected by programming one or two Fusible Link programmable read-only memories. \$595. **RGB Display Corp.**, 22525 Kingston Lane, Grass Valley, Calif. 95945, (916) 268-2222. **Circle No 352**

IEEE-488 port expands DEC Rainbow

The Rainbow GPIB-PC package, which includes a plug-in card, software



and documentation, provides an IEEE-488 interface for the Digital Equipment Corp. Rainbow 100 computer. The package provides GPIB talker/listener/controller functions and has an optional time-of-day clock and a parallel port. The software includes a set of driver routines, an interactive control program and support of applications written in C-86, MBASIC, CBASIC, Pascal MT+ and 8088 assembly languages. \$385. **National Instruments**, 12109 Technology Blvd., Austin, Texas 78727, (800) 531-5066 or (512) 250-9119.

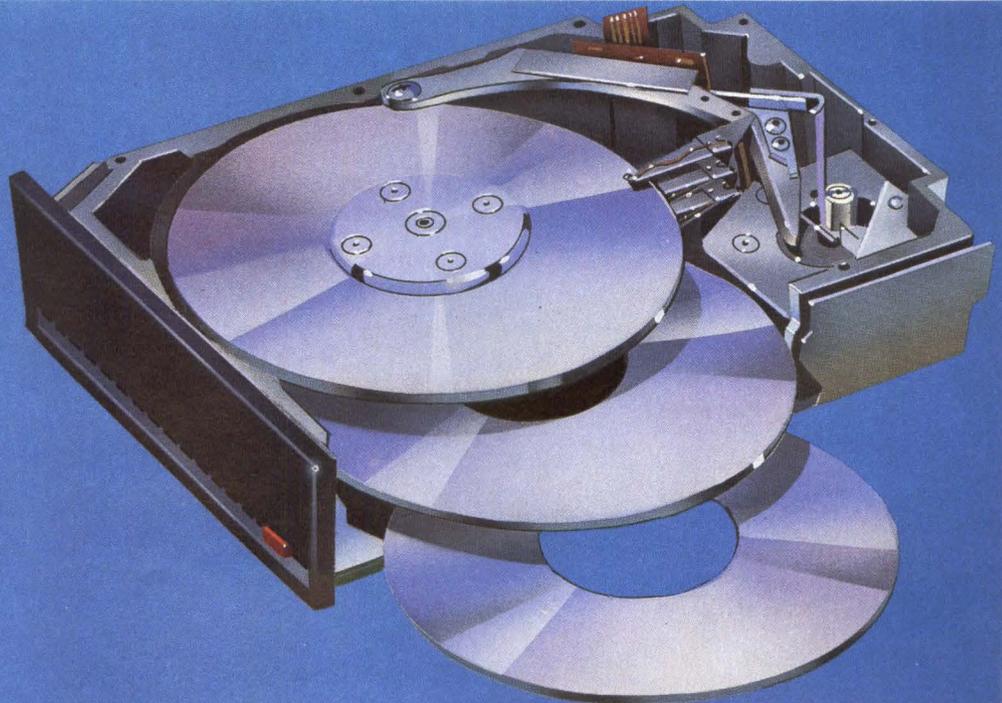
Circle No 353

A Platter Ahead in Half-Height Winchester

Tulin fits your data storage needs with half-height Winchesters storing 13.34, 26.7 and 40 megabytes (unformatted). But Tulin gives you more than big capacity in a little space. Tulin gives you a higher level of technology, better reliability, and more proprietary features.

Formed by leading Winchester technologists, Tulin is backed by the resources of one of the world's largest electronics companies. So don't be afraid to order your evaluation units now. We're ready to show that Tulin fits in your system.

Features: Capacities of 13.34, 26.7 and 40 megabytes (unformatted). ■ One/two/three platter design for more capacity now and later. ■ Half-height design. (Mount two in one minifloppy cavity.) ■ Inside hub spindle motor saves space. ■ Heat dissipation—only 15 watts ■ Standard ST506/412 interface ■ Dedicated head landing/shipping zone ■ Rotary actuator has only one moving part. ■ R/W head preamp inside head disc assembly for better signal to noise ratio and better protection from RF interference. ■ Automatic spindle brake and actuator lock



13.34 MB

26.7 MB

40 MB



TULIN FITS IN.

CIRCLE NO. 181 ON INQUIRY CARD

At last, a modem that goes where you want.

And does what you want.

The S-100 Modem™ by U.S. Robotics. 300/1200 baud. Auto dial/answer. A limited two-year warranty. Just \$449.*

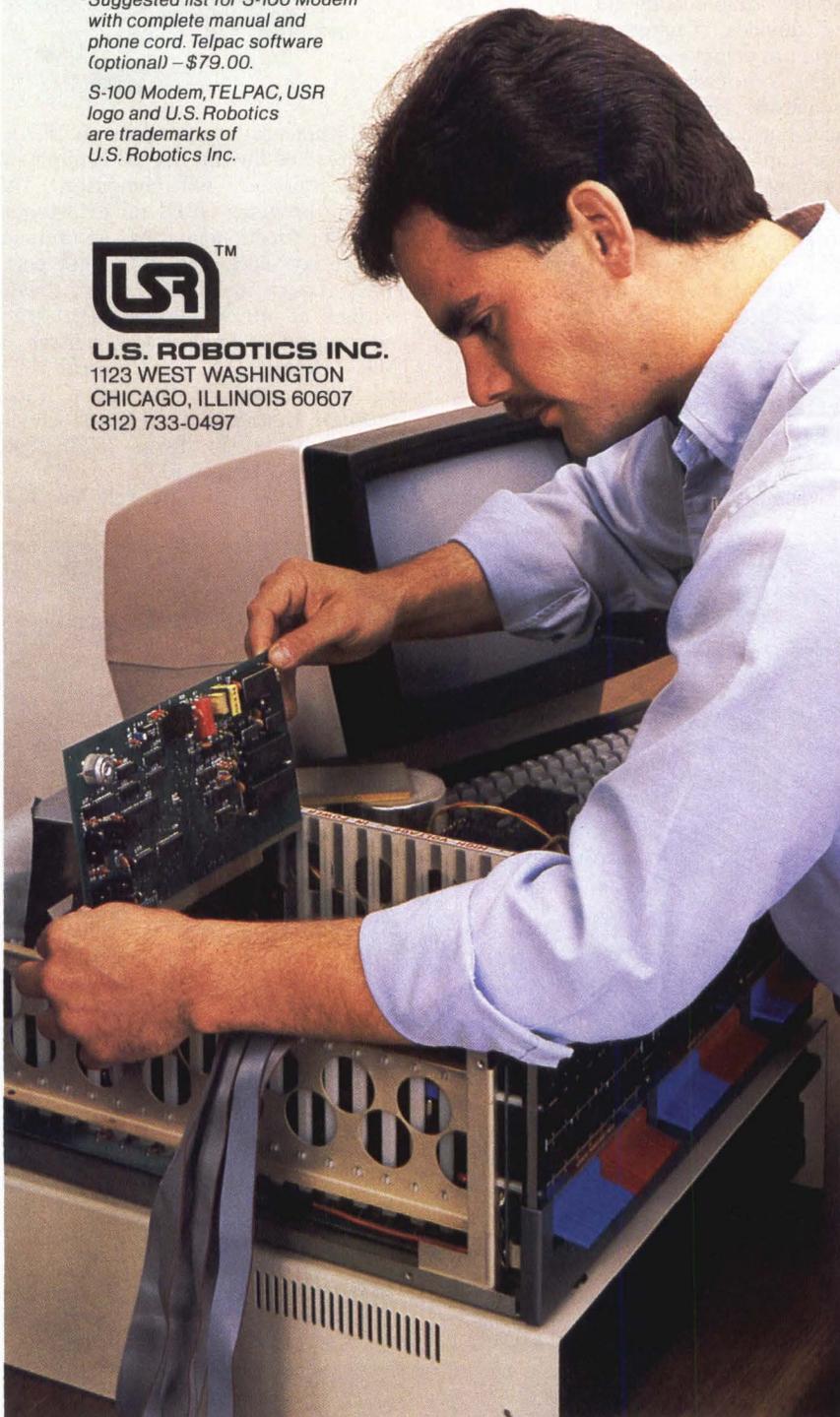
And it's fully-programmable with Telpac™—
USR's telecommunications software package.

**Suggested list for S-100 Modem
with complete manual and
phone cord. Telpac software
(optional) — \$79.00.*

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CIRCLE NO. 173 ON INQUIRY CARD

Products

SUBASSEMBLIES

Hard-disk controller is IBM PC I/O bus compatible

The P-Series disk controller serves as a single-card interface between the IBM PC I/O bus and the ST-506, 5¼-inch disk. The controller uses custom large-scale-integration (LSI) technology and an 8086 microprocessor to emulate the IBM PC disk controller instruction set. This feature makes the controller compatible with PC-DOS 2.0. The product also offers an IBM PC expansion board form factor, IBM PC I/O channel plug compatibility, multiple-sector read/write operations and consecutive physical-sector operations. Each P-Series disk controller supports two ST-506 Winchester disk drives and includes error detection with 8-bit error correction, 512-byte sector sizes and user-programmable interleaving. \$225 (OEM quantities). **Adaptive Data and Energy Systems**, 2627 Pomona Blvd., Pomona, Calif. 91768, (800) 824-0114 or (714) 594-5858.

Circle No 354



Clock/timer regulates multiple systems

The K-series clock/timer combines clock/timer functions with the ability to communicate, control and transmit date and time data through as many as five I/O ports to five data systems. It can handle RS232, RS422 and RS423 asynchronous ports; 4-, 8- or 16-bit-byte serial ports; and full parallel ports in five I/O positions. Users can configure calendars, time ranges, resolutions and output characteristics. Time resolution is 0.1 seconds, 0.01 minutes or 0.0001 hours. Time-base options include 50- or 60-Hz line frequency, internal temperature-compensated crystal oscillators or external 307.2-KHz frequency input. Prices start at \$507 for a single RS232-port system. **Chrono-Log Corp.**, 2 W. Park Rd., Havertown, Pa. 19083, (215) 853-1130.

Circle No 355

New Products

LITERATURE



Catalog describes RS232 interface devices

This eight-page catalog describes low-cost RS232 interface devices such as switches, printer buffers, data cables and line boosters. The catalog provides product and application information, diagrams, technical specifications and pricing information. **Western Telematic Inc.**, 2435 S. Anne St., Santa Ana, Calif. 92704, (714) 979-0363 or (800) 854-7226. **Circle No 356**

Brochure presents power problem solutions

An eight-page color brochure discusses the power problems that cause computer errors and failures and the conventional technologies traditionally used to correct these problems. The brochure explains Oneac Corp.'s use of a new technology in its approach to power conditioning and includes product performance information. The brochure also discusses the economics of power conditioning. **Oneac Corp.**, 2207 Lakeside Dr., Bannockburn, Ill. 60015, (312) 295-2800. **Circle No 357**

Application note discusses plotter accuracy

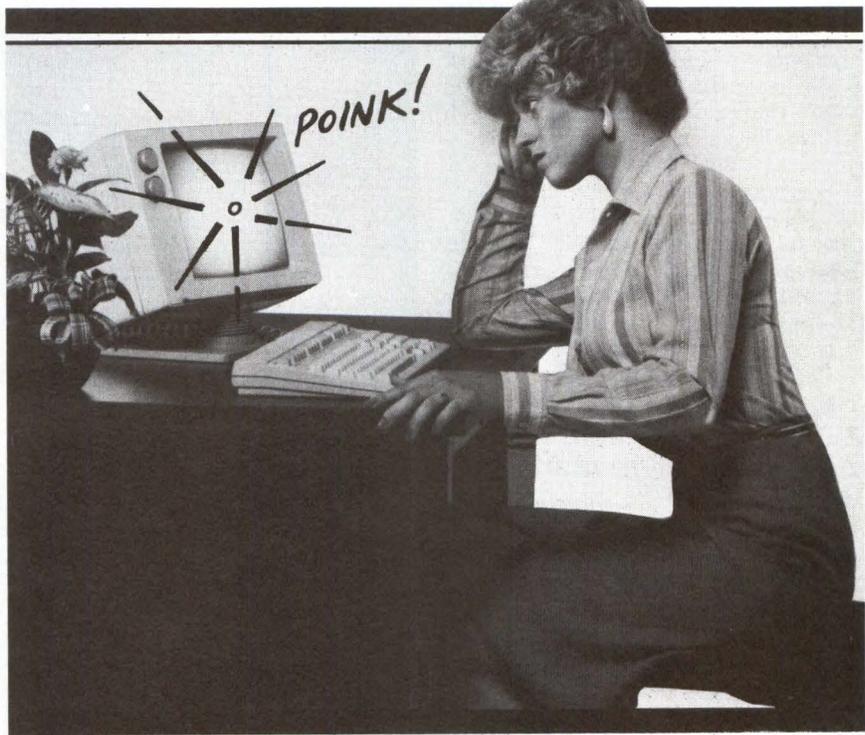
The meaning and measurement of drafting-plotter accuracy is discussed in a 12-page application note entitled "Plotter Accuracy—What It Means and How to Achieve It." The note covers the definition and explanation of accuracy, interpreting the accuracy specification and guidelines for accuracy. **Hewlett-Packard Co.**, 1820 Embarcadero Rd., Palo Alto, Calif. 94303. **Circle No 358**

Bulletin details network control

The ANM-800 advanced network manager, a system for centralized management and control of large data-communications networks, is detailed in a four-page, illustrated brochure. The bulletin notes the

benefits of ANM-800, including centralized network monitoring and control, real-time network status, color graphics displays and network statistics and reports. **Infotron Systems Corp.**, 9 N. Olney Ave., Cherry Hill Industrial Center, Cherry Hill, N.J. 08003, (609) 424-9400 or (800) 257-8352.

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CIRCLE NO. 174 ON INQUIRY CARD

New Products

LITERATURE

Study forecasts tape drive shipments

The Computer Tape Drive Industry: A Strategic Analysis analyzes the markets, technology, competition and trends of the cartridge, cassette and reel-to-reel tape drives of U.S. manufacturers. The study provides shipment forecasts for 11 tape drive products for 1983 through 1987 and breaks down the year-end 1982 installed base and 1982 shipments by vendor share. Profiles of 35 domestic and foreign tape drive manufacturers include analyses of product lines, marketing approaches and plans. The study also addresses tape drives' industry structure, marketing strategies and applications in five markets. 200 pages: \$2,790. **Venture Development Corp.**, One Washington St., Wellesley, Mass. 02181, (617) 237-3000.

Circle No 360

Study forecasts shifts in 1/2-inch tape drive market

In volume 2 of *Computer Tape Outlook*, authors Donald C. Collier and Raymond C. Freeman Jr. forecast growth to \$1.3 billion by 1987 and major shifts in products and technology in the 1/2-inch computer tape drive market. The study analyzes market characteristics and forecasts worldwide shipment volumes, revenues and market shares for eight classes of 1/2-inch tape drives from 1981 through 1987. It lists specifications for 221 models of tape drives produced by 36 manufacturers. It analyzes pricing trends and identifies expected technology shifts and product directions. \$1,250. **Freeman Associates Management Consulting**, 311 E. Carrillo St., Santa Barbara, Calif. 93101, (805) 963-3853.

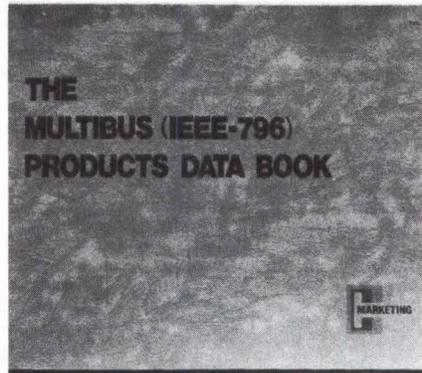
Circle No 361

Introduction to speech synthesis

Introduction to Electronic Speech Synthesis, a 134-page book by Neil Sclater, helps the reader understand how the three current digital-synthesis technologies are used to re-create a human voice electronically. Written in non-technical terms, this technical introduction explains what to expect in

speech quality as it relates to data rate and cost of memory devices. The author evaluates the complexity and cost of commercial voice-synthesis subsystems and offers guidance in determining how user-friendly they are. \$8.95. **Group Technology Ltd.**, P.O. Box 87, Check, Va. 24072, (703) 651-8153.

Circle No 362



Manual describes Multibus products

The 67-page *Multibus (IEEE-796) Products Data Book* provides technical data and comparative information on 1,179 Multibus-compatible products that are available from 137 board-level manufacturers, 22 hardware support suppliers, 18 system-enclosure sources, 12 mass-storage subsystem producers, 36 power-supply companies and 25 operating-system-level software suppliers. \$19.95. **C&C Marketing**, Mail Drawer #229, N. Aurora, Ill. 60542, (312) 879-2074.

Circle No 363

Dictionary defines engineering terms

Industrial Engineering Terminology, a 350-page dictionary of standard industrial-engineering terms, has 17 subject categories. It supplements the definitions with diagrams and calculations and is cross-indexed. \$75. **Institute of Industrial Engineers**, 25 Technology Park/Atlanta, Norcross, Ga. 30092, (404) 449-0460.

Circle No 364

Guide covers handling of magnetic media

The National Bureau of Standards reference guide, *Care and Handling of Computer Magnetic Storage Media*,

covers recommendations for daily care and handling of computer magnetic media, care and handling during long-term storage, scheduling of media maintenance, tape-management systems and operating clean rooms. In addition, it includes a reference list and two appendixes. One appendix discusses some of the mechanisms that cause tapes to deteriorate physically and chemically. The other explains how computer magnetic tape records data and describes some of the materials that make up the tapes. \$5.50. **Superintendent of Documents, U.S. Government Printing Office**, Washington, D.C. 20402.

Circle No 365

Report covers microcomputer security

"Managing Microcomputer Security," a 190-page report authored by Timothy A. Schaback, covers a wide range of security issues in the microcomputer environment. The report addresses security management considerations, physical security and environmental considerations, hardware security, software-security, database security and records management, communications security, audit considerations, microcomputer insurance, legal issues, preventive maintenance and disaster preparedness and recovery. \$22 (10 copies). **Computer Protection Systems Inc.**, 711 W. Ann Arbor Trail, Suite 4, Plymouth, Mich. 48170, (313) 459-8787.

Circle No 366

Annual reviews ribbon, toner industries

The Fourth Annual Guide to Ribbons and Toner/Product Overview and Industry Directory provides tutorial information and detailed company and product listings for 114 manufacturers of ribbons and electrostatic toners for computer printers, office machines and copiers and for 42 suppliers of substrates, inks or services to those manufacturers. In addition, product listing tables are provided, showing each company's product line and marketing orientation at a glance. 78 pages, \$20. **Datek Information Services Inc.**, P.O. Box 68, Newton, Mass. 02160, (617) 244-2290.

Circle No 367

Calendar

REGIONAL SALES OFFICES

FEBRUARY

- 14-17 Online '84, Seventh European Congress Fair for Technical Communications**, Berlin, West Germany, sponsored by Online GmbH. Contact: Online GmbH, Postfach 10 08 66, Nevigeser StraBe 131 D-5620 Velbert 1, West Germany, Telephone: (0 20 51) 2 30 71.
- 15-17 Dataquest Technology Small Computer Conference**, Monterey, Calif., sponsored by Dataquest Inc. Contact: Gail Van Tubergen, Conference Coordinator, Dataquest Inc., 1290 Ridder Park Dr., San Jose, Calif. 95131, (408) 971-9000.
- 20-22 Office Automation Conference**, Los Angeles, sponsored by the American Federation of Information Processing Societies (AFIPS) Inc. Contact: Ann-Marie Bartels, AFIPS Inc., 1815 N. Lynn St., Arlington, Va. 22209, (703) 558-3617.
- 20-24 APAC '84, Arabian Productivity Advancement Using Computers/Graphics**, Saudi Arabia, sponsored by World Computer Graphics Association (WCGA) Inc., Middle East Computer Graphics Association and SNAS Establishments. Contact: APAC '84 Conference Director, WCGA, 2033 M St., N.W., Suite 399, Washington, D.C. 20036, (202) 775-9556.
- 21 Invitational Computer Conference**, Stockholm, Sweden, sponsored by the Invitational Computer Conference. Contact: B.J. Johnson & Associates, 3151 Airway Ave., #C-2, Costa Mesa, Calif. 92626, (714) 957-0171. Also to be held in Paris on Feb. 23, Munich, W. Germany, on Feb. 28, Frankfurt, W. Germany, on March 1 and London on March 7.
- 21-23 SOFTCON**, New Orleans, produced by Northeast Expositions. Contact: Northeast Expositions, 822 Boylston St., Chestnut Hill, Mass. 02167, (617) 739-2000 or (800) 841-7000.
- 22-24 IDBMA/Pick Spectrum '84**, Reno, Nev., sponsored by the International Data Base Management Association (IDBMA). Contact: IDBMA, 9740 Appaloosa Rd., Suite 210, San Diego, Calif. 92131, (619) 578-3152.
- 22-25 "Microcomputers and Typesetting" Seminar**, Rochester, N.Y., sponsored by the Rochester Institute of Technology. Contact: Brenda Reimherr, T&E Center Seminar Coordinator, Rochester Institute of Technology, 1 Lomb Memorial Dr., P.O. Box 9887, Rochester, N.Y. 14623, (716) 475-2757.
- 23 Digital Computer Association's 32nd Annual Symposium**, El Segundo, Calif., sponsored by Digital Computer Association. Contact: Jerry Koory, The Rand Corp., 1700 Main St., Santa Monica, Calif. 90406, (213) 393-0411.
- 27-29 "Non-Impact Printing Technologies" Database Access Meeting**, San Francisco, sponsored by Advanced Technology Resources Corp. Contact: Jack Jordan, Advanced Technology Resources Corp., 6256 Pleasant Valley Rd., El Dorado, Calif. 95623, (916) 626-4140.

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27-29 "Micro Technology and Auditing" Conference, Atlanta, sponsored by MIS Training Institute Inc. Contact: MIS Training Institute Inc., 4 Brewster Rd., Framingham, Mass. 01701, (617) 879-7999.

FEBRUARY 27 - MARCH 2

1984 Electrex Exhibition (International Electrotechnical Exhibition), Birmingham, England, organized by Electrex Ltd. Contact: Electrex Ltd., Wix Hill House, West Horsley, Surrey KT24, 6DZ, England, (0483) 222888.

MICAD '84, Paris, sponsored by World Computer Graphics Association (WCGA) Inc. and the French Computer Graphics Association. Contact: Caby C. Smith, President, WCGA, 2033 M St., N.W., Suite 399, Washington, D.C. 20036, (202) 775-9556.

FEBRUARY 28 - MARCH 2

"Designing Real-Time Hardware for Digital Signal Processing" Course, Anaheim, Calif., sponsored by Integrated Computer Systems, Contact: Ruth Dordick, Integrated Computer Systems, 6305 Arizona Place, P.O. Box 45405, Los Angeles, Calif. 90045, (213) 417-8888.

"Inside the IBM Personal Computer" Seminar, Chicago, sponsored by Northeastern University. Contact: Catherine Zeigler, Program Assistant, State-of-the-Art Engineering Program, Northeastern University Center for Continuing Education, 370 Common St., Dedham, Mass. 02026, (617) 329-8000. Also to be held March 13-16 in Hartford, Conn.

MARCH

6-9 "Real-Time Pattern-Recognition Systems" Course, Washington, sponsored by Integrated Computer Systems. Contact: Ruth Dordick, Integrated Computer Systems, 6305 Arizona Place, P.O. Box 45405, Los Angeles, Calif. 90045, (213) 417-8888.

9-11 BizCom/84, Manchester, N.H., sponsored by WKBR Radio. Contact: Joan Shea, BizCom/84, 155 Front St., Manchester, N.H. 03102.

13-15 MICRO/SET '84, Detroit, sponsored by the Engineering Society of Detroit. Contact: Sheila Osann, Conference Manager, Engineering Society of Detroit, 100 Farnsworth, Detroit, Mich. 48202, (313) 832-5400.

13-16 "Digital Signal Processing" Course, Phoenix, Ariz., sponsored by Integrated Computer Systems. Contact: Ruth Dordick, Integrated Computer Systems, 6305 Arizona Place, P.O. Box 45405, Los Angeles, Calif. 90045, (213) 417-8888. Also to be held March 20-23 in Boston.

14-16 Dataquest Technology Telecommunications Conference, Fort Lauderdale, Fla., sponsored by Dataquest Inc. Contact: Gail Van Tubergen, Conference Coordinator, Dataquest Inc., 1290 Ridder Park Dr., San Jose, Calif. 95131, (408) 971-9000.

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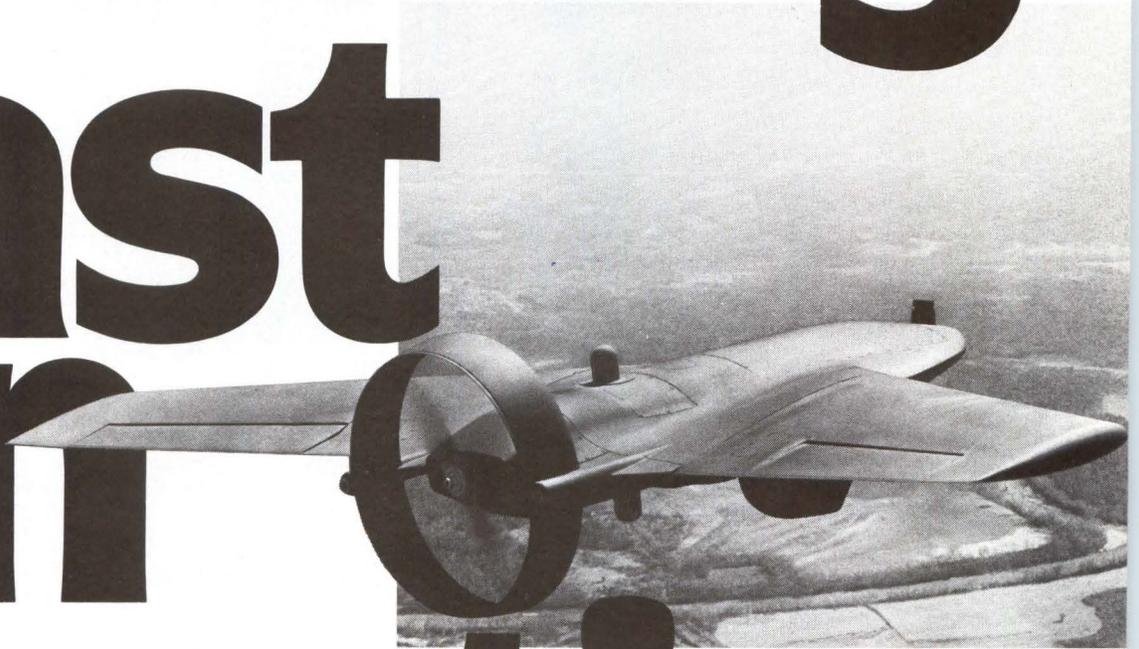
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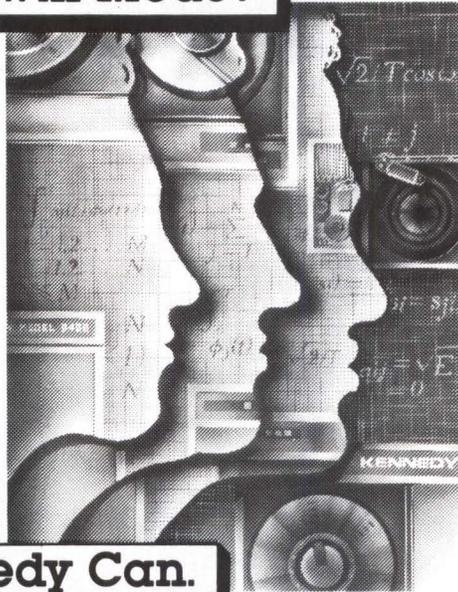
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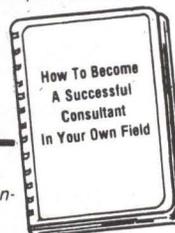
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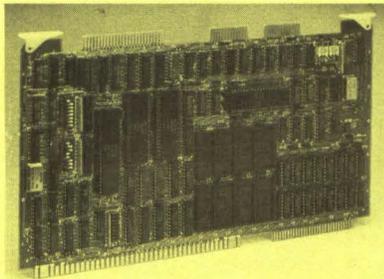
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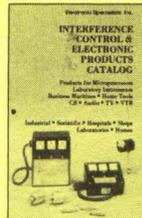
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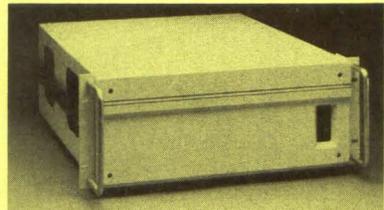
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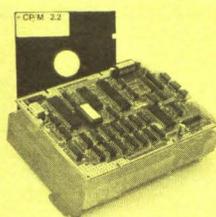
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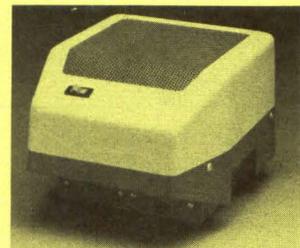
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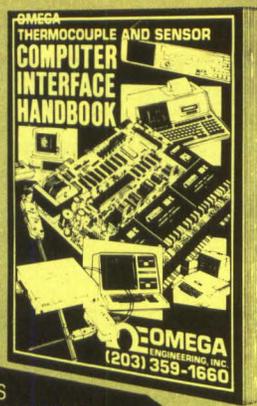
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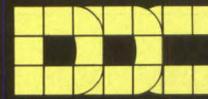
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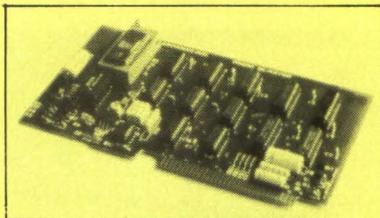
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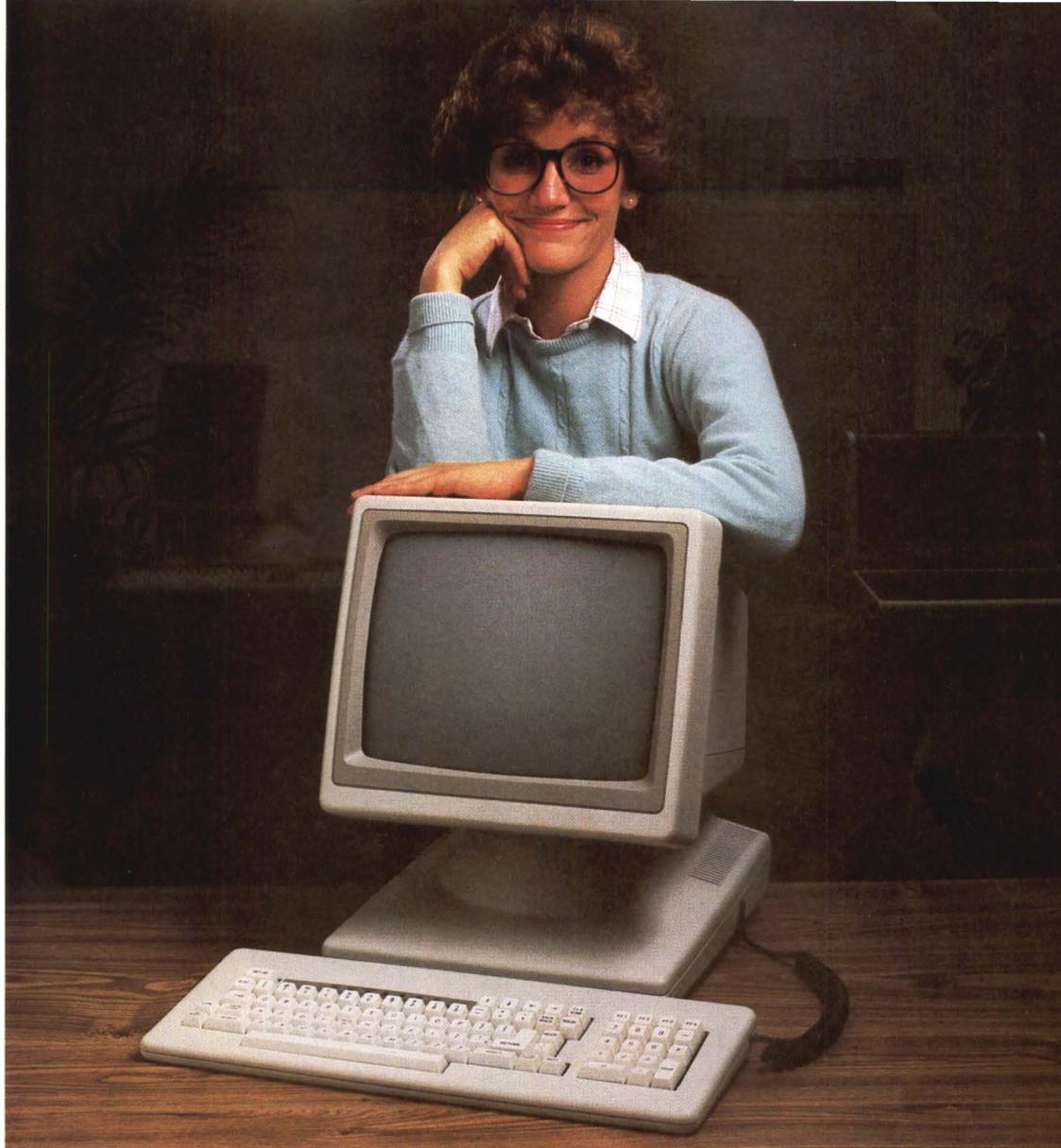
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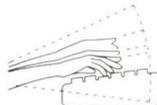
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