

Mini-Micro Systems

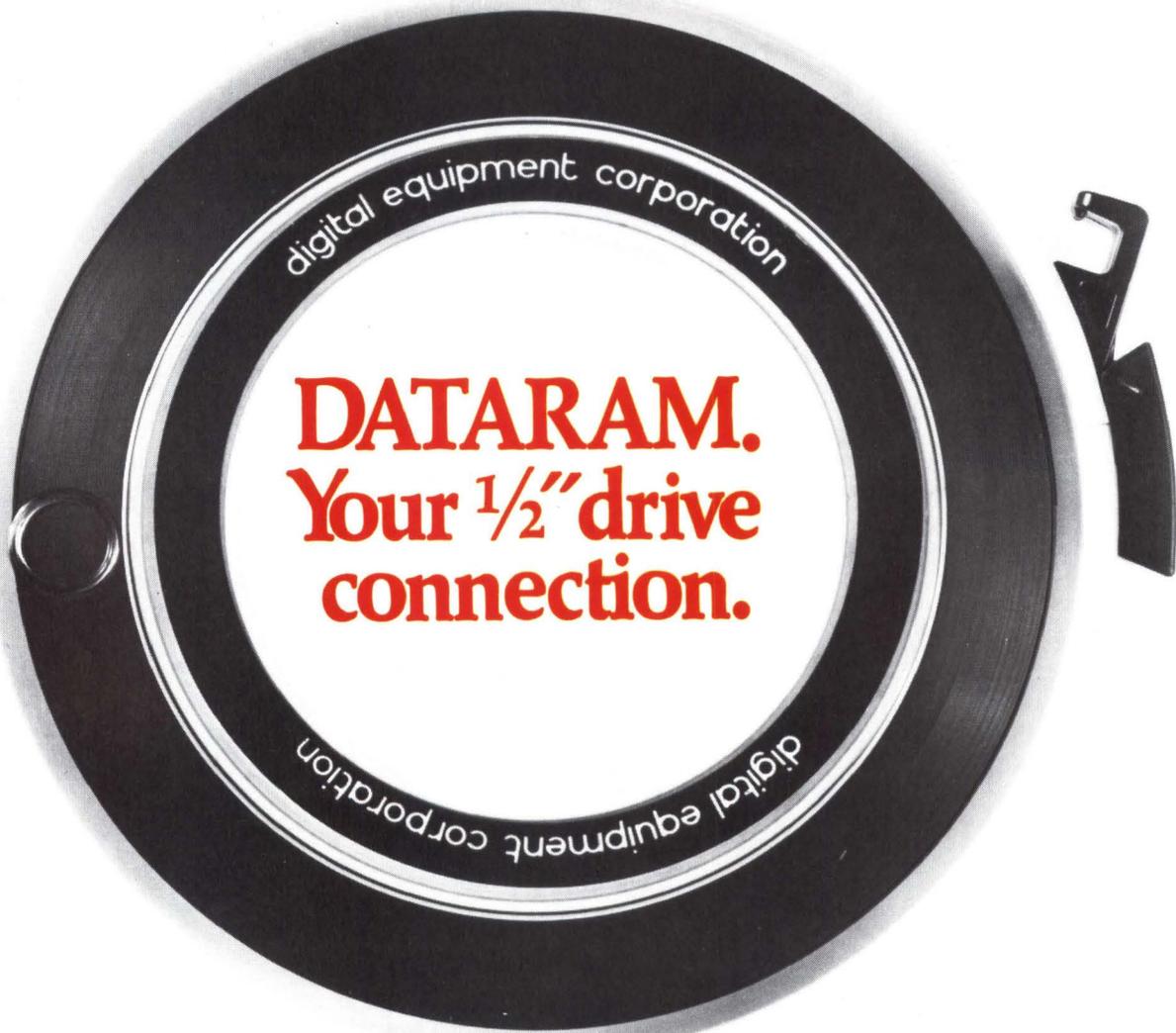
A CAHNERS PUBLICATION

OCTOBER 1983

Optical disk drive loads a gigabyte per 12-inch platter



H-P endorses sputtered disk media
Natural-language processing exits lab
Content-addressable memory reduces seek time



It's easy to interface your 1/2" drive to a DEC computer. When you have connections.

Dataram provides tape drive connections to your host LSI-11, PDP-11, or VAX computer, with a family of couplers/controllers that operate in NRZI, PE, or GCR modes. Dataram's couplers/controllers operate with 1/2" tape drives from all major manufacturers. As slow as 25 ips — or as fast as 125 ips. 200 BPI to 6250 BPI. With TM11 and TS11 emulations.

Start-stop or streaming. Efficient streaming is supported by a unique RSX-11M utility, FASTSAVE-11M, which provides optional backup and save capability for Dataram's streamer coupler. A full one-year warranty is standard.

For more information about 1/2" drive connections, call (609) 799-0071. We'll help you make the connection you need!

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AMPEX	KENNEDY	STC
CIPHER	PERTEC	TELEX
CDC	S. E. LABS	
DATUM	TANDBERG	
DIGI-DATA	TDX	

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DATARAM

CIRCLE NO. 1 ON INQUIRY CARD

With all the clamor about personal computers, a fundamental fact is often overlooked: some simply *work* better than others.

Consider the COMPAQ Portable.

A computer will make you more productive. A computer will make you more efficient. You hear it everywhere. But you don't hear much about which computer actually *works* best.

The COMPAQ Portable fits under a standard airline seat for business trips.

Works in more places

With the COMPAQ™ Portable, you can be as productive in your hotel room or your lake house as in your own office. It's a reliable companion on a business trip. It's a powerful sales aid in your customer's office.

You can move it from office to office to share its resources. You can move it into the conference room to answer questions.

What's more productive than a computer? A computer that works for you in more places.

Works with the greatest number of programs

The most important consideration when choosing a computer is "what programs will it run?"

The COMPAQ Portable runs more programs than any other portable. In fact, it runs more than most non-portables because it runs all the popular programs written for the IBM® Personal Computer without any modification. There are hundreds of them. They are available at computer stores all over the country.

Imagine the power of a *portable* word processor. There are dozens of word processing programs available for the COMPAQ Portable.

Planning, problem-solving, and "what-ifs" are a cinch with a variety of popular electronic spreadsheet programs. The COMPAQ Portable

runs them all.

There are accounting programs for anything from computerizing your family budget to full-scale professional management of payables, receivables, inventory, and payroll.

There are programs for making charts and programs for communicating with other computers.

So you get portability and you don't give up problem-solving power.

The combination adds up to the most useful personal computer on the market today.

Add-on options make it work the way you work

Inside the COMPAQ Portable are three open slots. Most portables don't have any. Electronic devices called expansion boards fit those slots and give the COMPAQ Portable new powers. As with programs, expansion boards designed for the IBM will work. With them, you can make your personal computer more personal.

Want to check a stock price? One expansion board enables the COMPAQ Portable to handle those communications over ordinary phone lines.

Want to use your company's central computer files while you're on a trip? There are boards that allow the COMPAQ Portable to communicate with a variety of large computers.

Other boards let you hook up controllers for computer games, increase memory capacity, or connect several personal computers in a network.

The added usefulness is free

The COMPAQ Portable doesn't cost any more than an ordinary desktop computer. In fact, it costs hundreds less than a comparably equipped IBM or Apple® III. The COMPAQ Portable comes standard with one disk drive and 128K bytes of memory, both of which are usually extra-cost options.

The bottom line is this—you just can't



All the popular programs written for the IBM PC run as is on the COMPAQ Portable.

buy a more practical, useful, productive computer. Compare the COMPAQ Portable.

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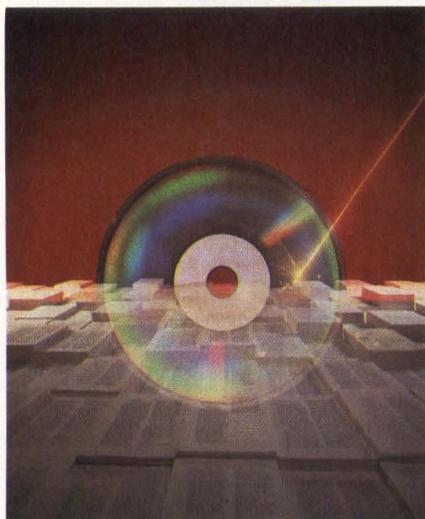
COMPAQ™

The most computer you can carry

Mini-Micro Systems

MINI-MICRO WORLD

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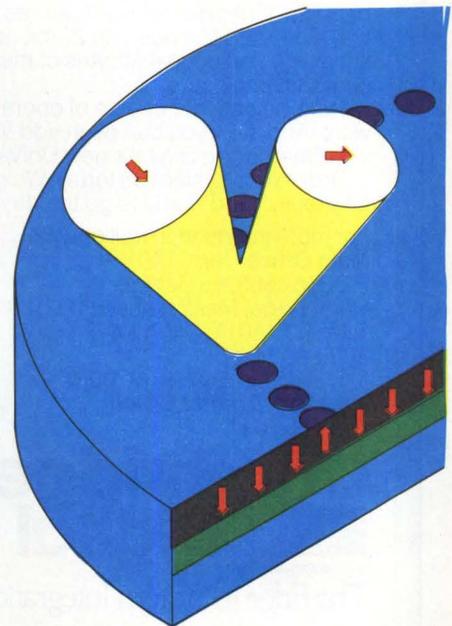
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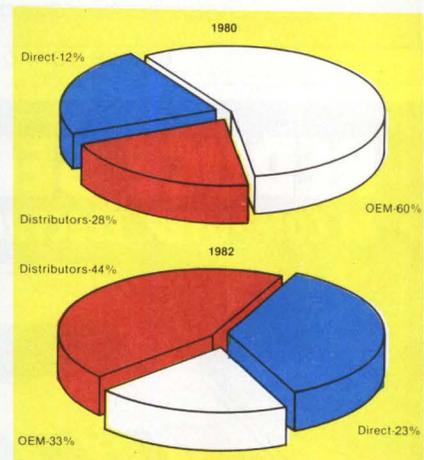
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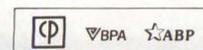
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p. 319 Preserving your good name



The New Definition of Performance



The CSS-800 Compact Storage System

The Problem—design a disk storage system that will raise the performance levels of a mini/micro computer by strategically managing data flow.

The Solution—our CSS-800, the most intelligent microprocessor-based storage system available today.

Our advanced architecture combines a cache memory with look-ahead buffering to cut access time by up to 90%, making your computer faster, more efficient, and more flexible than ever before. With 70 Mbytes of disk storage and 22 Mbytes of tape backup, our entry price, cost per Mbyte, and price/performance ratios are the best in the industry.

You need a storage system that is dependable as well as fast. The CSS-800 with Winchester technology affords maximum availability. Built-in diagnostics assure the reliability of all drives, controllers, and interfaces. Modular design makes repairs fast and easy. And we've backed the 800 with TRW's nation-wide service program to insure prompt and complete maintenance.

See us at Dexpo, Booth #1012 and Comdex, Booth #936.

The DEC Plug-in Solution Totally DEC* compatible, the CSS-800 emulates the RK07 disk and TU10 tape drives. System support is available under RSX-11M, RSTS/E and RT-11 operating systems as well as DSM, TSX, and UNIX. Q-bus or Unibus host interfaces are standard features. The whole rackmount or desktop package is only 5 1/4 inches high and weighs 42 pounds. Just plug our host interface into your back-plane and you're up and running with a truly compact and efficient system.

In today's complex world, the CSS-800 gives you a new definition of performance—more capacity and more speed for less money. Call us TODAY at (800) 368-2811, and we'll show you the technology of TOMORROW.

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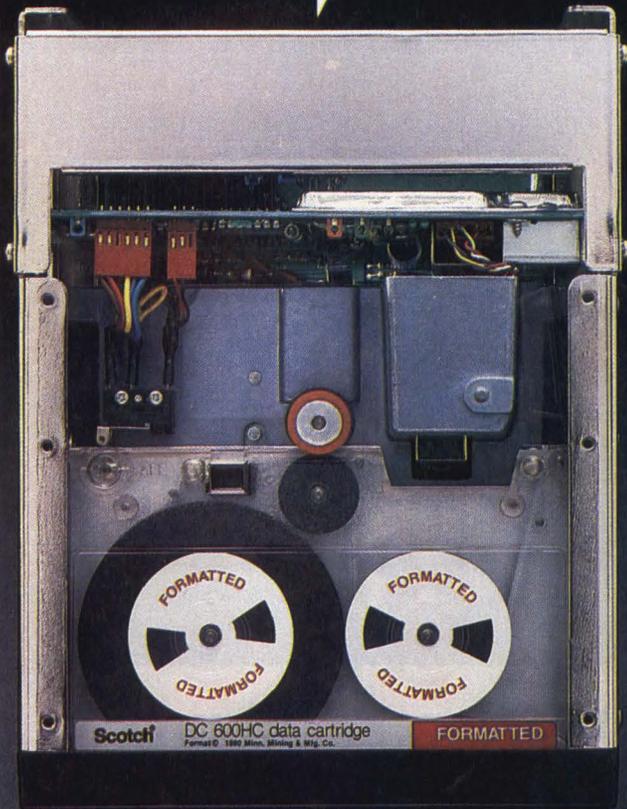
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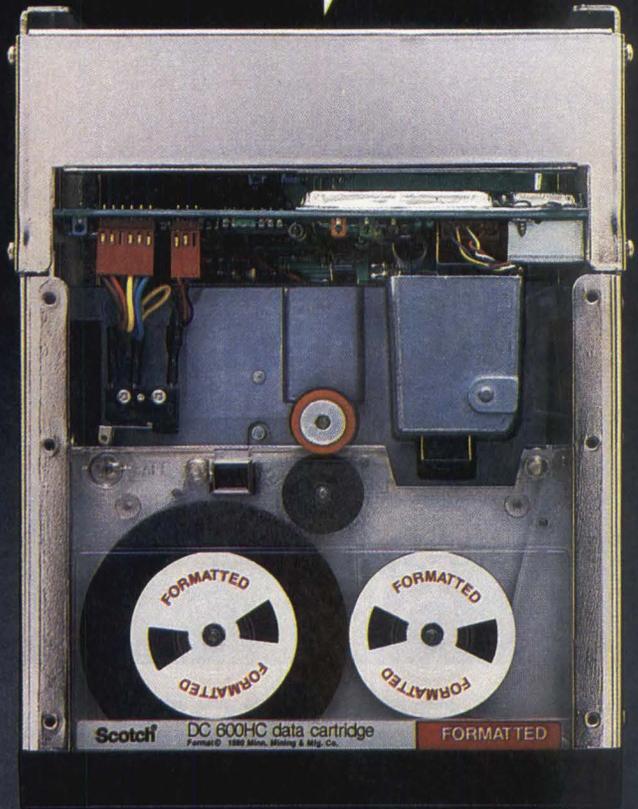


CIRCLE NO. 6 ON INQUIRY CARD

"I'M A
STREAMER."



"I'M BLOCK
ADDRESSABLE."



The HCD-75. It's both.

Meet the high capacity $\frac{1}{4}$ " cartridge back-up system with the split personality. The 3M HCD-75 does everything streamers do, and more! Now you don't have to choose between streaming and block addressability for data storage. The HCD-75 lets you design a reliable system that does both. Best of all, it's available right now — thousands of them are already in use — with the following high performance features:

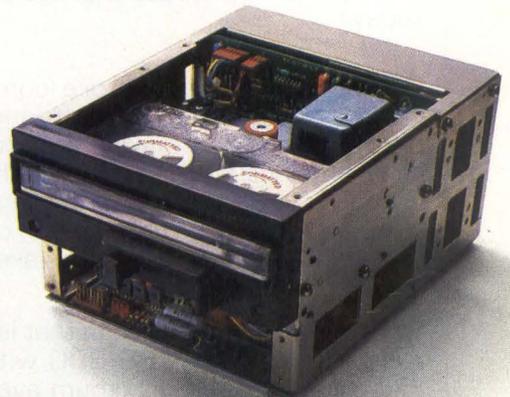
HIGH CAPACITY — a full 67 megabytes of formatted back-up storage — more than any other $\frac{1}{4}$ " system and most $\frac{1}{2}$ " systems.

DATA/CARTRIDGE INTERCHANGE — unlike some other systems, every HCD-75 drive

will read every 3M formatted data cartridge, no matter where it originated. A unique combination of stepper head and edge seek features allows unlimited cartridge interchange between drive systems.

COST EFFECTIVE — you get more for less. Total cost per megabyte with the HCD-75 is significantly lower than any other tape system.

Put it all together and you have one of the best friends a computer designer ever had: the 3M HCD-75 back-up system. For more information call (612) 736-9003 or write: Data Recording Products Division/3M, 3M Center 223/5N, St. Paul, MN 55144.



3M hears you...

3M

CIRCLE 125 FOR FIELD REPRESENTATIVE CALL. CIRCLE 135 FOR LITERATURE

Optical disk memory: new techniques, old problems

To satisfy ever-increasing mass-storage needs, system integrators and end users will soon have the opportunity to implement optical disk drives that offer higher storage capacities and lower cost per megabyte than magnetic disk drives. When incorporated into existing or new computer systems, these laser-based optic drives also promise higher resolution, lower power consumption and easier handling. Moreover, they should even compete favorably with the expected improvements in magnetic disk technology, such as vertical recording, thin-film heads and plated media.



But in their rush to market, optical disk drive manufacturers have chosen to employ the dubious marketing strategy of most infant technologies—the lack of standards or common approaches. For example, the manufacturers' optical standards committee cannot agree on disk diameter, composition, thickness or center-hole size. The result? Optical disks will come in a half-dozen different diameters, ranging from 2 to 14 inches, in erasable and non-erasable modes and in single- and double-sided formats. Other equally important standards issues that need clarification for system integrators include compatibility, interfacing and software—inherent complexities with any new technology.

As for applications, optical disk drives appear appropriate for data and document file storage and retrieval, off-line archival storage and on-line local storage. And, fortunately, they won't obsolete Winchester or floppy disk drives. In fact, they can functionally coexist in the same network or system with Winchester and floppy drives.

In evaluating such applications, though, system integrators and end users will probably move slowly and cautiously because the new and untested optical disk technology differs radically from the established and field-proven magnetic-disk technology. And optical disk drive manufacturers will contribute to that slowdown by not agreeing on universal parts and methods.

The successful introduction of optical disk technology into the high-volume product market centers on solving users' problems on a price/performance basis better than magnetic disk technology does. Let's hope that optical disk drive manufacturers haven't diffused their market penetration efforts by advancing individually rather than collectively.

George V. Kotelly
George V. Kotelly,
Editor-in-Chief

One SPIKE Can Cost DOWNTIME!

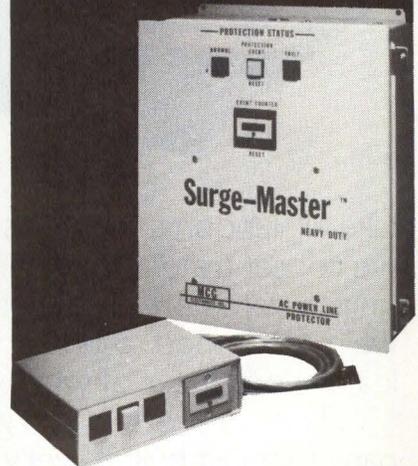
Overvoltage transients can bring the biggest installation down in a microsecond, or damage it cumulatively.

Surge-Master Heavy Duty Power Line Protectors give complete protection against all transients.

All computers and computer-based systems are vulnerable to transients in AC power lines caused by heavy motors starting up, power company load adjustments, welding operations—and of course, lightning. Even if your equipment operates from batteries charged by a UPS, you're not safe. If lightning knocked out your UPS, how long could you keep going?

The MCG Surge-Master offers two stage protection. The first reacts in nanoseconds to absorb lesser transients and the leading edges of major ones. The second stage absorbs the big ones, and has three modules on each line. So, in the unlikely event that one module should be knocked out, there are still two protecting you. And a system of indicator lights tells you not only when a fault has occurred, but exactly where it is. Modular construction makes replacement of damaged modules quick and easy. Initial installation requires minimal power interruption.

Available with capacities from 100 to 3000 amps; for 120, 240, and 480 VAC; and for single, 3 phase, wye and delta power systems. For more information, contact Dept. 30201 at 515/586-5125 or at the address below.



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CIRCLE NO. 7 ON INQUIRY CARD

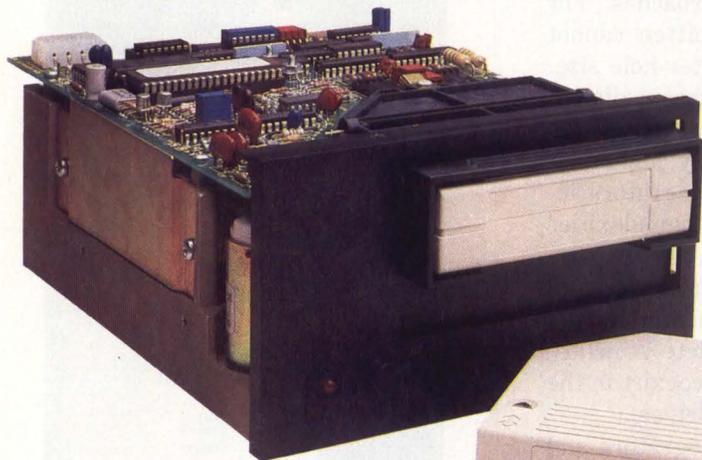
WE'RE A BRAND NEW COMPANY WITH A BRAND NEW PRODUCT.

WATCH EVERYONE DUMP ON US.

And read with us. And design with us. And depend on us.

Introducing the Tandon Tape Drive Company.

We're the newest of Tandon's advanced micro peripherals companies.



Like all Tandon companies, we concentrate all our energies on a single related product line. And like them, we're dedicated to becoming the world's leading producer of what we make best.

That's a pretty brash goal for a company that just built its very first tape drive. But we have the product to back it up.

INTRODUCING THE TANDON TM951 TAPE DRIVE.

What's the world's biggest producer

of micro peripheral disk drives doing in the tape drive business?

Building a half-inch tape drive with a capacity of 50 megabytes and an OEM price that's pure Tandon.

Everything about our streaming tape drive is pure Tandon. That's because we have the highest degree of vertical integration of any manufacturer in the business. Which means we can better control our costs and quality.

TO BUILD A DRIVE THIS GOOD, WE HAD TO USE OUR HEADS.

Tandon got its start as a head manufacturer. Our floppy heads quickly became the industry standard. Those are the very same heads we use on our new tape drive.

Our philosophy throughout has been to use evolutionary, rather than revolutionary, tape and floppy disk technology in our new drive. To lower costs and minimize risk for storing your back-up data.

That approach has paid off not only in a low price but also in high data reliability and performance.

With a soft



CIRCLE NO. 8 ON INQUIRY CARD

error rate of 1×10^9 and an MTBF of 8000 power-on hours.

FEATURES EVERYONE WILL WANT TO DUMP ON.

Our low cost and high reliability will help us become number one in disk back-up. So will our drive's great features.

The TM951 is the same size as a standard 5¼" floppy drive. It records on half-inch tape on twenty tracks, arranged in a serpentine pattern, using standard MFM format. And dual heads allow instant data verification while writing.

We not only make the drives, we also make the cartridges. From a unique Tandon design, using a video-style, self-threading, single reel for high performance and reliability.

DISK BACK-UP THAT KEEPS COSTS DOWN.

Providing the most advanced tech-

nology at the lowest possible price has made all Tandon companies leaders in their fields.

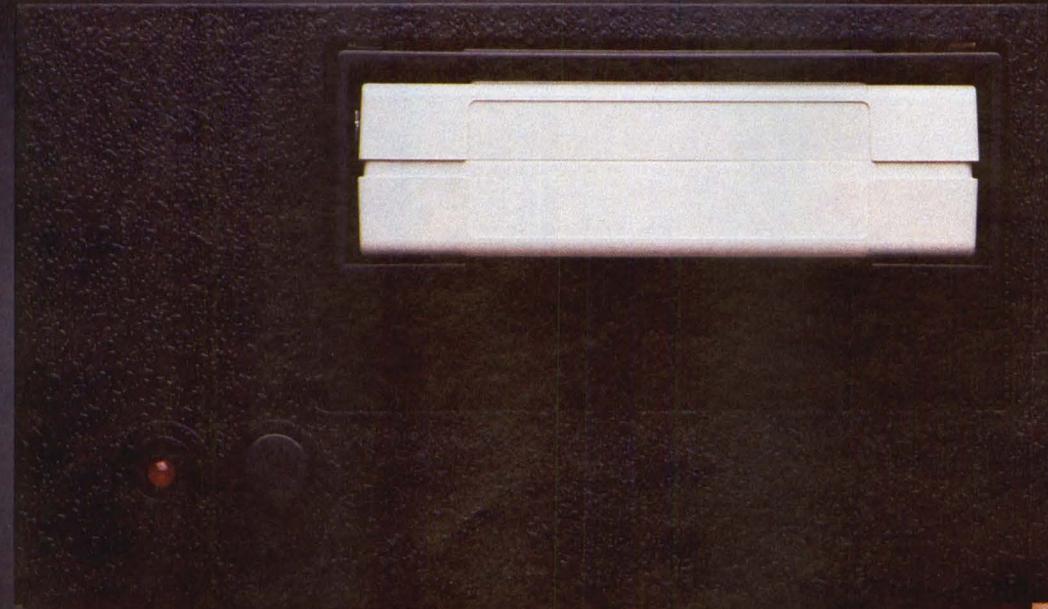
That's exactly how we intend to succeed in ours.

Five years ago our floppy company was a newcomer in a highly competitive market. Today it's the world's leading supplier of 5¼" drives.

That success story gives us a lot to live up to. Which is just what we've set out to do.

For full information on the newest tape drive from the newest tape drive company, call us. It's your chance to dump on us before everyone else does.

Tandon
THE MOST SUCCESSFUL DRIVE COMPANIES YOU EVER HEARD OF.



TANDON TAPE DRIVE COMPANY

Tandon Corporation, 20320 Prairie, Chatsworth, CA 91311, (213) 993-6644, TWX: 910-494-1721, Telex: 194794. Regional Sales Offices: Boston (617) 938-1916 • New York (201) 449-7720 • Atlanta (404) 934-0620 • Chicago (312) 530-7401 • Dallas (214) 423-6260 • Irvine (714) 675-2928 • Santa Clara (408) 727-4545 • Frankfurt, West Germany 6107-2091, Telex 411547 • London, England (0734) 664-676 Telex: 848411.

Kennedy's Model 9400 . . .

**2X the speed, 3X the density, 4X the capacity,
1/3 the cost.**

Kennedy's Model 9400 — an all-new nine-track vacuum column transport. Utilizing group-code recording, the tri-density 9400 has up to a 6250 bits-per-inch density and can store 180M Bytes of unformatted data, and all in a very small package. Model 9400 reads and writes industry-standard tapes and provides four times the capacity of conventional transports.

Model 9400 operates at 45 ips in the GCR mode and 75 ips in PE/NRZ1 modes with a rewind speed of 500 ips maximum with a nominal 350 ips speed.

The Model 9400 features four processors to separate data handling and control functions. An 8088 provides overall

system control and accommodates host input/output with a standard 4K-Byte data buffer expandable to 16K-Bytes.

Among the many features of the 9400 is its RS-232C communications port and complete internal software which permits off-line diagnostic operations by a terminal, the host computer, or by a remote test facility with a phone modem.

Best of all, Model 9400 is from Kennedy, designers of the finest peripheral tape products for twenty years.

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CIRCLE NO. 9 ON INQUIRY CARD

Breakpoints

IBM DROPS ITS NON-STANDARD MICROFLOPPY DRIVE

Just six months after IBM Corp. introduced a non-standard 102-mm., or 4-inch, microfloppy drive that was heralded as a major product for IBM's OEM marketers, the company has withdrawn the drive from the market. The company had planned to have the drive manufactured by Atlas Ltd., Hong Kong, a second source (MMS, September, Page 32). IBM now admits the drive's acceptance was less than resounding. "We've found that, despite our best efforts, the drive hasn't had a lot of market acceptance," says William Wachs, a senior OEM marketing representative for the company's Information Products division in Boulder, Colo. Others were less kind. "There was nothing mechanically wrong with the drive; it was producible, workable but simply not sellable," says Jim Porter, an independent disk drive analyst. Porter says IBM's withdrawal of the drive is highly unusual but not totally unexpected. A spokesman for a rival microfloppy manufacturer says the drive simply did not bring anything new to the market, and "even IBM couldn't make it a success." Another factor in the withdrawal was an unexpected rejection of the 4-inch specs at a meeting of the American National Standards Institute (ANSI) in Lake Tahoe, Calif., in late September. Not only did the drive fail to win any OEM contracts, it apparently did not win any acceptance within IBM. The company's Personal Computer division reportedly rejected the drive as incompatible with the present PC. Plans were in progress to put the drive on the forthcoming "Peanut" system. Atlas had announced development plans to gear up for what it expected to be a 1-million-drive-per-year contract. Atlas officials were not available for comment on IBM's withdrawal of the drive. IBM notes the drive will not be used in any future IBM products. It also does not disclose the number of 4-inch drives it had manufactured in Boulder or the disposition of the development and production team. In an official statement, the company says it has "every intention to proceed as an industry supplier of flexible disk products."

SEAGATE, TANDON JOIN FORCES FOR 5¼-INCH INTERFACE

Seagate Technology has formally introduced its ST-412HP high-performance interface as an upgrade from the industry-standard ST-506. The interface is the third entry in an interface controversy that began almost a year ago with the formation of the Enhanced Small Disk Interface (ESDI) committee by Maxtor Corp. (MMS, July, Page 34). Seagate brought some heavyweight endorsement to a recent press conference introducing its interface—including its chief rival in the low-end market, Tandon Corp. The main difference between ESDI and Seagate's interface is that Seagate's interface retains the data separator on the controller instead of the drive. The joint agreement is a first between the two top suppliers of 5¼-inch Winchester. In addition to Tandon, Atasi Corp. and Priam Corp. will manufacture 5¼-inch drives with the interface, while Western Digital Corp. and Adaptec Inc. have announced they will have controllers.

DATAPRODUCTS DEVELOPS DOT-MATRIX PRINTER

Some details of the long-rumored "Project Mercury" under development at Dataproducts Corp., Woodland Hills, Calif., have begun to emerge. Industry sources believe the project represents Dataproducts' first dot-matrix printer, to be introduced early in 1984, with initial product shipments beginning six months later. The printer is said to operate in both data-processing and letter-quality modes with a maximum print speed of 400 lines per minute. The printer should have graphics capabilities as well, and a four-color ribbon may be an option. Dataproducts officials decline comment on the report.

HARRIS TARGETS 3.9-MIPS ECL-BASED MINI AT BROAD MARKET

The computer systems division of Harris Corp., Fort Lauderdale, Fla., was expected to introduce early this month an emitter-coupled-logic- (ECL-) based superminicomputer, the Harris 1000, with a single-precision Whetstone rating of 3.9 million instruction per second (MIPS). Harris claims the 1000 offers the highest performance of any supermini. The new machine will be targeted at computer-aided design/computer-aided

Breakpoints

manufacturing (CAD/CAM), scientific and technical markets as well as high-performance business markets. The 1000 runs Harris' Virtual Operating System (VOS) and is compatible with all other Harris minis, the company says. The CPU has both 48- and 64-bit-wide data paths and seven-stage pipeline processing. The 1000 has an integral floating-point processor. Main memory ranges from 1.5M to 12M bytes. The system supports 48M bytes of virtual-address space. X.25 support and IBM 3270 emulation are provided. List price of a basic configuration including the CPU with 6K bytes of cache memory, a communications network processor, an operator console, the VOS operating system and dual cabinets for rack-mountable peripherals is \$250,000.

COLUMBIA SIGNS \$20 MILLION CONTRACT WITH HALLMARK

Columbia Data Products Inc. has signed a \$20 million contract with distributor Hallmark Electronics, Dallas. The order calls for Hallmark to take approximately 10,000 units of Columbia's IBM PC-compatible MPC desktop and VC portable personal computers over the next year. Hallmark is expected to resell the systems to small OEMs, systems houses and value-added resellers that Columbia does not reach with its factory direct OEM program.

TRICOM NETS DISTRIBUTION AGREEMENT WITH BIG 3 AUTO MAKER

Tricom Systems Corp., Hayward, Calif., an automotive vertical market systems house riding high on the resurgence of car sales, is expected to announce this month a five-year distribution contract with one of the "big three" U.S. auto manufacturers. The name could not be disclosed at press time. The contract calls for the manufacturer to market Tricom's automobile dealer maintenance department automation system to car dealers and involves joint research and development on future Tricom products. The initial value of the contract is estimated at \$11.2 million. Tricom officials say another auto manufacturer is ready to sign a \$5 million contract for the company's hardware.

MORROW DESIGNS ADDS HARD DISK SYSTEM

Morrow Designs Inc., San Leandro, Calif., planned to introduce a hard disk version of its MD computer line at the CP/M exhibition late last month in Boston. Called the MD11, the product includes the following accoutrements for \$2,745: an 11M-byte Winchester drive, the CP/M+ operating system, a 24-line/80-character monochrome terminal, Microsoft BASIC 80, BaZic (compatible with North Star BASIC), the LogiCalc spreadsheet package, a spelling checker by Morrow, the PersonalPearl database manager, 128K bytes of RAM, a keyboard, the Quest bookkeeping system and a 5¼-inch, 44K-byte floppy disk drive. The price is \$1,000 more than Morrow's floppy-based system. In mid-September, Morrow filed for a public offering, proposing 1.28 million shares of common stock at \$15 to \$18 per share.

TELEVIDEO EXPANDS SYSTEMS LINE WITH 80186 SYSTEM

TeleVideo Systems Inc. is preparing to expand its multiuser systems line at next month's Comdex show. It plans to introduce an Intel 80186-based system. The new 1608, which will replace the company's 8-bit 806/816, will be offered as a shared-resource controller for configurations of as many as 16 8- or 16-bit TeleVideo desktop systems. Like the preceding 806/816 series, the 1608 will use the company's Mmmost operating system, an executive that enables users of 8- and 16-bit CP/M packages to work together and exchange files. A 1608 with a 40M-byte Winchester disk drive, 256K bytes of RAM, a 1M-byte floppy drive and ports for eight workstations is expected to carry a \$7,995 price tag. In a separate development, TeleVideo worked out an agreement late last month with Digital Research Inc. giving the software house rights to TeleVideo's TeleDraw graphics package. The two companies are also working closely on future software releases, TeleVideo officials say.



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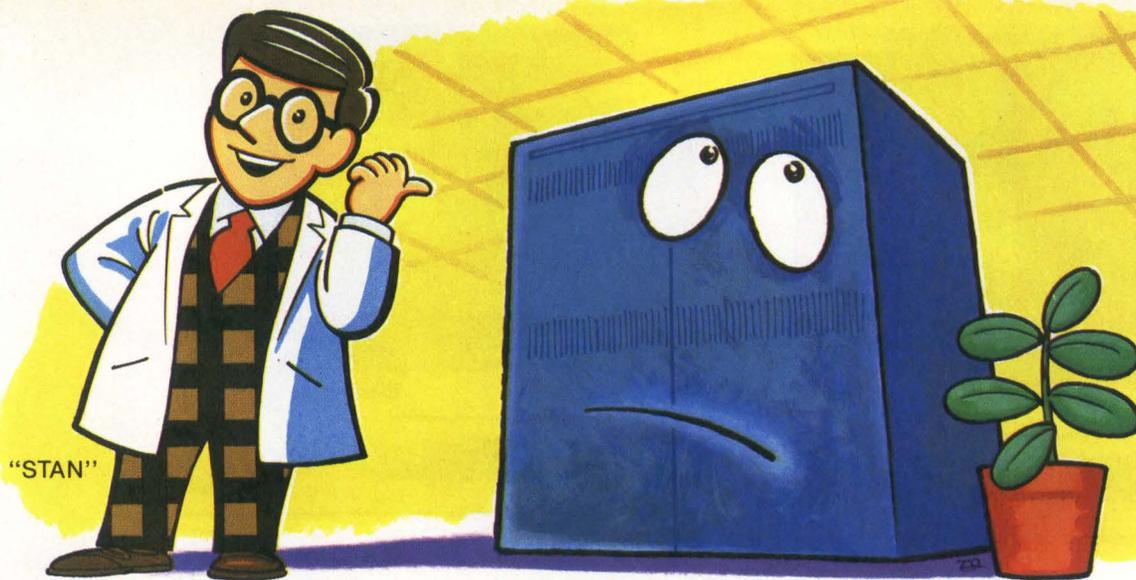
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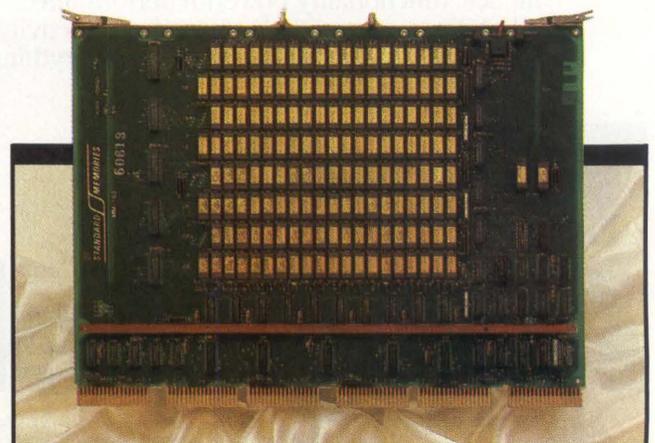
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Breakpoints

HP TO SUPPORT FOUR PERFECT SOFTWARE PROGRAMS ON NEW MICRO

Hewlett-Packard Co. has agreed to purchase and market four programs from Perfect Software, say representatives of both companies. HP will have different versions of Perfect Writer, Perfect Speller, Perfect Calc and Perfect Filer for its new touch-screen model 150 and its previous personal computers. The programs are expected to be available this year. Combined with support of MS-DOS, DBase II, Lotus 1-2-3, WordStar, VisiCalc, M-BASIC and other software for its new touch-screen model, the agreement would continue to move HP's newer personal computers to markets outside its traditional technical and engineering base.

NORTHWEST SOFTWARE ASSOCIATES LINKS IBM PC, INTEL DEVELOPMENT SYSTEM

XFERPC, a new communications package from Northwest Software Associates, Spokane, Wash., allows IBM PCs, PC-XTs and most compatibles to exchange and compare files with Intel Corp. microcomputer development systems, regardless of the structure or content of the files. Jointly developed with Selkirk Software, also of Spokane, the package is designed to be used by field-service personnel with PC-compatible portables, by engineers working at home and by users of Intel microcomputer development systems. The \$200 package has two flexible disks and is available in customized OEM versions.

SYSTEM LETS VT100 EMULATE IBM PC

Vendors continue to bring out new products that promote the coexistence of personal computers in distributed environments. Some personal computers "act as" the Digital Equipment Corp. VT100, IBM 3270 and other terminals; other add-on devices from third-party vendors allow terminals to double as personal computers. Santa Clara, Calif., start-up Solaris Computer Corp.'s initial offering, expected late last month, enables VT100s and VT100 clones to emulate the IBM PC. The \$2,595 PCE workstation contains an Intel 8088 processor, 128K bytes of memory expandable to 600K bytes and two 320K-byte, 5¼-inch floppy disk drives. Solaris says the screen can be split to show distributed-processing and MS-DOS applications simultaneously. Price of the system includes MS-DOS and BASIC.

KONTRON INTRODUCES ENTRY-LEVEL DEVELOPMENT SYSTEM

Kontron Electronics, Culver City, Calif., should introduce the KDS-908 development station at next month's Wescon show. Priced at \$6,500, the unit will support Kontron's in-circuit-emulation (ICE) and logic-analysis modules, with sets available for 80186, 80188, 8086, 8088, 8085, 8080, 68000, 6809, Z8001, Z8002, Z80, NSC800 and the 65XX family. The KDS-908 can be used as a complete single-user system or as a workstation in Kontron's development systems.

ALPHACOM TO INTRODUCE DAISY-WHEEL PRINTER FOR HOME MARKET

Alphacom Inc., a Campbell, Calif., producer of thermal printers, is reportedly considering an early 1984 entry into the low-end daisy-wheel printer market. Price of the new letter-quality printer has not yet been set, but company officials believe a low-speed unit could be offered for less than \$400. Manufacturing will be performed by the company's suppliers in Hong Kong and Taiwan, which are now producing more than 35,000 units a month of Alphacom's thermal-printer line. As with the thermal printers, the target market for the letter-quality daisy-wheel unit will be home computer users, and Alphacom is likely to apply its strategy of offering changeable interface cables for each computer system to its daisy-wheel line.

TECHFILES: A quick look at industry developments

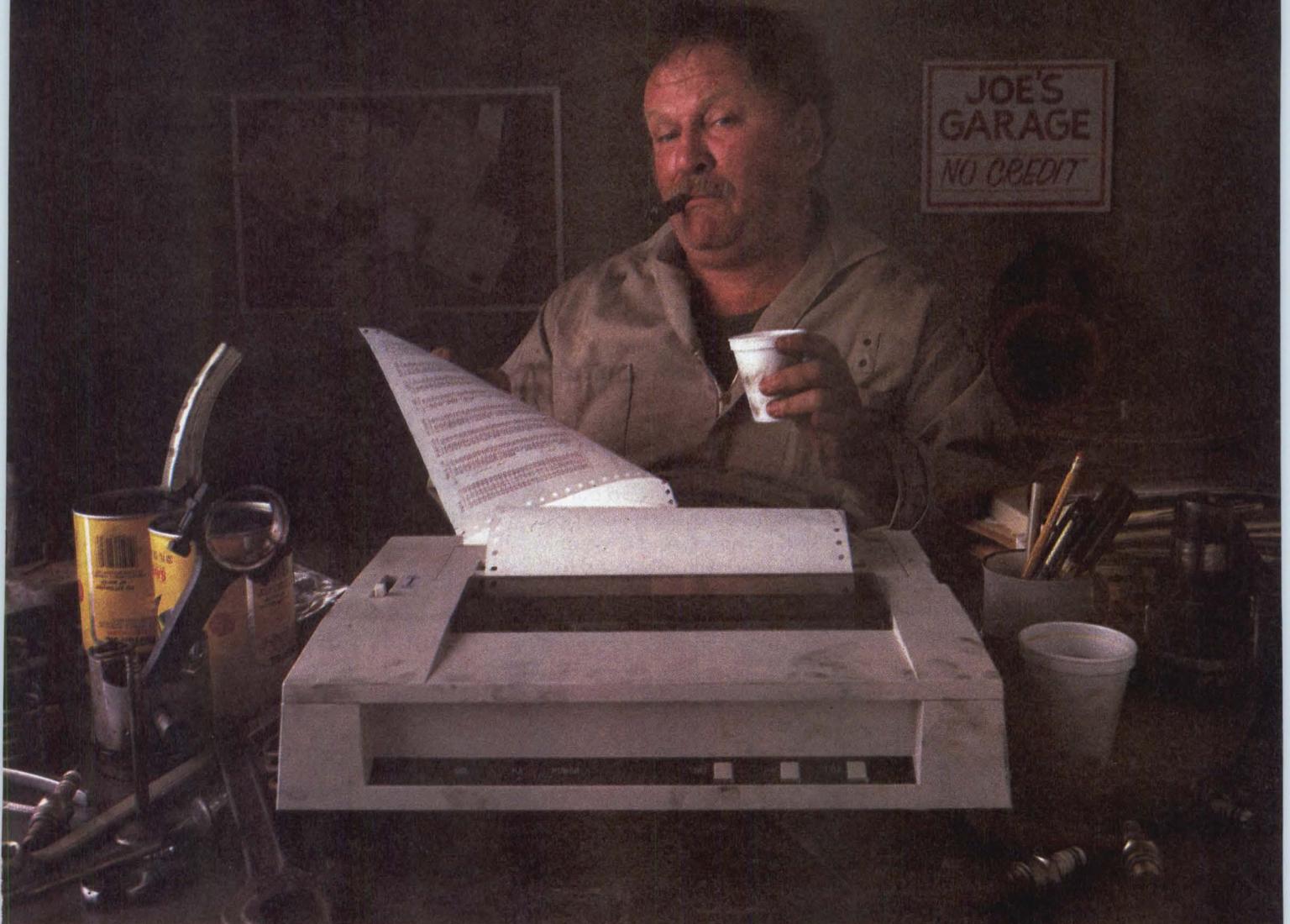
DEXPO Preview: Over 400 new DEC-compatible products should be introduced at DEXPO/West at the Las Vegas Convention Center, Oct. 23-26, according to Expoconsul International Inc., the show's sponsor. Approximately 400 vendors are expected to exhibit to as many as 8,000 attendees. Expoconsul anticipates that two-thirds of the

Breakpoints

approximately 2,000 to 2,500 Digital Equipment Corp.-compatible products will be software applications. Preliminary press information indicates that there may be less software introduced for the Professional personal computer series than at DEXPO/East last May. The May show featured many applications that were ported to the Professional from the VAX and PDP-11....The **Independent RSTS Users Society (IRUS)**, which will exhibit at DEXPO/West, notes that its name will soon change to include all DEC computers and operating systems. IRUS officials say they found an increasing number of members converting from RSTS systems to VAX operating systems....The DEC-run **DEC Users Society (DECUS)** Conference will be held from Monday through Friday nearby at the MGM Grand. Industry sources say DEC may hold off the expected introduction of its VT200 series terminals until after DECUS....Exhibitor **Compu-Share Inc.**, Lubbock, Texas, plans to release interactive order-entry and inventory-control packages for RSTS. Called OE-11 and IC-11, respectively, the packages have been ported from the VAX/VMS operating system. Compu-Share says the packages, written in DIBOL, provide on-line inventory updates and are designed to be integrated with Compu-Share's AR-11 accounts-receivable package. Prices for combined OE-11 and IC-11 packages range from \$5,500 to \$8,500, depending on hardware....**Computer Information Systems**, Braintree, Mass., is expected to announce VMSACTSYS, a menu-driven resource accounting package for VAX/VMS. The system monitors and bills for system resources and software used on single systems or systems connected via DECnet. Price is \$2,995....**Scientific Information Retrieval Inc.**, Evanston, Ill., plans to port its SIR/DBMS scientific database-management system to VAX/UNIX systems. The system supports relational, hierarchical and network data structures, as well as inverted lists and multiple record types....Two products for connecting PDP-11s and VAXs to an Ethernet local-area network (LAN) should be unveiled by **Able Computer**, Irvine, Calif. The EASYWAY controller supports layers 1 through 4 of the International Standards Organization model. CONNECT software handles the layer 5 session protocols. EASYWAY list price is \$7,200. CONNECT list price is \$1,000....**Grant Technology Systems Corp.**, Chelmsford, Mass., plans to feature three new analog input boards for Q-bus microcomputer systems. Speeds of the single-slot, DEC-standard-sized 8.9-by-5.2-inch boards are 50 to 200 KHz. List prices range from \$1,295 to \$1,795....Console-configurable magnetic-tape controllers for LSI-11 and PDP-11 systems are expected to be introduced by **MDB Systems Inc.**, Orange, Calif. Configuration information is stored in non-volatile static RAM. List price for the Q-bus controller is \$2,600. List price for the Unibus controller is \$2,950. MDB should also unveil a disk controller for LSI-11 systems that automatically configures any of eight RM and RK disk drives.

Random disk files: The 3½-inch microfloppy disk drive form factor may be boosted by yet another heavyweight manufacturer—Apple Computer Inc. Although neither side has confirmed it, **industry observers expected Apple to announce a major contract for the Sony Corp. microfloppy early this month.** The microfloppy is expected to be featured in the forthcoming Macintosh microcomputer, a less pricey Lisa version, now expected in January. Sony's microfloppy dominates the sub-5¼-inch floppy market, largely due to Hewlett-Packard Co.'s commitment to use the drive in its personal computers. HP has shipped 60,000 of the microflops; that number is expected to rise with the introduction of HP's newest personal computer in September....**Unconvinced the Sony drive will be standard is Micro Peripherals Inc. (MPI)**, Chatsworth, Calif., a major supplier of 5¼- and 8-inch floppy drives. MPI rowed against the tide initially to endorse the Hitachi-Maxell 3-inch drive and now will support the 3½-inch drive. Peter Banhazl, marketing manager for floppy disk products, says the Sony microfloppy has "certain flaws," not the least of which is an unclear migration path to double-sided,

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Breakpoints

double-density recording. Under MPI's licensing agreement, the company will manufacture 3¼-inch drives designed by Tabor Corp., Westford, Mass. Banhazi says "major systems contracts" are in the works implementing the Tabor drive....While the dust on the microflop controversy stirs, **some makers of sub-5¼-inch Winchester disks have settled on a proposed media-dimension standard.** The standard calls for rigid media to be 95 mm. (3.74 inches) in diameter and 1.27 mm. (0.050 inches) thick. No standards on media magnetic characteristics or areal densities have been set, however. Those agreeing to the standard include drive makers Seagate Technology and MiniScribe Corp. and media makers Dysan Corp., KSI Disk Products, Nashua Corp. and Poly Disc Systems. Applied Information Memories, a recent disk and media start-up (MMS, September, Page 40), has endorsed the standard for both its disks and media....**Computer Memories Inc.** plans at the Comdex fall show to add two high-capacity, 5¼-inch, closed-loop Winchester disks to its line, which was announced at the National Computer Conference last spring. The newcomers are expected to have 60M-and 80M-byte capacities, making them the new top-of-the-line models.

Terminal files: As expected, **Wyse Technology has followed up last month's introduction of the WY-50 with an American National Standards Institute (ANSI) standard version of the same unit called the WY-75.** At a single-quantity price of \$795, the WY-75 is priced \$100 more than the WY-50. Both terminals feature a 14-inch diagonal tilt-and-swivel screen with 80- or 132-column displays. Wyse is also said to be considering introduction of a desktop computer built around the WY-50 terminal.

Micro files: Wang Laboratories Inc. may have tapped a lucrative new outlet for third-party distribution by targeting the soon-to-be-independent regional Bell System operating companies. The first such distribution agreement should be signed this month with Southern New England Telephone's Sonacor Systems division. The contract is expected to cover a number of Wang products including word processors, personal computers, voice-mail systems and 32-bit minicomputers, all of which will be sold with a new NEC America Inc. data/voice digital PBX.

Printer files: Radio Shack recently introduced a drop-on-demand ink-jet color graphics printer. The CPG-220 is to be sold for \$699 at Radio Shack outlets. The unit prints seven colors at 2,600 dots per second (dps) in a graphics mode or 37 characters per second (cps) for text with 7-by-5 dot-matrix characters. Resolution is 640 dots per line to "dump" a CRT screen on the TRS-80 Color Computer.

Mini files: In mid-September, IBM Corp. introduced two medium-sized 4300 series computers, the 4361 and 4381, until then known as the "Glendale" project. The two fill a gap between the 4300 family's earlier members and 308X series processors. The higher-end 4381 runs the MVS-XA virtual-storage extended-architecture operating system. The 4361 is targeted at scientific and engineering markets and thus may be the most threatening move by IBM against such competitors as Digital Equipment Corp. and Data General Corp. Prices range from \$150,000 to \$620,000....**DG,** Westboro, Mass., reportedly will present a paper at the upcoming IEEE International Conference on Computer Design on a five-chip version of its 32-bit Eclipse MV/8000 supermini. DG joins Hewlett-Packard Co., which has a single-chip, 32-bit processor at the heart of its HP-9000 system. DEC is known to be working on a four-chip version of its VAX supermini. DG spokesmen decline comment on the product.

Breakpoints

Notes from overseas: Forever upbeat, **Comdex Europe** management is predicting a turnout of 10,000 qualified attendees, up 25 percent from last year's gathering, when it opens its doors this month on the second of these annual affairs. Probably, a few computer mavens, party to last year's unqualified debacle, are around to raise skeptical eyebrows over claims that anything approaching 8,000 qualified independent sales organizations (ISOs) turned up for the '82 Comdex/Europe launch. Giving credit where credit is due, however, this year's Comdex has managed to lure as exhibitors both IBM Corp. and Digital Equipment Corp., two trendsetters noticeably absent last year. Comdex/Europe director Wim Van Halder says he's also noticed another new wrinkle or two in the exhibitor ranks. For instance, the Japanese, who were nowhere to be seen last year, should account for 10 to 12 percent of the anticipated 250 stands. Van Halder figures 20 percent of the companies there last year won't return. American firms with no marketing arm of their own in Europe will be less well-represented than last year. Their places have apparently been filled by small low-profile European companies. The question is: will the 1,800 expected exhibitors really get to meet the folks they're spending all this money to see? Van Halder's studies peg the whole European remarketing population at 20,000 ISOs. To attract them, Comdex has launched a two-wave publicity campaign. The first, in five languages, hit at the end of August. The second, in French, German and English, was kicked off in the last weeks of September. The campaign will account for 535,000 fliers either mailed directly or inserted into European computer publications, plus some last-minute advertising. But these books are primarily end-user, not dealer, publications. Despite all the hoopla, Comdex's existence doesn't seem to have made much of an impact on the fragmented European consciousness. The talk is about Sicob last month in Paris, the giant German Systems show in Munich, West Germany, the week before Comdex begins and the upcoming Compec '83 in England next month.

IBM is said to have up to 80 percent of the targeted 1,000 PC dealers in its Europe/Middle East/Africa division. In Germany, for instance, the count is now at 79, even though the local resellers balked at first about signing with IBM because it had already lined up Metro, the country's largest discount house, as a dealer (MMS, August, Page 14). IBM Deutschland is going to be the first of the European subsidiaries to have its own chain of retail stores selling the PC. Expectations are for 10 stores to be set up in major German metropolitan areas over the next 18 months.

Apple Computer Inc. last month was very tight-lipped about the restructuring of its European operations, planned this month. Apple executives say only recently-promoted Apple Europe general manager Michael Spindles and ex-ITTer Phil Chevaux are privy to the details. Apple should create five marketing regions. France, Italy, Germany and the United Kingdom are expected to operate as independent entities, but the rest of Europe will be grouped together and fall under the tutelage of Chevaux, working out of Zeist, the Netherlands.

English **IBM** dealers are wondering whether the announcement they're expecting from Big Blue on Oct. 10 will be a Value Added Remarketer (VAR) program for the PC or debut of the 32-bit Series/1 box that was spotted a few weeks ago in the pre-production test area of IBM's manufacturing facility in Boca Raton, Fla. IBMers said at the time the delay in the machine's release was the question of whether to call it Series/1 or introduce it as a whole new line. Meanwhile, IBM is said to be revving up to make as many as 100 worldwide product announcements this fall.

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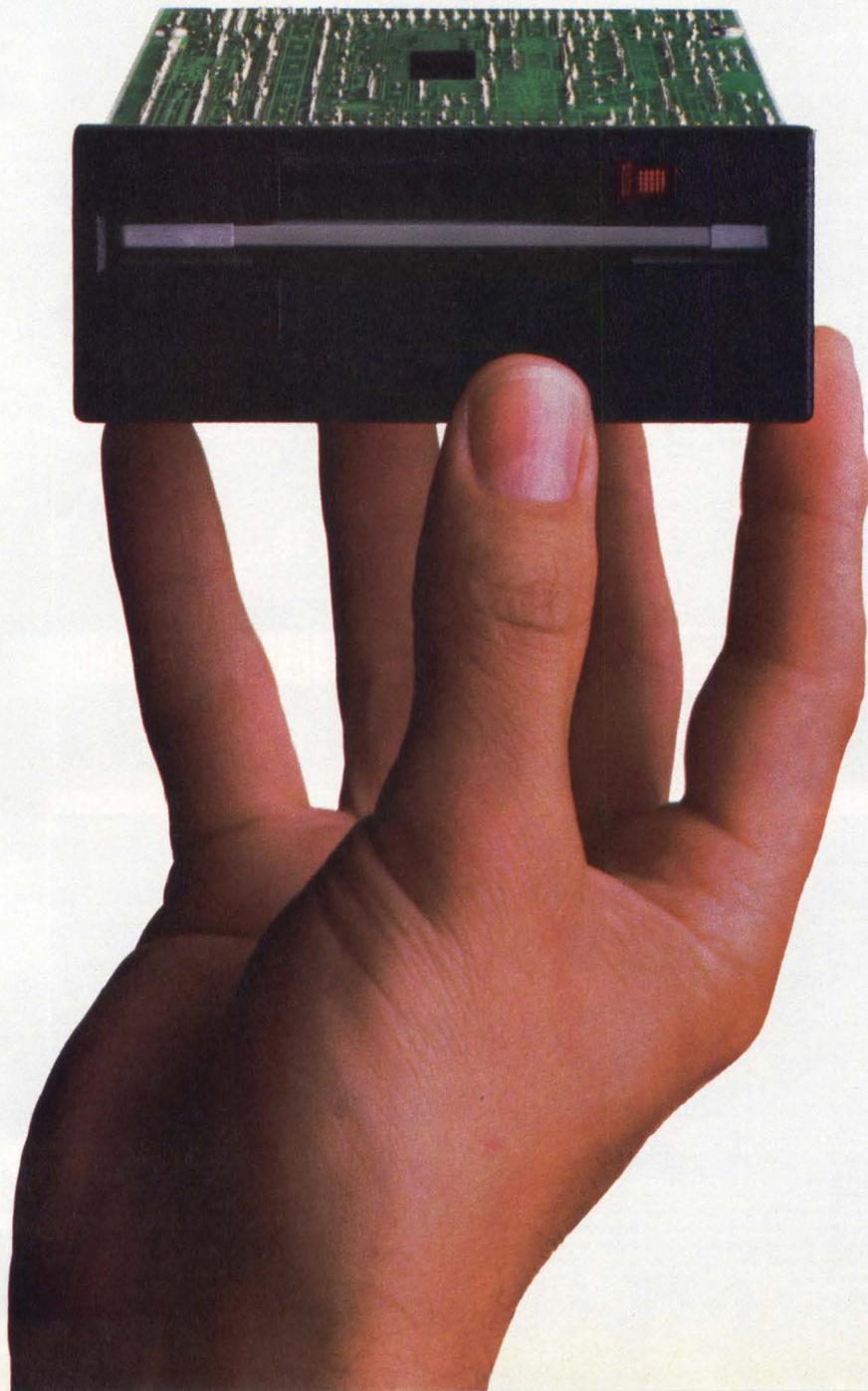
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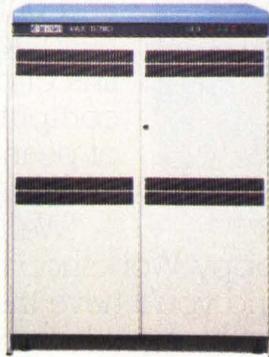
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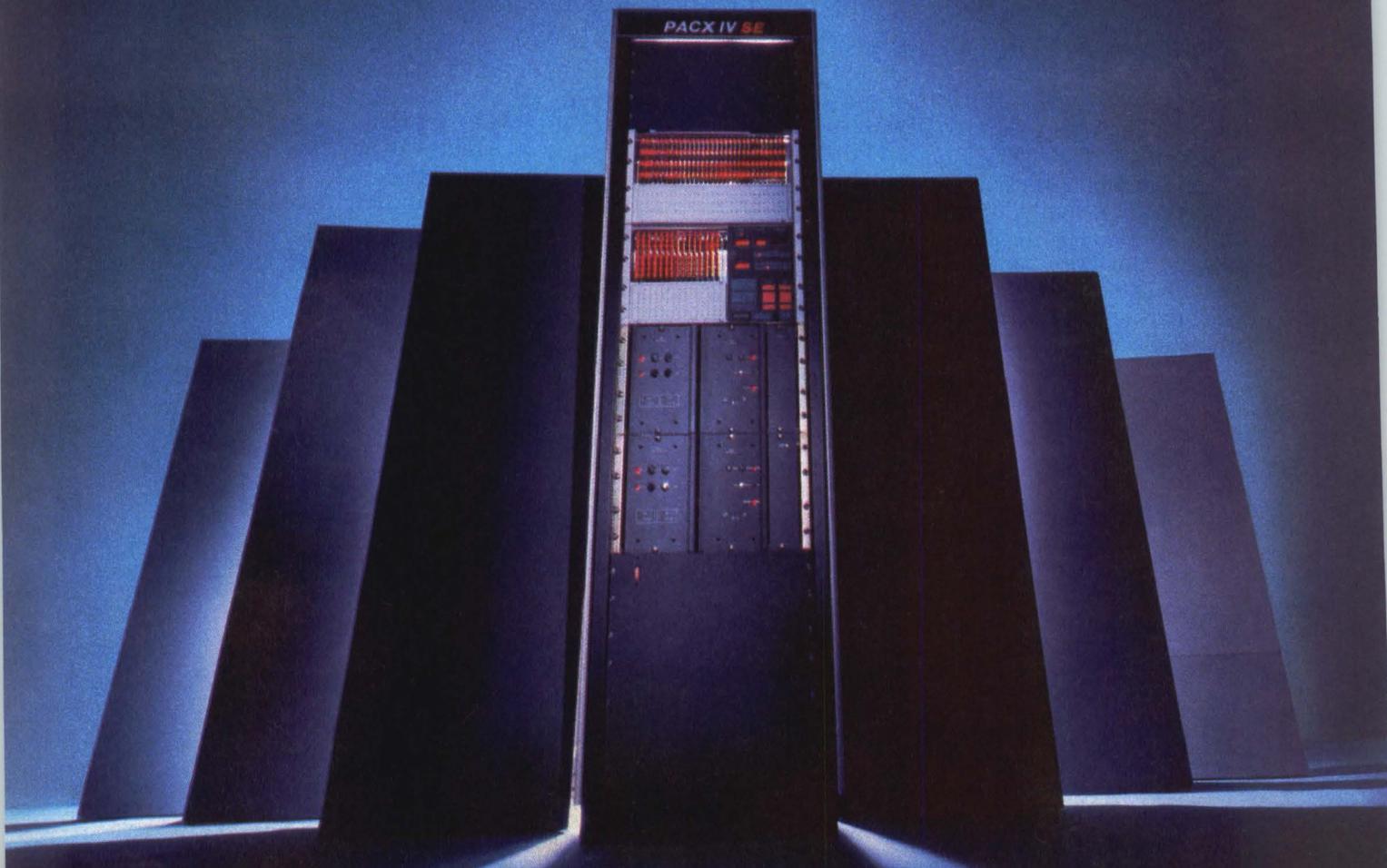
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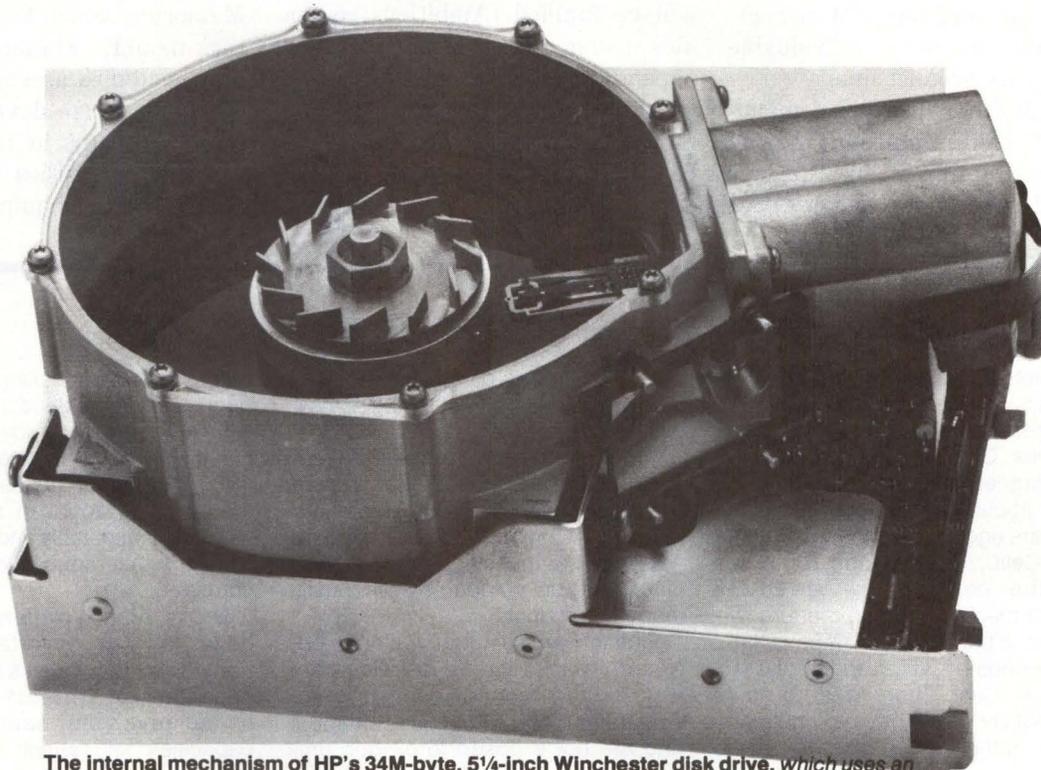
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The internal mechanism of HP's 34M-byte, 5¼-inch Winchester disk drive, which uses an HP-developed thin-film sputtered disk.

HP endorses sputtered media in forthcoming drives

Hewlett-Packard Co. has thrown its considerable weight and about \$30 million behind an endorsement of sputtered thin-film media for forthcoming Winchester disk drives (see "HP approaches sputtered media with caution," Page 28). Industry observers speculate that IBM Corp. and Digital Equipment Corp. are not far behind in adding thin-film media for today's 5¼-inch and smaller disks.

"The technology is likely to get widespread acceptance over the next year as higher recording densities require it," asserts disk drive industry analyst James Porter. Sputtered media has recording densities potentially four times greater than those of conventional oxide media, notes HP's James

Stinehelfer, marketing manager for the Boise, Idaho, Disc Memory division.

Despite differing opinions on whether sputtering or plating is how to achieve higher recording and track densities, HP is firmly in the sputtered camp. HP will use the technology on all its future small drives, beginning with the 5¼-inch "Nickel," HP's first small drive, which is expected to be introduced in January. Until now, HP has purchased its 5¼-inch Winchesters from Seagate Technology.

Nickel will be used in high-capacity applications, beginning with the first 41M-byte model (34M bytes formatted), which could ultimately see service in HP's 32-bit series 9000 desktop engineering

stations. Nickel is strictly a captive product in various HP systems, states Stinehelfer. The company's second product to use sputtered media—likely to be in production by next March—is a 3½-inch disk that is expected to become an OEM product.

Although HP hoped to introduce the 5¼-inch product last summer, it found the bugs that are typical in the first production of a new technology product. As a result, Nickel may have missed its market window, says an HP staff member. This would not necessarily hinder the company. "HP has the means to generate a lot of business within its own ranks," comments Porter.

HP's real market push will come when it introduces the 3½-inch Winchester, which is likely to fit on its new personal computer that uses Sony Corp.'s 3½-inch microfloppies (see "PC market is instrumental to HP's future," Page 29). Between its

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captive needs and the OEM market, HP expects to have a valuable addition to its product line.

Although other disk drive manufacturers take comfort in the promise of thin-film media, they are concerned about when that promise

will be fulfilled. Ambitious companies using new technologies will depend on an available supply of reliable thin-film media. Such companies include Maxtor Corp., which has developed a 380M-byte, 5¼-inch drive, and Applied Information

Memories, which has an 821M-byte, rack-mount, 5¼-inch drive with four head/disk assemblies.

Ampex Corp. developed the first thin-film media in 1966 to increase recording densities in its "instant-replay" video equipment. Only in

HP APPROACHES SPUTTERED MEDIA WITH CAUTION

Hewlett-Packard Co. approached the decision to gamble \$30 million on sputtered media with typical caution, observes Glen Moore, manager of HP's Magnetic Recording Technology center about the project that began five years ago in the company's Santa Rosa, Calif., research labs. He recalls that the company reviewed all thin-film media from both manufacturers then in the market—Ampex Corp., El Segundo, Calif., and PolyDisc, Torrance, Calif. There was no doubt then that HP would have to make and control rather than buy its media

because of a lack of outside suppliers and the uncertainty of using a new technology.

"Sputtering simply allows greater control of the magnetics," Moore comments. There are still no sputtered disks on the market, although Applied Information Memories and other start-up companies are busily readying products.

Plating involves many steps, between which the substrates are exposed to oxygen. In sputtering, the substrates enter a vacuum chamber and are not exposed to oxygen until

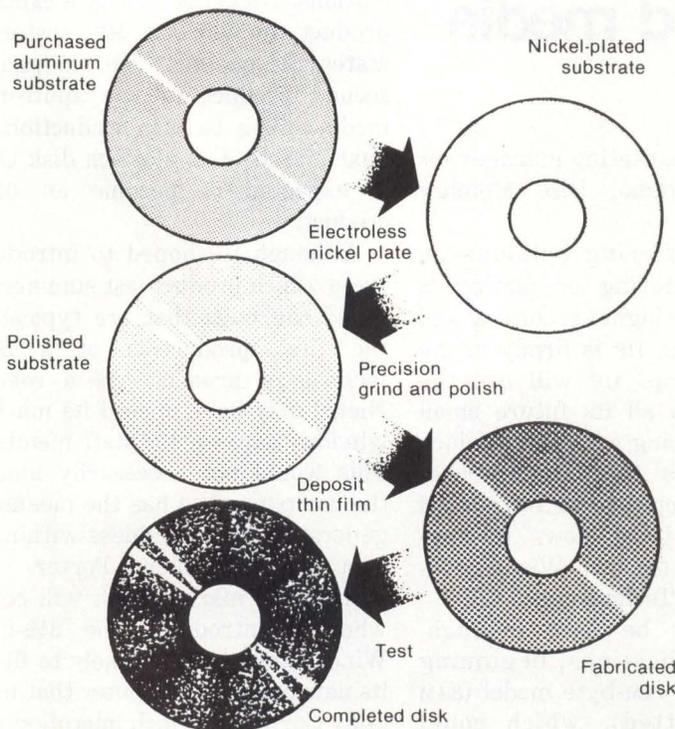
the process of depositing a thin film of magnetic particles is complete.

HP's sputtering process also eliminates the use of lubricants, reducing the chance that heads will stick to their landing zone. In addition, HP's head/disk assembly includes chemical filters that reduce wear caused by corrosion.

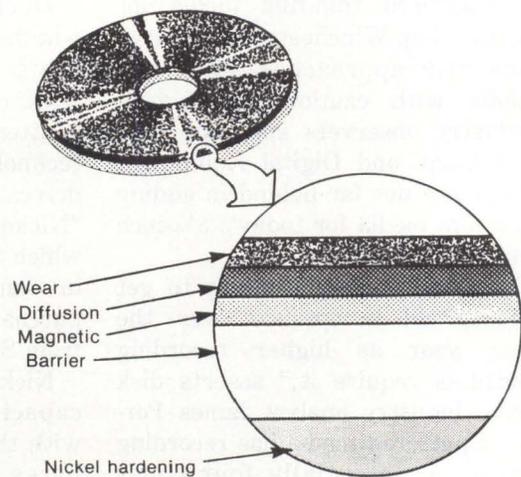
Unlike 14-inch platters, which allow heads to fly at comfortable distances from the media, today's 5¼-inch disks bring the heads at least 10 µin. closer to achieve the same recording capacities as 14-inch disks in less space.

Moore believes thin-film media may obsolete HP's bulky 14-inch disk drives as smaller drives achieve higher capacities. Although HP plans to manufacture 8-inch thin-film platters, it will not build 14-inch thin-film disks, he says.

THIN-FILM RECORDING DISK MANUFACTURE



THIN-FILM DISK LAYERS



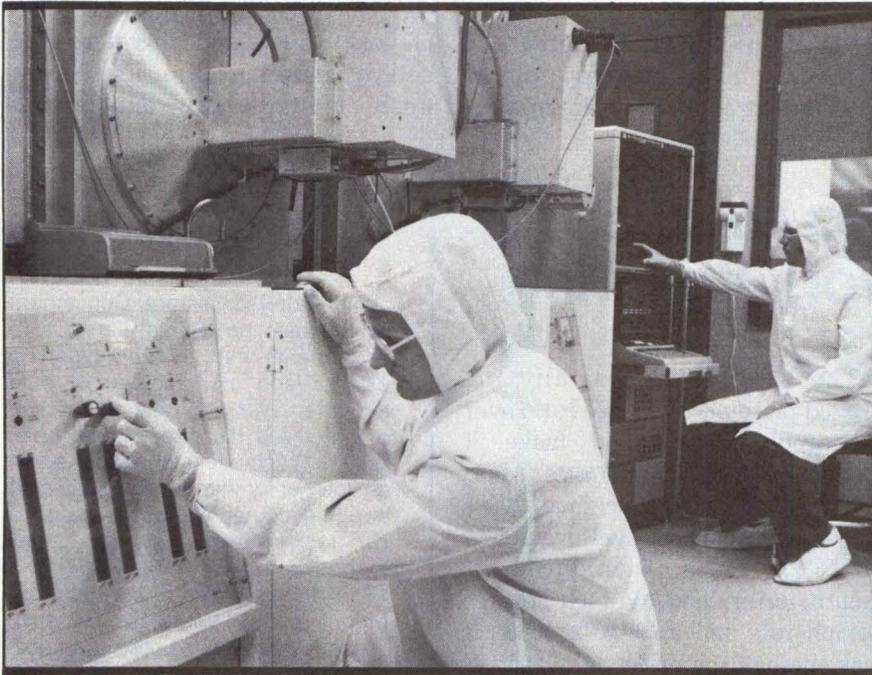
recent years, however, has the growth of the market for 5¼-inch Winchester forced disk drive manufacturers to look beyond oxide media to achieve higher densities in a small space. The demand for thin-film media has forced Ampex

into an enviable but difficult role as the only one that can manufacture very high volumes of plated disks.

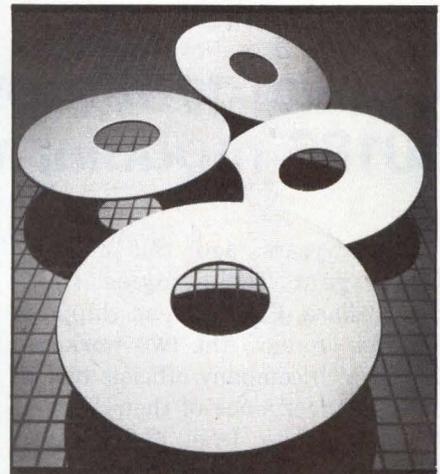
IBM has invested millions of dollars in sputtered thin-film media at its General Products division in San Jose, Calif. The company has

given no warning about when the product will be announced.

DEC has also invested in thin-film media research without an announced product. However, in July, news leaked out of the company's Maynard, Mass., headquarters about a multimillion-dollar contract with Evotek Corp., a two-year-old manufacturer of high-capacity, 5¼-inch Winchester drives and thin-



HP uses an in-line deposition system to manufacture sputtered thin-film media.



HP manufactures its own sputtered thin-film media because there are few outside suppliers and it can control its supply and yields.

PC MARKET IS INSTRUMENTAL TO HP'S FUTURE

Hewlett-Packard Co.'s instrumentation business has made it the billion-dollar giant it is today. In the personal computer market, however, HP with its Series 70, 80 and 100 systems has competed for two years and garnered less than 5 percent of the market.

HP's new strategy is to attack the personal computer market more zealously. It has formed a Personal Computer division whose first product is expected this month, has cut costs and is launching a massive television and newspaper advertising campaign and an aggressive dealer-recruitment drive.

Vertical integration is the key to the new strategy. "In the past, HP has been content with moving horizontally

with higher priced products," states James Stinehelfer, marketing manager for HP's Disc Memory division, Boise, Idaho. "That's not going to serve us well enough anymore in the next 10 years."

HP's new system is expected to run MS-DOS applications and include Sony Corp.'s 3½-inch disks that are standard on the Series 80. The system is expected to use a touch-screen terminal being developed at HP's Data Terminal division in Sunnyvale, Calif. Industry observers believe HP will set the price of the system at less than comparably equipped IBM PC systems.

HP's varied personal computer offerings, formerly spread through at least three divisions, are now

consolidated into the new Personal Computer division in Corvallis, Ore. In addition, other divisions, such as the Data Terminal division, the Computer Products group and Disc Memory, have focused a large part of their research and development on personal computers. "We have taken the necessary steps since the beginning of this year to make this a dedicated personal computer company," comments Stinehelfer.

HP is also stressing cost efficiency. "The survivors will be the low-cost companies," adds Stinehelfer. HP has taken steps to cut costs by reducing inventories and is preparing to manufacture some products overseas.

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film media. Much media attention has focused on DEC's proposed use of Evotek's 31M-byte drives. But sources within Evotek, Fremont, Calif., say DEC was interested in Evotek's plated-media process.

There is not only a short supply of thin-film media, but also poor yields. Ampex continues to improve its yields, but the pressure of demand has made increasing yields difficult. The lack of satisfactory

yields from the little available plated media that exists often means some delays in initial shipments of higher capacity drives from companies relying on high-density recording.

HP's sputtering process is sensitive to defects in substrates. As much as 50 percent of substrates received are unusable because a slight nick in the substrate can be detected through the thin coating,

remarks Glen Moore, manager of the HP Magnetic Recording Technology center.

HP staffers in Boise admit that the pilot production under way has not generated enough volume to determine an accurate yield in a high-volume run. However, the company is determined to exceed 90 percent yields and therefore has delayed introduction of its product until January. HP expects to

Convergent moves to Intel 80186 modular workstations

Three years ago this month, Convergent Technologies Inc., Santa Clara, Calif., began shipping its first product, the IWS workstation, which company officials hailed as the convergence of then-current technology: an Intel 8086 microprocessor, 8-inch floppy disk storage, a bit-mapped display and an eye-catching, small-footprint desktop package. Early next year, the company will introduce what Convergent vice president of strategic business development Pauline Alker calls the converging technology of 1984 and beyond: an Intel 80186 microprocessor, 5¼-inch floppy disk drive/Winchester disk drive storage, a modular component packaging scheme linked by a proprietary bus and a choice of four operating systems. The company is also launching a lap-sized portable computer (see "Convergent takes a new tack..." right). The NGEN (for new generation) workstations, which replace their 8086-based predecessors, reflect the accelerated rate of technological change in the microcomputer business, Alker observes. "When we introduced IWS, we thought the technology cycle would be 24 to 30 months. Now, it looks more like 18 months."

The NGEN's dramatically improved price/performance ratio over its predecessor should make it extremely attractive to OEMs, Alker adds. She gives the original IWS a price/performance level value of one. The AWS, introduced 12 months later, had 5¼-inch storage peripherals and an 8-MHZ 8086. It was one-half the price and 1.7 times the performance of the IWS. Two years later, the NGEN's forthcoming introduction at a target price of 25 percent of the IWS and 2.6 times the processing power should net a 10:1 price/performance improvement over three years, Alker explains.

However, Alker stresses that the price/performance features of the new series are secondary. She adds, "The primary objective has been to provide our OEMs with one product that has full market fit," meaning a flexible design that OEMs and their end-user customers can alter as needs change. For OEMs, the modular design means they do not have to order a different model when they want to change one of the components of the system. "With the AWS and IWS, we had packaged systems that came in different models with different memory and storage capacities. Now, we have

CONVERGENT TAKES

In its four-year history, Convergent Technologies Inc., Santa Clara, Calif., has made its mark as a trend-setting designer and manufacturer of OEM hardware. With its OEM supermini-computer line launched (MMS, April, Page 157) and a rejuvenated workstation line set for introduction early next year, the company now is taking a new tack—straight into the retail personal computer market.

The divergent technology at Convergent is the WorkSlate, an \$895 notebook computer aimed at executives and professionals. The brainchild of Convergent's year-old Advanced Information Products division, the WorkSlate is the company's first consumer product. The company will offer the product to OEMs and other value-added resellers, but division marketing manager Karen Toland says WorkSlate will flow primarily through high-end retailers such as department stores and specialty computer stores such as ComputerLand and Businessland.

The 45-employee division, which was originally code-named "Ultra" and kept separate from other Convergent developments, has identified a potentially huge market for a simple notebook computer with a variety of straightforward canned applications. "There is an estimated 10 million- to 12 million-unit market for personal computers among management-level workers," explains Toland, "but there's a potential 30 million-unit market for machines aimed at people who want to replace pencil, paper and calculator."

guarantee 100 percent usability of all disks in its drives after six months. "The small computers in use today are usually critical to the operation of a company: they just can't go down," opines Stinehelfer. "Besides, you can't continue to have growth in your service department at today's costs."

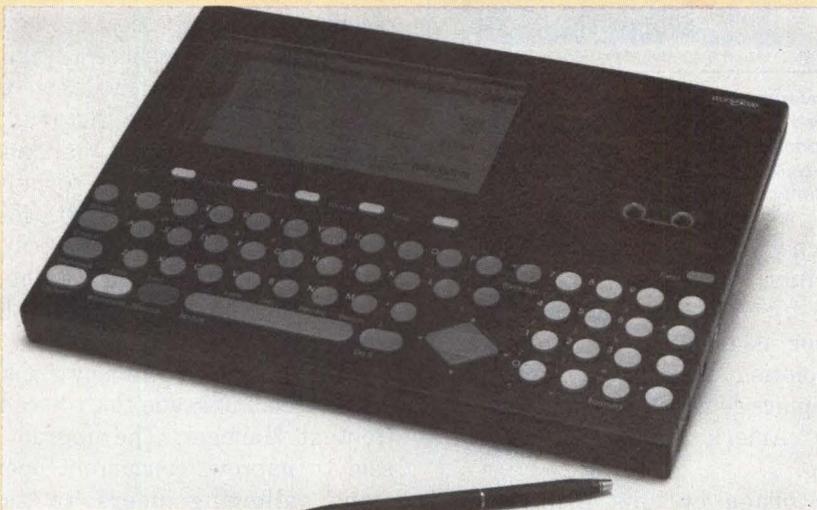
Costs are the reason behind HP's decision not to include thin-film heads on its new small drives.

Despite millions of dollars in research on thin-film-head technology, HP discovered that it could do no better making its own heads than buying heads from outside sources. Although the company is continuing research and will likely use thin-film heads on future products, it will concentrate its efforts on media. "It's better for us to work on one technology in which we know we're ahead," observes Stinehelfer.

HP, IBM and DEC are not the only companies that recognize a market opportunity in thin-film media. As many as 26 companies (or company divisions) to manufacture thin-film media have been formed in the past year. All hope to relieve Ampex of some of the pressure—and some of the rewards—and bring magnetic recording to the threshold of future drive technologies.

—Robert A. Sehr

A NEW TACK WITH PORTABLE COMPUTER FOR RETAILERS



Convergent Technologies' \$895 WorkSlate notebook computer integrates an 8-bit Hitachi 6303 CMOS microprocessor, 64K bytes of ROM, 16K bytes of RAM, a microcassette recorder and a 16-line-by-46-column liquid-crystal display.

The WorkSlate will be priced to compete with products such as Epson America Inc.'s HX 20 and Radio Shack's model 100. Toland emphasizes, however, that the portable was designed from the ground up to perform white-collar tasks and is not designed to compete with general-purpose portable computers. For example, it does not include a BASIC programming capability.

WorkSlate is a simple 8½-by-11-by-1-inch package with a series of built-in application packages for spreadsheet analysis, cost estimating, client time billing, expense reporting, appointments calendar and telephone listing

with automatic dialing capabilities, all running under a proprietary WorkSlate operating system. The system also has many voice- and data-communications features that enable it to operate as a speaker phone, a broadcast-only telephone-answering machine or a 300-bps data terminal. However, it does not support BASIC.

The basic hardware design revolves around a Hitachi America Ltd. 6303 CMOS microprocessor, which is based on an 8-bit Motorola Inc. 6800 chip. With 64K bytes of ROM for system software and applications and 16K bytes of user memory and the

16-line-by-46-column LCD, the system consumes less than 1W of power, claims Toland. A microcassette system developed by Olympus of Japan provides magnetic storage. It accommodates audio recording on the upper track and compressed digital data at 2,400 bpi on the lower track. This method enables a user to annotate data with audio notes, Toland points out. The microcassette will also be used for distribution of "taskware," a series of vertical application packages that Convergent plans to develop with third-party suppliers using the WorkSlate operating system. Early taskware (which will retail for \$20 to \$40) includes personal tax, sales reporting, loan analysis, portfolio analysis, financial statements, estate planning and marketing management.

WorkSlate uses surface-mounting manufacturing techniques developed in lower priced consumer products. The method enables Convergent to load components on two sides of the board. Toland notes that use of two custom gate arrays enables Convergent to eliminate more than 30 integrated circuits (ICs) on the board. Production will begin in the fourth quarter at Convergent's new 100,000-square-foot Santa Clara plant, but the company may shift production offshore in the future. The basic WorkSlate is the first of a family that will include a WordSlate product for text editing.

With the high-volume consumer electronics production methods, WorkSlates will "come out like cookies," Toland comments.

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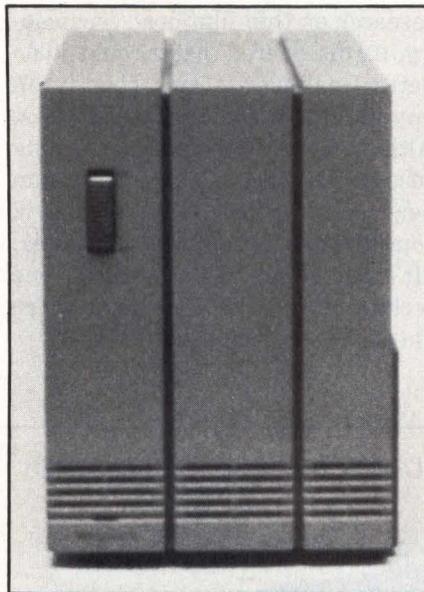
'exploded' the package into components. Each component can be ordered with the level of functionality and price/performance appropriate to the application and market," she explains.

Convergent's concept allows the same basic hardware elements to serve a broad range of uses, starting with an intelligent workstation and proceeding through personal computer functionality to a powerful front-end processor node in a distributed data-processing system, Convergent officials add. "You can start with the basic CPU, keyboard and display and add other modules or swap modules without throwing anything away," Alker remarks.

A new proprietary x-bus serving as the data path, physical connection and power-distribution system among the system's various modules enables the modular packaging scheme to work. The x-bus can extend as far as 24 inches from the system controller module and has an estimated peak data-transfer speed of 12M bits per second (bps). NGEN uses a DC power converter, which is about the size of a brick and is placed on the floor. With the adapter, maximum power within the system is 36V, and adapting for international power requirements is simplified, a Convergent spokeswoman claims. Alker says the x-bus will be open to OEMs that wish to build their own modules.

The basic element of the series is the CPU system controller module, which measures 8½ inches high by 5¾ inches wide by 11 inches deep. It contains the 80186 CPU, 256K bytes of main memory, a video controller and an I/O board with two RS232 serial ports, an RS422 port for local networking and a parallel printer port. The CPU board has expansion slots for three 256K-byte daughter boards.

In addition to supporting an



Convergent Technologies' Intel 80186-based modular NGEN workstation uses a proprietary bus and runs CTOS, XENIX, MS-DOS and CP/M-86. Shown is the CPU system controller module.

80-character-by-29-line display, the 12-inch monitor can handle 728-by-348 bit-mapped graphics. Color is available with the same resolution using an optional color graphics controller module based on NEC America Inc.'s 7220 graphics chip.

Storage options include dual floppy and floppy/Winchester combinations. The 5¼-inch slimline floppy disks store 630K bytes each (formatted), and the Winchester disks are available in 5M-, 10M- and 12.5M-byte capacities. They come in

Alliances grow in \$10 billion Ada market

Like bees to nectar, an increasing number of companies are being drawn to the sweet market for Ada programming language applications. The U.S. Department of Defense estimates the market for embedded computer software will total \$10 billion by 1990.

8½-by-11-by-2¼-inch modules.

Alker notes the hardware is also designed for "multiple independent follow-on design paths" that will allow OEMs and end users to revamp installed systems. One expected upgrade, Convergent sources state, is an Intel 286-based CPU. Some OEMs are expected to design their own NGEN modules, Alker adds.

On the software side, the NGEN systems will run Convergent's proprietary CTOS operating system and three commercial operating systems: Microsoft Corp.'s MS-DOS and XENIX and Digital Research Inc.'s CP/M-86. XENIX, which was recently added for the 8086-based machines, is a UNIX-based package that runs in native mode on the NGEN CPU. MS-DOS and CP/M run as guest operating systems under CTOS, which supports resource sharing and access to CTOS files. Users can switch among CTOS, MS-DOS and CP/M without rebooting and without interfering with other workstations in a cluster.

With NGEN, the company plans to introduce an upgrade to CTOS called Context Manager. The upgrade is said to improve concurrent operations, allowing users to take advantage of the operating system's 10 available partitions. Prices had not been set at press time, but Convergent officials indicate prices will start at about \$5,000.

—Geoff Lewis

Ada is expected to become the single computer language for all branches of the U.S. military by 1985. Development of Ada has created a flurry of activity as computer firms push to form alliances that could well decide future market leaders. Among the

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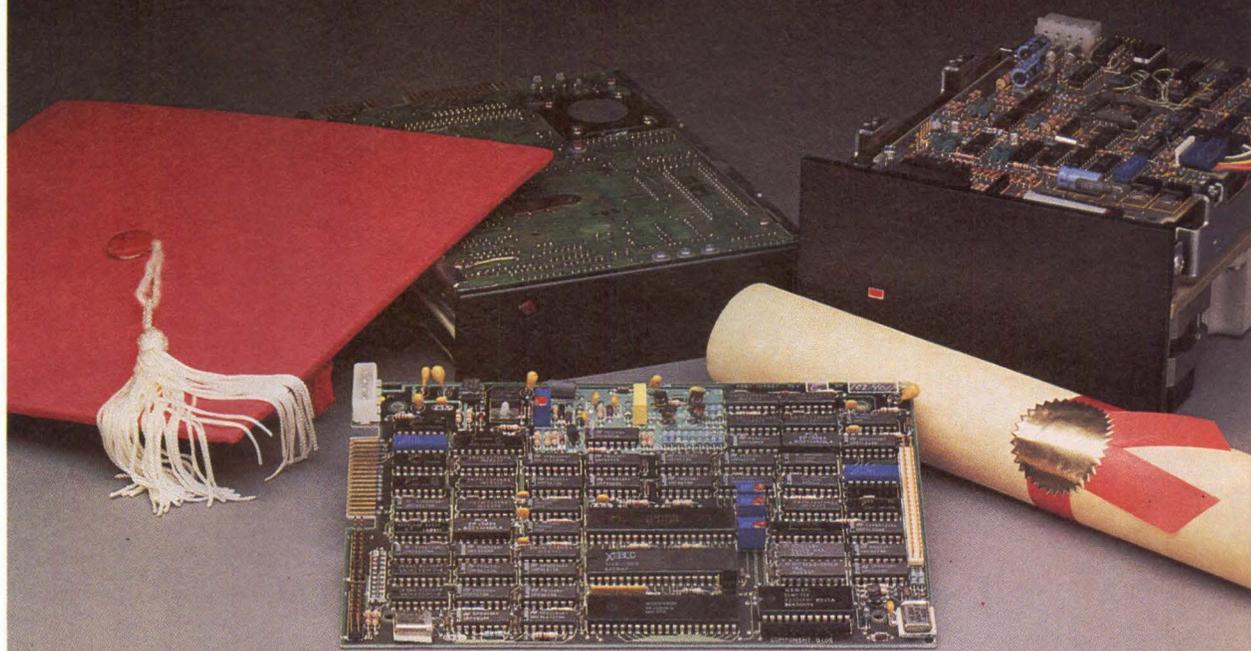
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The morning part of the seminar is an in-depth applications oriented discussion of Xebec's industry leading Winchester controller. The afternoon session provides an in-depth look at Shugart's 5 1/4" Winchesters and appropriate floppy back-ups. Shugart and Xebec will also briefly outline their exciting new directions for the future of mass storage products.

These informative meetings will run from 8:30 a.m. to 4:30 p.m. There will be a nominal charge to cover meeting notes and a luncheon. One lucky participant will be able to put into immediate practice the lessons of the seminar since we'll be awarding a Shugart 10 megabyte Winchester and a Xebec controller.

For further information and reservations call your contact at the Hamilton/Avnet facility in your area.

The schedule of seminars is as follow:

- 1st Week**
Oct. 3 Sunnyvale
 Contact: Allyson Bergman (408) 743-3300
Oct. 4 San Diego
 Contact: Pam Milhausen (619) 571-7500
Oct. 5 Orange County
 Contacts: Debbie Mussachia (714) 754-4103
 Dena Hewes (714) 754-6083
Oct. 6 Los Angeles
 Contact: Sue Potts (213) 558-2411
Oct. 7 San Fernando Valley
 Contact: Carol Milton (213) 716-4500
2nd Week
Oct. 11 Dallas
 Contact: Kathy Sarvis (214) 659-4100
Oct. 12 Houston
 Contact: Terrell Jarnigan (713) 780-1771
Oct. 13 Chicago
 Contact: Lydia Ptak (312) 860-7780
Oct. 14 Cleveland
 Contact: Sue Jerome (216) 831-3500
3rd Week
Oct. 17 Toronto
 Contact: Coleen Forester (416) 677-7432
Oct. 18 Boston
 Contact: Ann Benard (617) 935-9700
Oct. 19 South Jersey
 Contacts: Vera Hart (609) 424-0110
 Ruth Van Dine (215) 831-8554
Oct. 20 Baltimore
 Contact: Ladonna Hillman (301)995-3524
Oct. 21 Atlanta
 Contact: Deborah Bryson (404)447-7502



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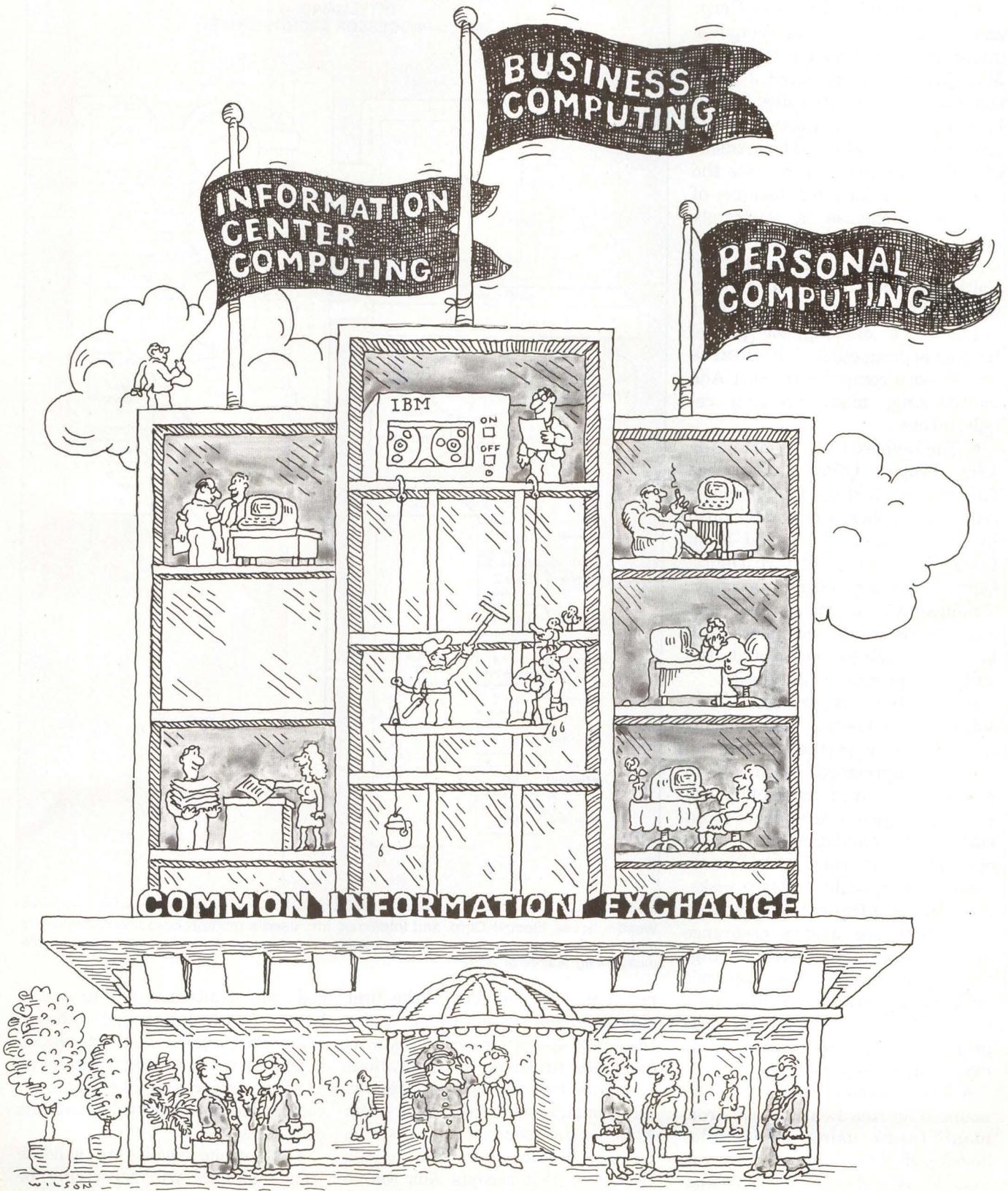
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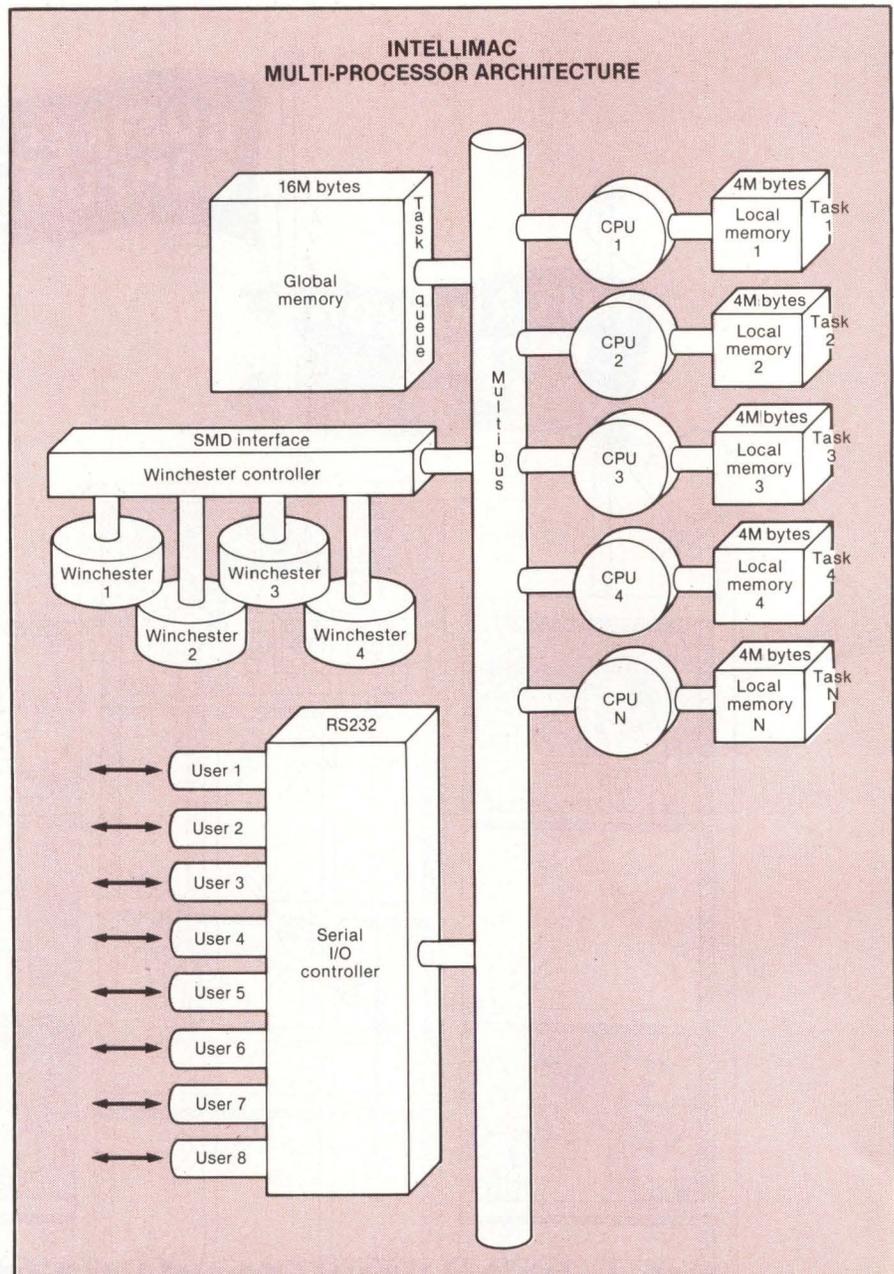
recent significant developments:

- Westinghouse Electric Corp. and Intellimac Inc., a minicomputer integration firm based in Rockville, Md., jointly demonstrated a novel computer architecture called "closely coupled asynchronous parallel processing" to Defense Department officials. The architecture uses the powerful multitasking feature of Ada. Westinghouse is separately developing an Ada compiler at its Defense Electronics Center in Baltimore. Intellimac is attempting to raise \$14 million through its first public stock offering for partial funding of production of the IN/MP68 single-board computer to meet Ada multitasking, multiprocessing requirements.

- The Defense Department's Ada Joint Project Office (AJPO) has formally certified the first commercial Ada compiler, jointly developed by Data General Corp. and Rolm Corp. Testing of a Western Digital Corp. compiler began in July. Confident AJPO officials predict that six Ada language compilers will have successfully completed the validation process by July 1984.

- CACI Inc., an Arlington, Va., software engineering and consulting firm, is expected to sign an exclusive agreement with DG to provide Ada program training and software engineering support to DG staff members and compiler customers. The agreement will include support for specific software tasks, including configuration management, software quality assurance and development engineering. "With our earlier Ada software engineering training programs," states Walter Rolling, CACI Ada project director, "we have about 10 man-years of experience."

- This summer, Gould Inc. announced an Ada Learning Environment (ALE) using a compiler developed—but not yet DOD-validated—by Softech Inc. The compa-



Westinghouse Electric Corp. and Intellimac Inc. used a multiprocessor architecture to make the first demonstration of closely coupled asynchronous parallel processing tied to the multitasking feature of Ada.

ny claims the compiler is the first Ada language system to run under the UNIX operating system. ALE is available in three configurations incorporating various Concept/32 minicomputers. Prices range from \$129,000 to \$366,000. Gould's Ada package features an ICSA-to-Ada translator that accepts Ada source

code and translates it into C, the basic UNIX language. The C compiler produces an executable image of C. Programs written on ALE are expected to be upwardly compatible with DOD-validated Ada compilers.

- A second facility to validate Ada compilers will reportedly be

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located at Wright-Patterson Air Force Base, Dayton, Ohio. Similar to AJPO's certification facility in Washington, the Wright-Patterson center will run the Ada validation suite, consisting of more than 1,500 software tests. However, it will consider compilers designed for U.S. Air Force use only. Westinghouse is developing an Ada compiler to submit to the Wright-Patterson validation facility in October 1984.

The Westinghouse/Intellimac demonstration linked four MC68000-based processors, each with 256K bytes of memory, a 512K-byte global memory, eight RS232 intelligent serial interfaces and a 16M-byte Winchester disk drive. Intellimac's IN/7000K computer hosted an Ada multitasking program written by Westinghouse engineers to demonstrate the system's message-passing capabilities. The demonstration ran five Ada tasks, including one for real-time graphics display that depicted the status of each processor through ASCII mes-

sage transmissions of varying lengths.

"I was impressed," comments Maj. Allan Kopp, Air Force project element monitor for the Ada program. "The Westinghouse program did not require assembly-level experience to operate, but could be run by someone with some systems-level experience."

To achieve Ada-standard multi-processing, Intellimac engineers modified the board-level PROMS, disks and bus drivers of the IN/7000K. Westinghouse developed the high-level software; Intellimac modified the hardware and developed other software, including the kernel that controls interprocessor communications and the I/O interface. The Westinghouse/Intellimac

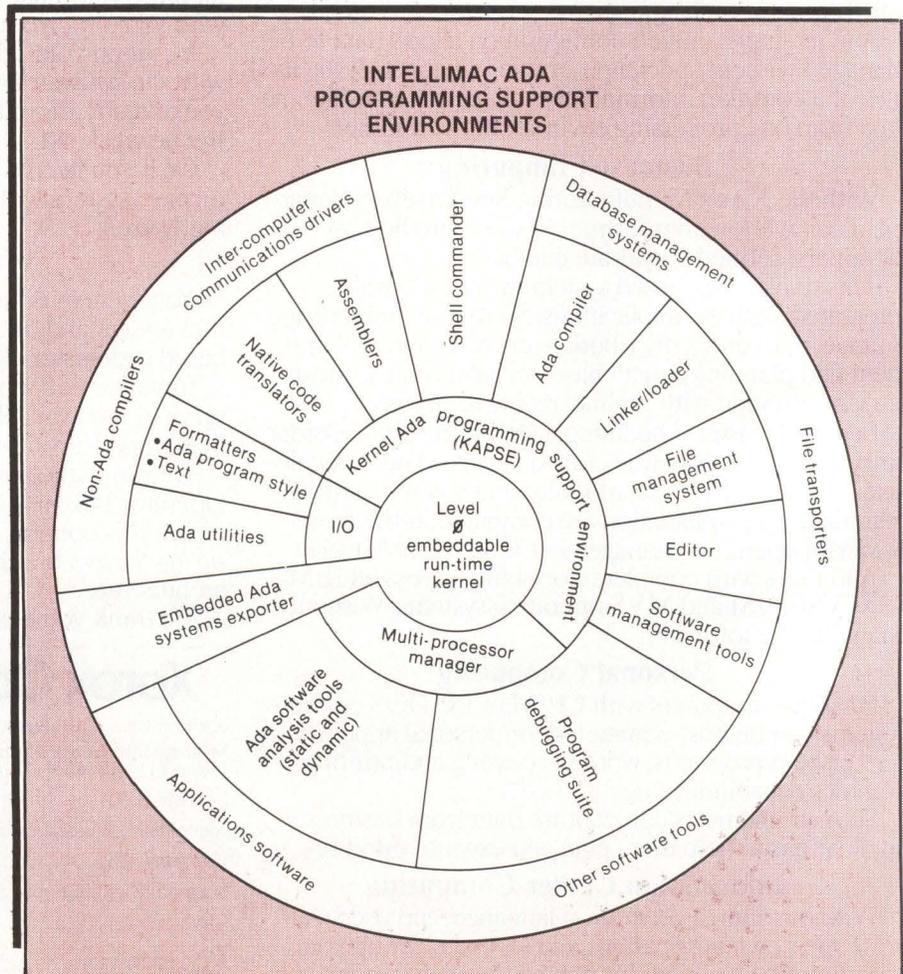
system employs TeleSoft's Ada compiler and Renaissance Systems Technologies Inc.'s operating system.

Intellimac president Dick Naedel reports that the company is preparing to begin manufacturing hardware with the MP68 single-board Multibus computer. Based on Motorola Inc.'s MC68010 chip, the MP68 features as much as 64K bytes of non-volatile, on-board memory and as much as 256K bytes of EPROM (see "Intellimac's MP68 at a glance," below). To capitalize its foray into hardware manufacturing, Intellimac is going public sometime this fall through the investment firm of D.H. Blair.

The company is also in the early stages of a \$2.5 million program to

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AVG. POSITIONING TIME (ms)	27	18	20	70	83
TRANSFER RATE (K Bytes/s)	1,012	1,859	1,229	593 / 1,200*	625
INTERFACE	SMD	Modified SMD	SMD	SA4000	ST506/SA4000
POSITIONING METHOD	Rotary Voice-Coil	Rotary Voice-Coil	Rotary Voice-Coil	Buffered Stepper	Buffered Stepper

*48 M Bytes Configuration available only in 1200 K Bytes/s



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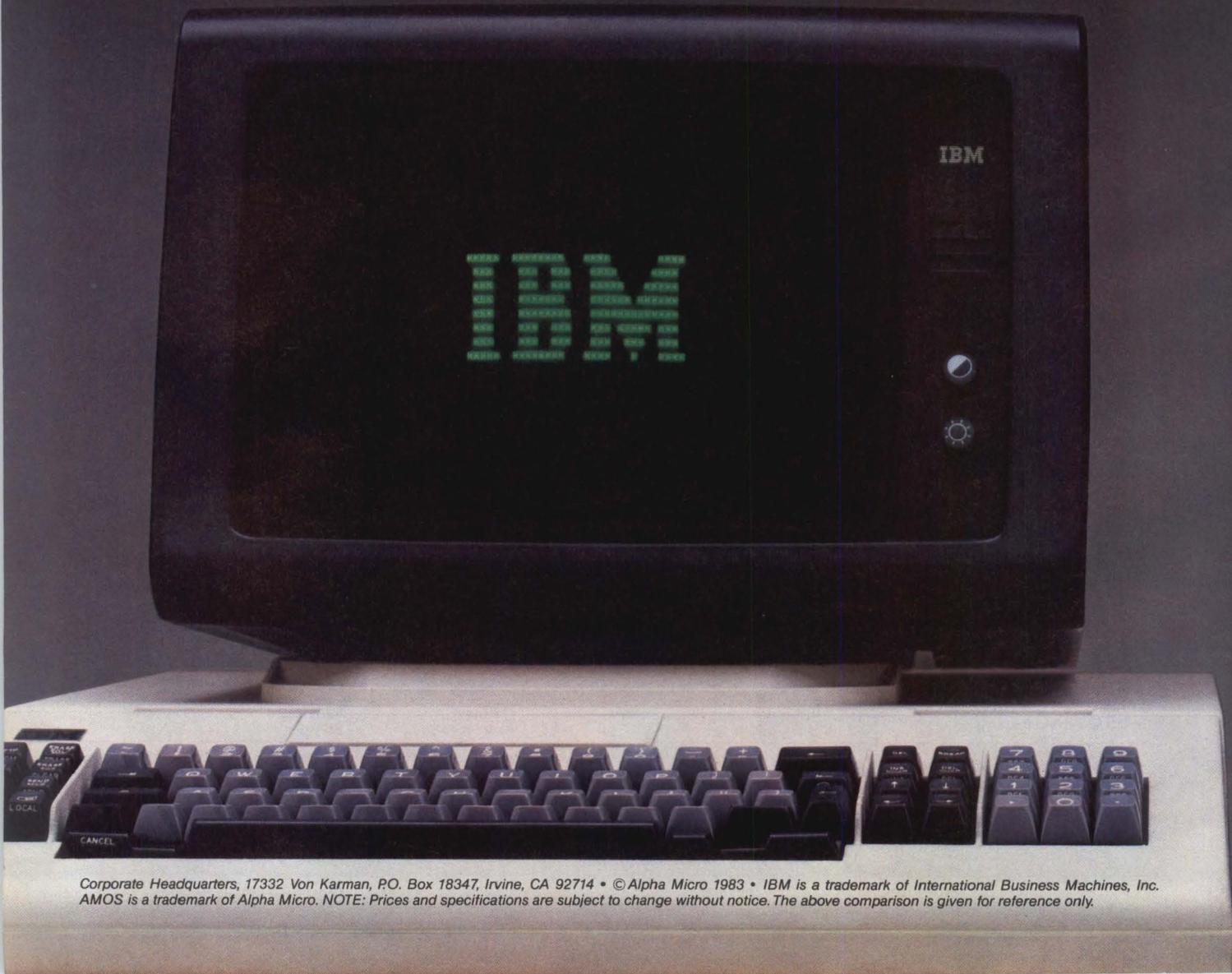
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CPU	MC 68000	IBM 5360
MAIN MEMORY	512 KB	256 KB
MASS STORAGE		
Disk	60 MB	60 MB
Back-up	VCR Interface	1.2 MB Diskette
WORK STATIONS (max.)	30	30 (local)
COMMUNICATIONS	2780/3780	BSC, SDLC
PRICE (typical)	\$ 25,000	\$ 30,475

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introduce a rugged series 7000 computer. It has formed a limited R&D partnership with AITech, Tel Aviv, Israel. Under the partnership, Intellimac will provide computer hardware to AITech for ruggedization in exchange for exclusive North American marketing rights for the product. The first prototype is expected in December.

The 7000R series will be a family of military-specification (MIL-SPEC), interconnectable component boxes for building various general-purpose computer system configurations. These include an executive CPU with 16-/32-bit, 8-MHz, MIL-SPEC MC68000 processors, task

processors, memory modules, storage devices and peripheral controllers.

Westinghouse is abandoning the MC68000 for military applications, reports Mark Gaertner, Ada program manager. Work is under way to develop a CPU based on the Air Force's instruction-set architecture. The current design uses very large-scale integration (VLSI), says Gaertner, but this will change to very high-speed integration in 1985.

Gould's computer systems division was expected to announce details of its Ada compiler at the Federal Computer Conference in September. The company was also

expected to introduce a "super-smart" disk controller containing as much as 2M bytes of cache memory. The new disk system should improve Ada program execution as much as 500 percent, asserts a company spokesman.

Like other Ada product developments, Gould's ALE offering is aimed at future Ada programmers, whose ranks are expected to swell dramatically. Programmer training is expected to play a crucial role in determining which companies succeed in capturing market share for Ada-related hardware and software.

—Stephen J. Shaw

ANSI, Tektronix push GKS graphics standard

Although the proposed graphical kernel system (GKS) standard for computer graphics must still be fine tuned, little doubt remains that the draft standard will be finalized before next summer's Siggraph show in Minneapolis. Tektronix Inc., Beaverton, Ore., a major graphics hardware and software supplier, has decided not to wait for official sanction from the American National Standards Institute (ANSI) before offering GKS software. Nonetheless, the alternative standard proposed, Siggraph CORE, probably has enough support from major suppliers to remain a de facto standard.

Other major software suppliers such as Integrated Software Systems Corp. (ISSCO), San Diego, and Precision Visuals Inc., Boulder, Colo., also have indicated support for GKS.

The announcements came at this year's Siggraph show in Detroit, where the ANSI X3H3 graphics standards committee confirmed there would be no major changes

between the current document and the final standard. The standard includes specific software language bindings, beginning with a FORTRAN interface that the committee will review this fall. Subsequent revisions may include bindings to Ada and Pascal. The bindings were

PROPOSED GRAPHICS STANDARDS' KEY DIFFERENCES		
	GKS	Siggraph CORE
Bundled attributes	✓	
Full 3D capabilities		✓
Language bindings	✓	

inserted to give GKS device independence, allowing users to use devices from different vendors with little software modification.

A key difference between CORE and GKS is that GKS allows for bundled attributes, such as color and dash, which the software sees as a way to distinguish data. The difference resulted from certain manufacturers' hopes for greater device independence. Bundled attri-

butes permit each workstation to decide how to represent attributes. ANSI won a modification of some bundled attributes from the original European standard, thus gaining more direct control of some attributes in U.S. hardware.

The GKS standard is the work of the German Deutsches Institut für Normung (DIN), which adopted some features of a parallel standard being developed by the Association for Computing Machinery's (ACM's) Siggraph Graphics Standard committee. The Siggraph CORE document was designed for vendor and device independence and for 2D and 3D line drawings.

However, because Siggraph is not an official standards body, it could only publish its recommendations and pass them on to ANSI's X3H3 committee. Meanwhile, the International Standards Organization (ISO) is considering only GKS. As a result, GKS gained momentum and forced not only ANSI but also many major U.S. hardware and software manufacturers to give it priority (MMS, November 1982, Page 175).

Some observers, including Dr. Peter Bono, chairman of ANSI's X3H3 committee, believe GKS and

EMULEX TALKS DEC

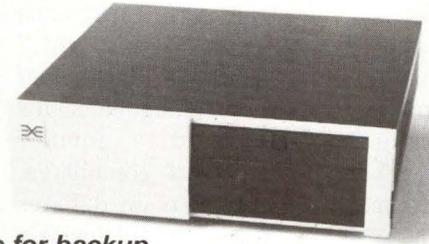
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Siggraph CORE are virtually identical. "If we had started out with Siggraph CORE instead of GKS, we would still have the same document (as the draft standard)," he remarks.

Others, however, believe GKS is not as complete as Siggraph CORE, especially in addressing 3D applications. "I'm afraid the Europeans have given us a flat world," maintains Bob Heilman, director of software product management for Ramtek Corp. and a former member of the X3H3 committee. Heilman has attended many debates on whether GKS can ultimately address 3D. He asserts that the debates have not convinced him. "We can't offer our customers software that doesn't use the full capability of the hardware," Heilman comments. "We'll continue to offer CORE-based products with our 3D units."

Heilman, however, expects Ramtek to support GKS software

when it becomes standard. "But just because CORE does not become an official standard doesn't mean it can't remain a de facto standard," he adds. He notes that, although many Tektronix competitors advertise PLOT 10 GKS compatibility, such compatibility does not exist. "What you really have is 4010 compatibility," he contends. The 4010 terminal is both GKS and CORE compatible.

Because GKS is the first official standard to offer device independence, it allows Tektronix to compete in an ever-widening market with its already popular PLOT 10 software-development tools, Ashley notes.

Tektronix's PLOT 10 GKS includes FORTRAN 77 source code that allows programmers to fine tune their packages. The software includes device drivers for Tektronix terminals and plotters and a model for non-Tektronix devices. List price of a license is \$7,500.

Don Van Dyken, vice president of

Precision Visuals, agrees that 3D support is necessary, noting that some of his company's customers require it. For those customers, Precision Visuals offers CORE products as well as support for the GKS standard.

The true indicator of acceptance for any standard—with or without ANSI blessing—is industry acceptance. In that respect, GKS is miles ahead of CORE. Most major software suppliers have at least tentatively agreed to adopt the GKS standard. "This is the first real graphics software standard," comments Jerry Ashley, manager of graphics software products at Tektronix. "Until now, the software industry has been policing itself." Average package price, including source code with input and output routines, is \$8,070 in single-unit quantities.

Ashley also emphasizes that Tektronix will continue to support its CORE user base.

— Robert A. Sehr

Multiwindow UNIX for IBM PC combines MS-DOS emulation, networking

A Dallas start-up—Lantech Systems Inc.—has developed a version of UNIX for the IBM PC and other microcomputers that it feels effectively bridges the gap between single MS-DOS applications and multitasking capabilities while addressing microcomputer networking needs.

Lantech's uNETix operating system, which is written in C, enables simultaneous multitasking of UNIX and MS-DOS applications, with each application program displayed in a separate window. The system allows as many as five MS-DOS applications to run simultaneously with five or more UNIX applications, claims Arthur Olender, Lantech's director of software development.

Although the company recommends using a maximum of 10 windows (to match the PC's 10 function keys), the number of possible UNIX windows is limited only by screen space, Olender adds. Data can be transferred between windows, including MS-DOS/uNETix transfers.

The uNETix distributed file system (uNETix-DFS) version allows transparent remote-file and device access. The company is expected to preview uNETix-VFS, a virtual file-networking system for connecting microcomputers, minicomputers and mainframes, at Comdex.

Olender explains that the use of UNIX pipes and filters enables fast data transfer between windows. Each window has a zoom feature.

The system does not actually incorporate MS-DOS but "gives the appearance of MS-DOS to the user," he states. The MS-DOS emulator is actually an application that uses UNIX commands and runs under uNETix.

Software tested to run under the MS-DOS emulator includes Microsoft BASIC, Wordstar and dBASE II. Any packages conforming to IBM software guidelines should run on uNETix, Olender adds. UNIX version 7 applications run under uNETix after recompiling, and System III applications need some tweaking before they can be recompiled for uNETix.

Olender emphasizes that uNETix-DFS file sharing does not involve

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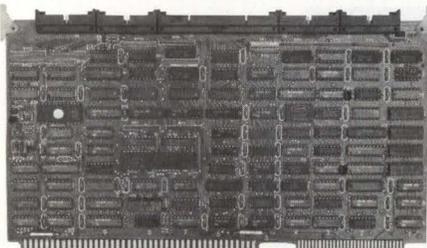
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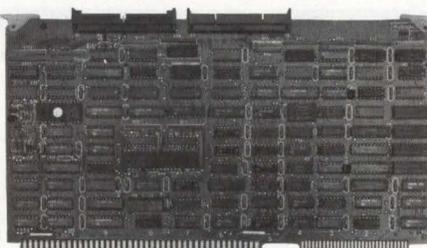
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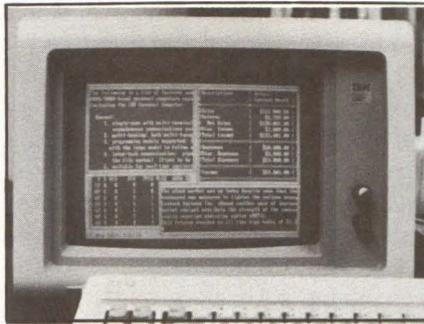
NEWS

simple file transfer. A remote-mount command allows a user to access a storage device as if it were part of his own system. The networking software, which was jointly developed with Plexus Computers Inc., uses the top four layers—application, presentation, session and transfer—of the International Standards Organization's (ISO's) Open Systems Interconnection (OSI) reference model.

The Lantech software also allows a PC to emulate an ASCII terminal. The company hopes to offer a 3270 link written by a third-party vendor. With such links, a PC user could extract data from a VAX or a mainframe while other applications are running and then move the data directly into another window.

Olender says the package improves on the Visi^{On} concept by offering true multitasking. Visi^{On} features multiple windows but processes only one job at a time. (MS-DOS 3.0, due late this year, is expected to offer multitasking, as does Concurrent CP/M.) The Lantech package occupies 128K bytes of RAM; it requires 256K bytes of RAM and two floppies to run. Visi^{On} occupies 100K bytes of RAM and also requires 256K bytes to run. Lantech is porting the software to Motorola MC 68000- and National Semiconductor 16032-based machines in addition to an Intel 8086-based non-IBM-compatible machine. The software also runs on the COMPAQ Computer Corp. and Columbia Data Products Inc. IBM-compatible computers.

Jean Yates, president of software market research firm Yates Ventures, San Francisco, says uNETix offers some advantages over XENIX and other versions of UNIX. She states that the multitasking and networking combination with UNIX and MS-DOS will be "extremely appealing" to owners of \$5,000 to \$8,000 two- to five-user microcomputer systems who don't want the



Lantech Systems Inc.'s uNETix operating system for the IBM PC and other microcomputers enables five MS-DOS application programs to run concurrently with five or more UNIX applications. Each application is displayed in a window.

high overhead of UNIX. The uNETix package includes fewer utilities than a full-blown version of UNIX. UNIX typically contains about 500 utilities, but uNETix has only about 20, those needed to fit the market-niche requirements, she claims.

Lantech expects to sell 100,000 copies of uNETix, mainly to OEMS

and application companies over the next year, states Michael McChesney, vice president of corporate development at Lantech. List price of a package with uNETix, the MS-DOS emulator and a C compiler, is \$300. In comparison, list price for Visi^{On} is \$495 (plus \$250 for a mouse), and list price for Concurrent CP/M-86 is \$350. List price of a uNETix-DFS package with the emulator will be around \$250. OEM and end-user availability of uNETix and uNETix-DFS is scheduled for this month. Details for uNETix-VFS were not solidified at press time, but plans call for the package to sell for less than \$1,000.

Lantech is an outgrowth of a former company called Advanced Digital Products Inc. At Advanced, Olender and Derrel Foster, Lantech's vice president of research and development, developed C applications for the 8086.

—David A. Bright

HP renews attack in desktop plotter battle

Hewlett-Packard Co. has stepped up its attack in the desktop plotter war by introducing the six-pen HP 7475A and repositioning its two-pen 7470A plotter, which was introduced last year.

HP claims the 7470A and 7475A offer higher resolution—0.001 inches—and higher plotting speed—21.2 inches per second—than other plotters selling for the same price.

The 7475A, at \$1,895, provides a removable six-pen carousel and plotting on A- or B-sized paper. For its role, the 7470A helped pioneer the market for less-than-\$2,000 multipen plotters. Its price has been reduced 30 percent from \$1,575 to \$1,095 because of high-volume production. HP expects the 7475A to fill the needs of business graphics

applications and the two-pen model to attract personal computer users.

Although unwilling to provide sales figures, HP officials claim demand for the 7470A has exceeded allotted production capacity. "Frankly, it was a greater success than we thought it would be," asserts Craig Schmidt, product manager at HP's San Diego, Calif., division where the plotters are produced. "We've had to ramp up production because of the backlog we had on the 7470A." Although delivery time of the 7470A had been several months, it is now weeks.

Market studies of desktop plotters have projected annual growth rates as high as 40 percent, and many new suppliers, including California Computer Products Inc.

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and Mannesmann Tally Corp., have recently entered the market for less-than-\$2,000 plotters (MMS, July, Page 28). Brian Moore, general manager of HP's San Diego division, estimates that business and professional use of microcomputers will create a \$10 billion market by 1985. Moore says that HP developed its desktop plotters to support in-house computer systems,

performance basis, but we won't reduce costs by cutting features."

Schmidt attributes the products' performance edge to a technology developed for the eight-pen, large-format HP 7580A plotter introduced in 1981. The technology substitutes a drive that moves the paper on the x axis for arm-mounts that move the pen along both axes and uses DC servo motors instead of stepper

widths and 10 colors. The reason that the 7475A design team chose to use six pens, Schmidt explains, is that six pen positions allow users to employ three or four colors as well as pens of different line widths.

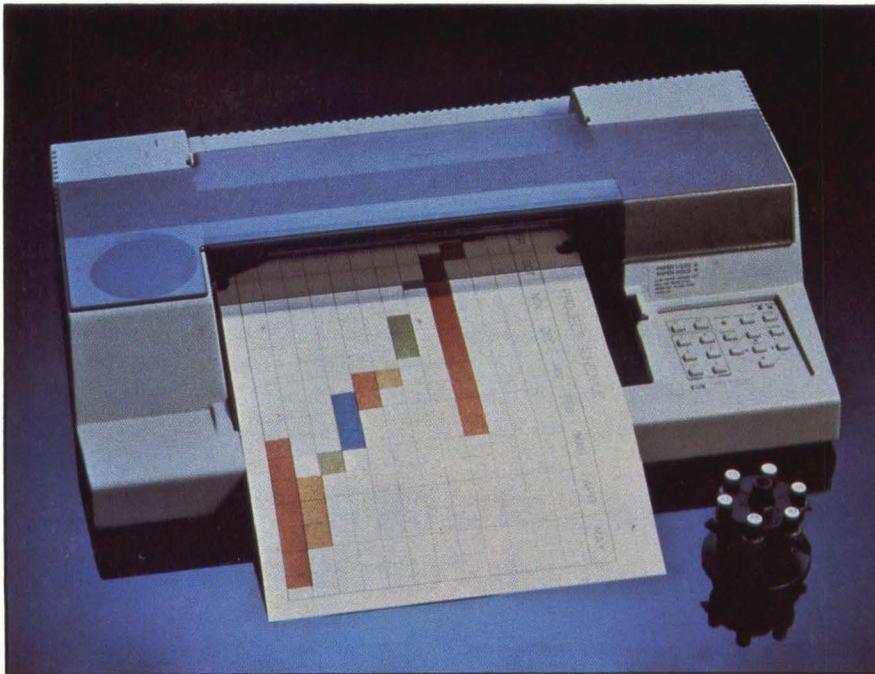
The 7475A features single-command automatic area-fill, thus reducing the software-command memory storage space by 95 percent. The plotter also incorporates more than 50 other commands for pen movement, character sets, scaling and crosshatching patterns.

Pens on both plotters are automatically capped when not in use to prevent drying out, and a damping system that reduces the impact on the pen as it hits the paper extends pen life. HP licenses and recommends only its own pens, paper and overhead transparencies for its plotters. The transparency material requires a removable backing to work in the paper-moving drive. The two models have different paper-loading procedures; as a result, the backing material is not interchangeable. Schmidt points out that the company has recently developed a transparency film that dries in about 30 seconds.

In line with the desire to broaden the market for its plotters beyond HP system users, the company is encouraging third-party software development for both plotters. The success of the 7470A has led more than a dozen software suppliers, such as Business and Professional Software Inc. and Lotus Development Corp., to support it for graphics applications on the IBM PC. Many packages running on Apple Computer Inc., Digital Equipment Corp. and other personal computers support the 7470A, and many will support the 7475A as well.

Either an RS232C or HP's HP-IB version of the IEEE-488 interface is available. The company expected the 7475A to be available last month.

—Edward S. Foster



Hewlett-Packard's six-pen HP 7475A plotter sells for \$1,895. It plots at a resolution of 0.001 inch on A- or B-sized paper.

but is now offering plotters to "the entire market."

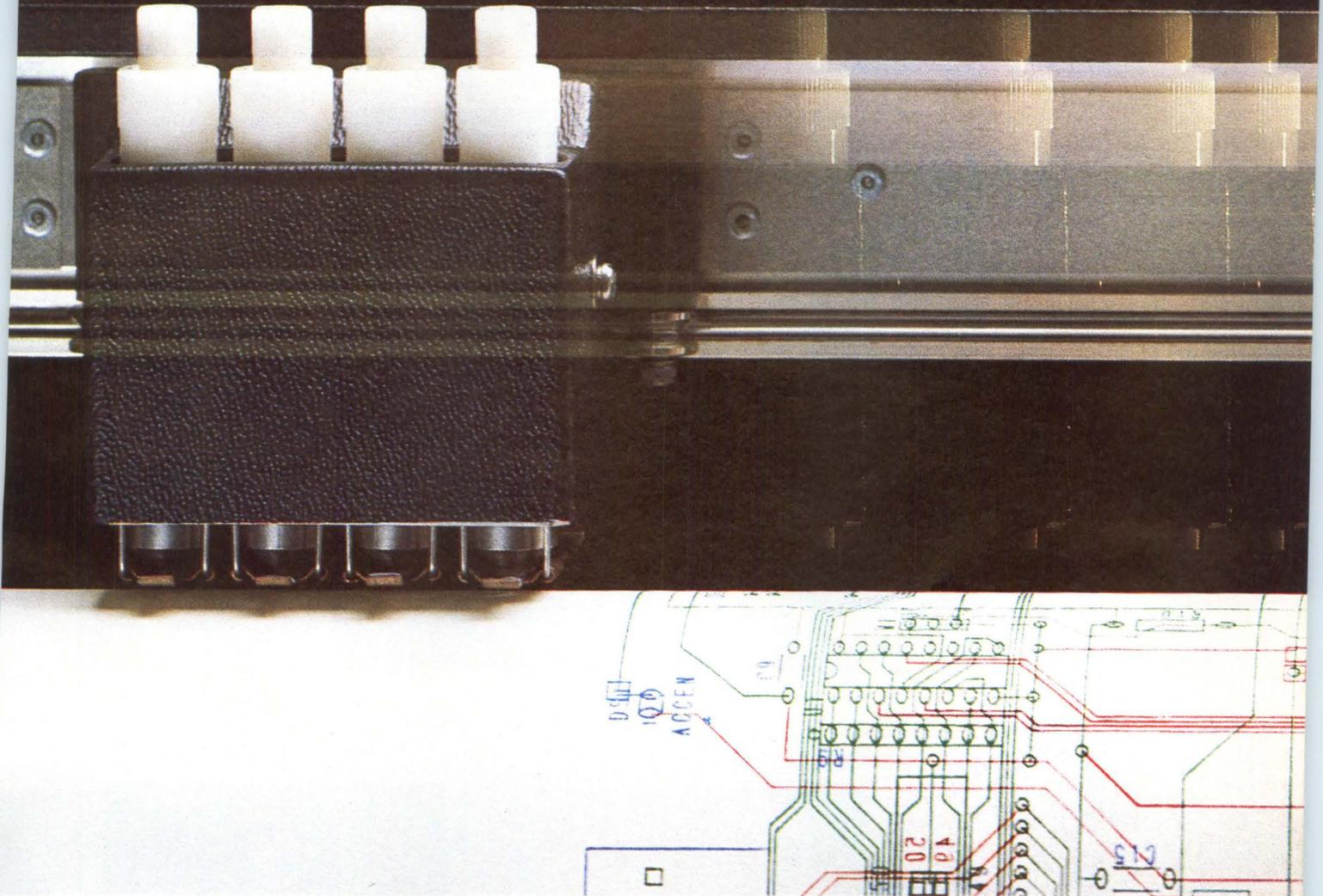
Several plotters introduced or demonstrated at trade shows this summer, however, offer more pens for less money than the HP 7470A. For example, Japanese producers introduced units with four pens or more for less than \$1,000. Moreover, price cutting like that in the low-end dot-matrix printer market over the last few years is likely. HP's strategy is "to survive price competition by (offering) high quality," comments Schmidt. "We will be competitive on a price/

motors. Rather than creating diagonals by making incremental steps along the x or y axis, Schmidt explains, the DC motor allows turning in any direction. An optical encoder with an LED source and detector keeps the pen in position.

Although the technology uses more sophisticated controllers and customized integrated circuits than stepper motors use, the extra cost is offset by lower power consumption and lighter paper-moving mechanisms than those used with stepper motors.

Pens are available in two line

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The Elusive Glitch.

From the early computer days, there's a story told about a Computer Wizard who secretly loaded in a routine which drove the other programmers wild. At random intervals, this routine would automatically activate itself and print out the following message: "I AM THE ELUSIVE GLITCH... CATCH ME IF YOU CAN!" Then it would reset, disappear deep into the memory of the machine, and patiently wait for the next unsuspecting moment before activating again. There was no way to find it.

Engineers debugging today's complex digital systems know all too well that the "Elusive Glitch," or other troubles induced by hardware problems such as race conditions and noise, can occur even without the help of the Computer Wizard. In the world of logic timing analyzers, a glitch is defined as an unwanted signal that passes through a threshold twice

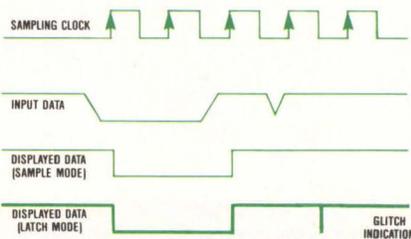
between sample clock edges. Since a glitch, by definition, is never sampled by a logic timing analyzer, it's no wonder that it often falls into the "elusive" category.

When logic analyzers were first introduced, users were sometimes frustrated with the instrument because it was not capable of solving glitch-induced problems that ranged from illegal states and extraneous counts to major, unrecoverable system crashes.

As a first attempt to remedy the situation, logic analyzer manufacturers included a latch mode in

their timing analyzers. In this mode, the analyzer "remembers" the previous sample and arms a latch to capture any transitions occurring before the next sample clock edge. If a transition did occur, the latch is set and sampled at the next clock edge. Latch circuits are generally sensitive to transitions of five nanoseconds duration or longer. Thus, a glitch that is latched into the analyz-

er's memory is always displayed as a pulse one clock sample period wide as shown below:



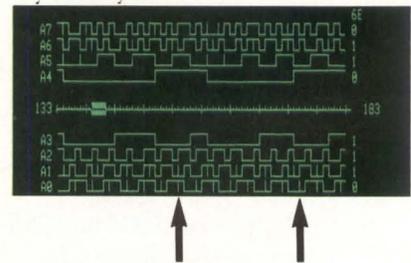
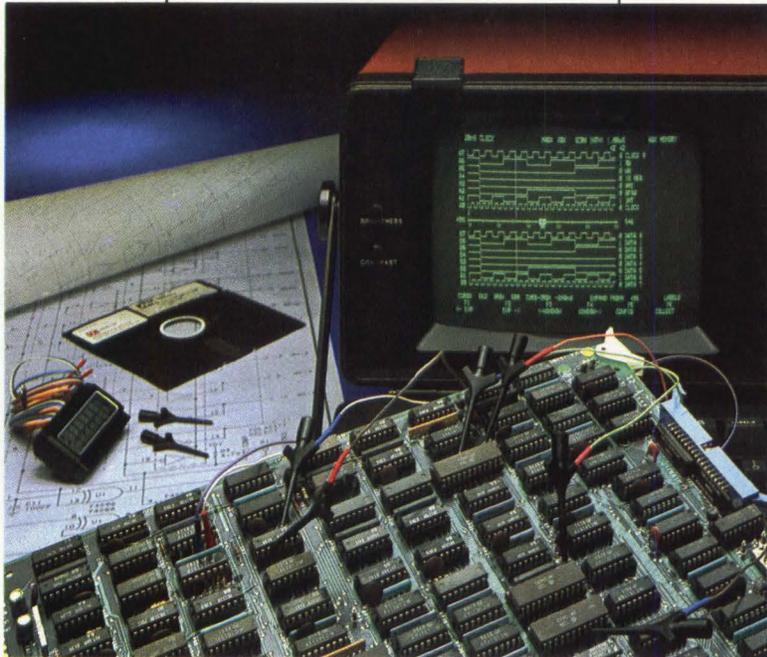
Although the latch mode was a step in the right direction, engineers have found that the display of a

glitch in the form of a clock pulse made it difficult to identify. A means of highlighting the occurrence of a glitch was needed. Nicolet Paratronics solved this problem by splitting its 1000-word, 16-channel timing memory into 8-channel data memory plus an 8-channel glitch memory. Using the same sample clock, both memories receive data through an 8-channel timing probe.

However, since the glitch memory incorporates the latch circuit described above on each of its 8-channels, glitches are latched and clocked into the glitch memory when a glitch occurs. By contrast, the data memory does not have this latch mechanism, so it will not "see" the glitches.

To achieve the glitch display shown below, the two memories are simply superimposed. At each location where the memories differ, the display software draws a vertical line.

The NPC-700 series also includes a binary display mode that allows you to view the contents of the data memory and glitch memory side-by-side.



For a complete set of Designer Notes, call **(800)-NICOLET**, (415) 490-8300 (Calif.); In Canada: (416) 625-8302. TWX: 910-381-7030, Nicolet Paratronics Corporation, 201 Fourier Avenue, Fremont, CA 94539.

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HEARD ON THE HILL

By Stephen J. Shaw

Soviet high-tech activities put U.S. on defensive

Boy Scouts, Russian spy buoys and purloined microchips may sound like the stuff of a "Hardy Boys" mystery, but these very elements provide an object lesson in export administration.

In a widely reported incident several months ago, a troop of Boy Scouts on a West Coast beach discovered a buoy floating a few yards offshore. This would have been unremarkable in itself, except for the "СССР" stenciled in Cyrillic lettering on the buoy's side. The Boy Scouts turned the buoy over to the U.S. Navy, which discovered that it contained underwater detection devices capable of identifying the acoustical "signature" of American submarines.

In a July interview with *The Washington Post*, assistant U.S. Department of Defense secretary Richard N. Perle revealed that the buoy contained a Soviet copy of an Intel Corp. microprocessor chip. The copy was so precise, said Perle, that when it was replaced by an original chip, the device worked perfectly.

When contacted by *Mini-Micro Systems*, Perle's office referred the matter to a Pentagon spokesman, who said the matter was too "goosey" to comment upon further—for national security reasons. Naval intelligence officials, the spokesman continued, refused to release details on the type of chip found in the buoy, placing the DOD in the ironic position of protecting Soviet technology secrets. Intel denies knowledge of the incident and reiterates that it will adhere to its policy of no exports to the U.S.S.R. or members of the Warsaw Pact.

Perle's disclosure came on the same day that the House Armed Services Committee voted to approve a critical amendment to H.R. 3231, the Export Administration Act of 1983. The committee recommended that the Militarily Critical Technologies List

(MCTL) be incorporated into the Commodity Control List (CCL) by April 1, 1985. The MCTL is a classified list developed by the secretary of defense. It lists those goods and technologies that, if exported, would significantly improve the military capabilities of U.S. adversaries.

Integration of the MCTL into the CCL would strengthen the DOD in

Perle testified regarding additional evidence of Soviet imitation of U.S. computer technology including:

- Eight types of Soviet microprocessors based on designs from Intel, Western Digital Corp. and Texas Instruments Inc.;

- Three East German microcomputers copied from Intel and Zilog Inc. designs;

- Equipment acquired from the United States, West Germany, the United Kingdom, Switzerland and Japan that has allowed the Russians to construct an impressive microelectronics establishment, the Soviet

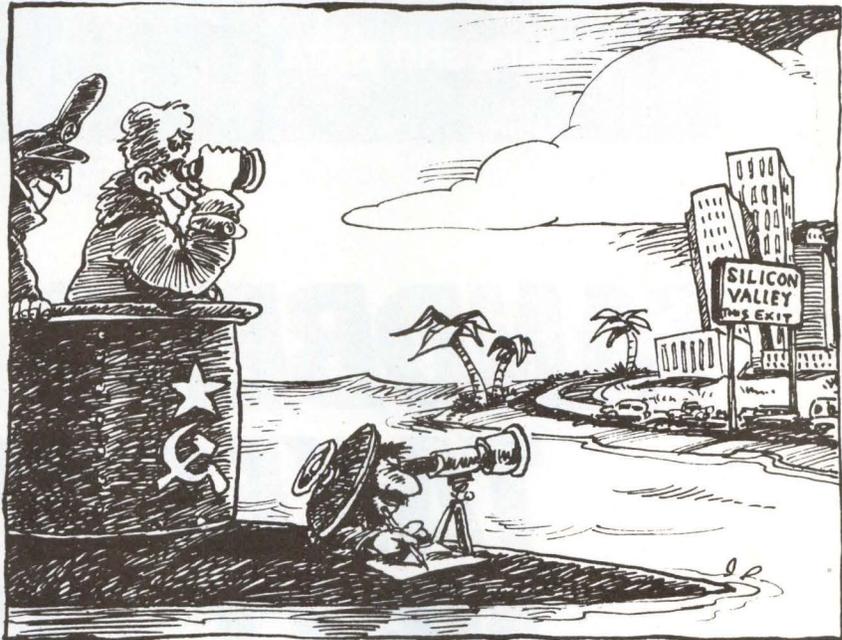


Illustration by Jon McIntosh

deciding which equipment and technologies can be exported. It's likely that exports of advanced computer equipment will be restricted more tightly than ever.

In testimony before the House Armed Services Committee, Perle submitted photographs comparing U.S. and Russian 8-bit microprocessors. The Soviet version, he says, was clearly a deliberate copy of its U.S. counterpart made possible by reverse engineering, a capability the Soviets have acquired during the past few years.

equivalent to Silicon Valley, in the Zelograd region;

- The Soviet RYAD computer system that is a direct copy of IBM Corp.'s 360 computer.

Perle estimates that 30 percent of all Russian integrated circuits are direct copies of U.S. designs. U.S. technology, he charges, is obtained through illegal diversions of shipments through Western Europe where Soviet intelligence is concentrating efforts to obtain U.S. computer technology.



TANDBERG DATA TAKES THE NEXT STEP

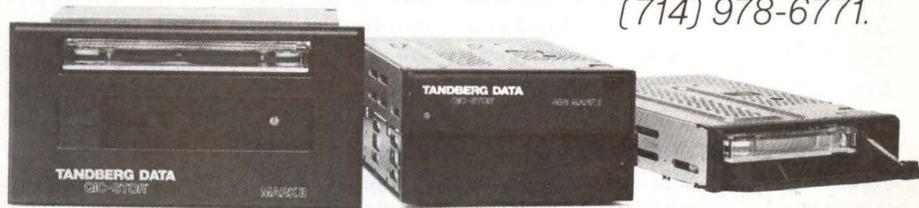


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Software houses target UNIX market with Wang BASIC and Pascal packages

The UNIX systems market, swelling over the past two years with scores of new microcomputer and minicomputer products, continues to attract independent software vendors as well. But despite widespread efforts to develop a body of application programs in UNIX's C language, independent software houses continue to add products based on more market-proven languages.

Oregon Software, Portland, Ore., has adapted its Pascal-2 compiler—developed for Digital Equipment Corp. PDP-11 minicomputers—for Motorola Inc.'s MC68000 microprocessor. TOM (The Office Manager) Software, Seattle, an independent software house specializing in packages for Wang Laboratories Inc.'s 2200 systems, has developed TOMBASIC—an interpreter designed to run TOM's Wang BASIC-2 packages on a variety of Motorola MC68000, Intel 8086- and Zilog Z8000-based microcomputers. The package is also being adapted to run on minicomputers from Prime Computer Inc. using Prime's forthcoming C compiler.

TOM has worked out cooperative agreements with Prime and five microcomputer vendors to port its software to their hardware. Doug Katlove, TOM's vice president of operations, says no OEM or cross-marketing agreements are involved. The first two microcomputer ports are for the Altos Computer Systems 586 and the Fortune Systems Corp. 16:32. Those ports are scheduled for release this month. Packages for Pixel, Plexus Computers Inc. and Prime will follow later this fall.

Katlove reports that the company will continue to market its 40 office-automation and other vertical

packages—along with TOMBASIC—to independent software dealers, OEMs, system houses and consultants. A TOMBASIC package will carry a license fee of \$500 to \$4,000, depending on the target system, Katlove adds.

He expects the market for the BASIC-2 interpreter to be users or packagers of UNIX/C-based systems seeking a body of commercially installed applications packages. "Very few of our (approximately 4,000) Wang users have outgrown their 2200s. Our market is new customers," Katlove asserts.

Oregon Software marketing vice president David Cloutier is positioning the company's Pascal-2 compiler for what he estimates to be the 30 percent of UNIX programmers who would prefer Pascal. Cloutier asserts that programmers have had to forgo Pascal in UNIX microcomputer environments because of performance penalties of earlier Pascal compilers.

Oregon Software was founded in 1977 by a group from the Oregon Museum of Science and Industry that developed a Pascal compiler for

the PDP-11. It has developed what Cloutier calls a high-performance Pascal that includes nine optimization aids: global-register allocation, common subexpression elimination, expression targeting, array-index simplification, branch-trail merging, range tracking, constant folding, dead-code elimination and short-circuit evaluation.

The company previously sold its DEC packages directly to end users but will sell the microcomputer versions primarily through OEMs, starting with Dual Systems Corp. and Masscomp. Prices of the initial version are \$600 for the compiler only and \$1,650 with debuggers and other development tools. The initial version is compatible with UNIX Version 7 and System III. It will be available under Microsoft's XENIX and Unisoft's UniPlus+ packages.

To its DEC packages, Oregon Software has added a SourceTools package designed to help programmers manage Pascal development projects on the VAX/VMS and RSX-11M operating systems. Price is \$3,600.

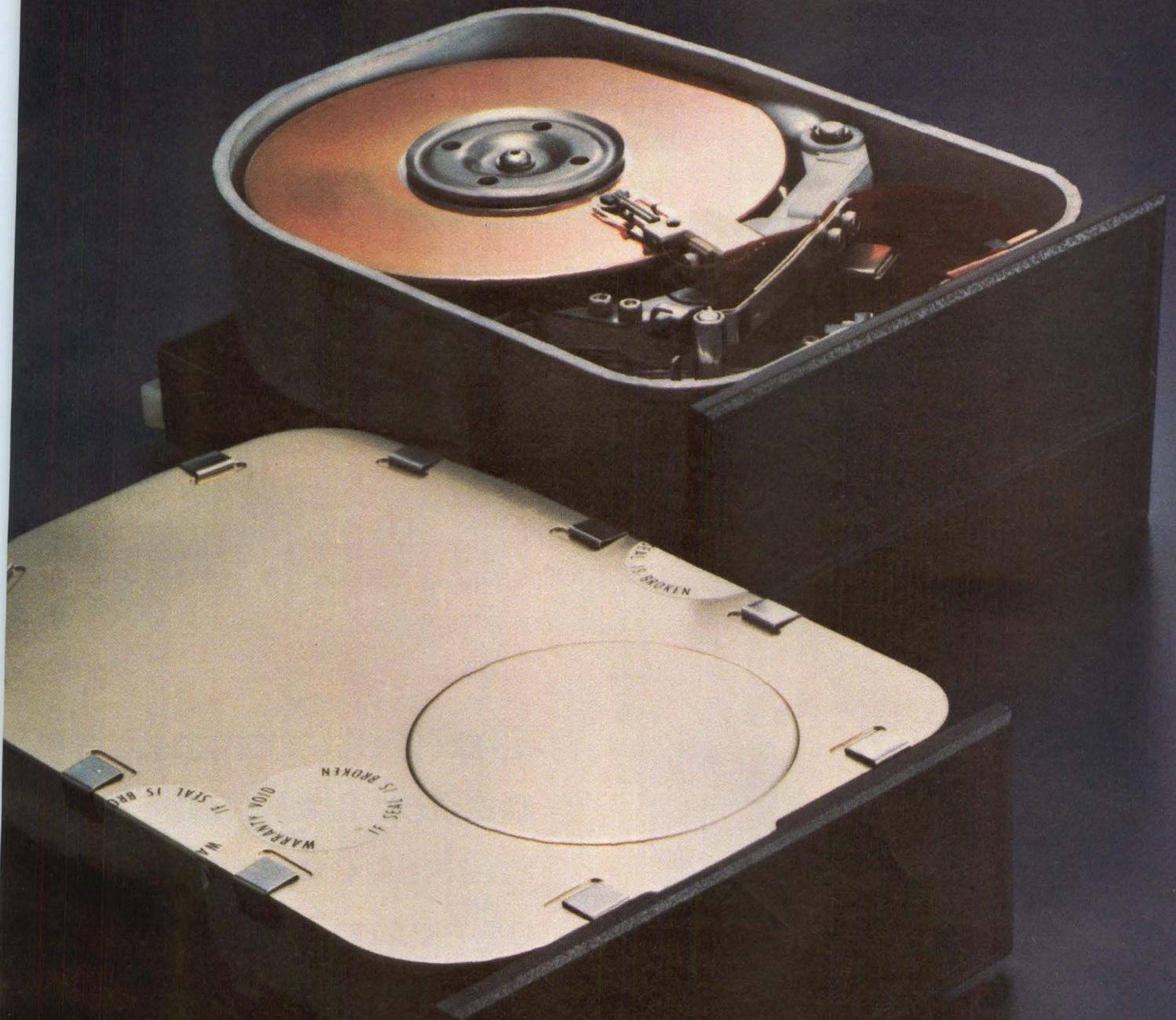
—Geoff Lewis

Dataproducts links with 3M for non-impact printer

Next year, Dataproducts Corp. and 3M Co. will make a joint thrust into the market for low-speed non-impact page printers—a market that industry observers call explosive. Market research firm Dataquest Inc., for example, expects the market to have a compound annual growth rate of 130 percent through 1987.

The two companies announced their agreement in July. They will

develop and market a family of page printers for office-automation and multiuser workstation applications. 3M, St. Paul, Minn., will contribute its non-impact printing technology and manufacturing capabilities; Dataproducts, Woodland Hills, Calif., will add interfaces, develop applications software and market the products through OEM and distributor channels. Dataproducts is considering selling directly to end users



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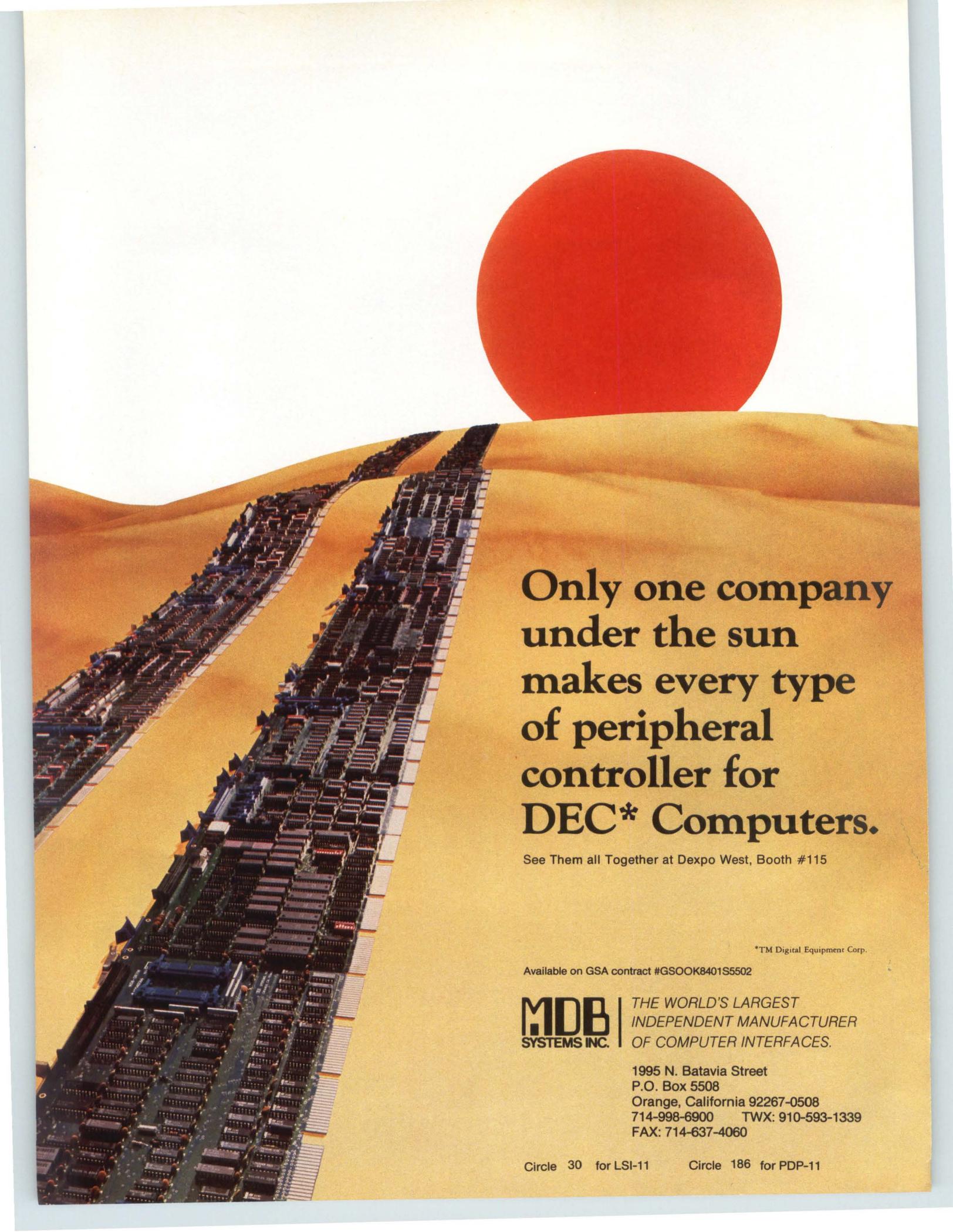
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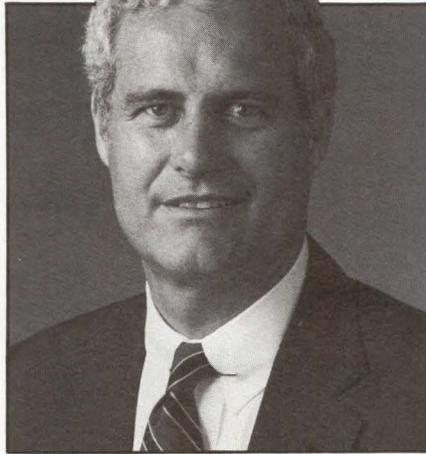
NEWS

as well.

Dataproducts describes the joint effort's first product as a desktop electrophotographic unit printing 15 pages per minute (ppm) at a resolution of 300 by 300 dots per inch (dpi). The printer is still a prototype, and initial shipments are not expected before the second half of next year. A Dataproducts spokesman confirms reports that the printer will employ an imaging system based on a laser diode and selenium photoreceptor drum. 3M's dry dual-component toner will be used in a heat-fusing technique that will allow the product to print on cut-sheet paper and labels. The printer might also be able to print on transparencies. Four on-line fonts and down-line-load capability will be standard. The initial configuration is likely to have dual input cassettes containing 250 and 100 sheets, respectively.

Observers agree that the product will enable the two companies to take advantage of each other's strengths. "This move gives Dataproducts a shortcut into the non-impact technology that is beginning to threaten its primary line printer business," comments Donna Wheatley, senior industry analyst at Dataquest. "At the same time, the arrangement gives 3M an outlet for its technology in a market in which it has no significant presence." She notes that 3M's experience in the copier industry, including its strong position as a supplier of mono- and dual-component toners, will make for considerable synergy with Dataproducts' established position as a major supplier of system printers.

3M has several patents in non-impact printing technologies. However, the printer's imaging system and drum apparently will not employ them. 3M does not discuss details of the printer, but the company reportedly will obtain the



John Harker, senior vice president of marketing and corporate development at Dataproducts Corp., feels that the market for low-speed page printers is the best opportunity for the Dataproducts-3M non-impact printing venture.

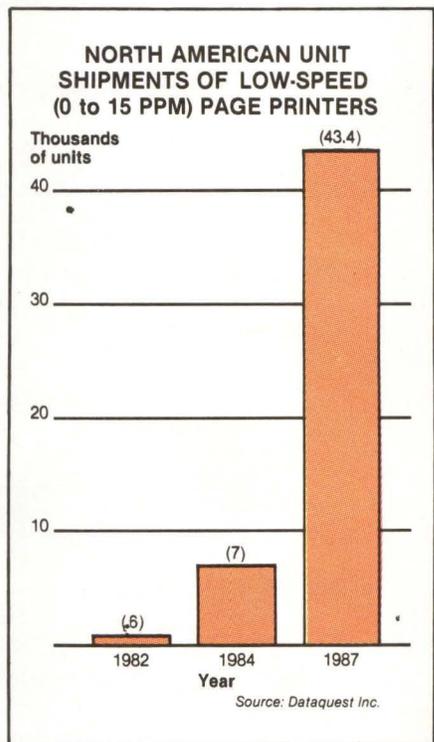
basic print-engine components from another manufacturer or license them from Toshiba of Japan. Officials at Toshiba America Inc., Tustin, Calif., do not comment on the reports but say Toshiba's technology involves a laser diode and selenium photoreceptor drum. The company acknowledges plans for OEM products using such components.

Dataproducts is not secretive about seeking a partner to speed its entry into the non-impact page printer market (MMS, August, 1983 Page 73). Some observers are surprised, however, that Dataproducts' initial product prints only 15 ppm, roughly equivalent to high-speed line printers.

Part of the reason for Dataproducts' choice is that the company believes a wide-open market exists for the lower speed page printer. "The high end of the speed spectrum is the best-established part of the non-impact printer market, with people like IBM having had products out for some time," remarks John Harker, Dataproducts senior vice president of marketing and corporate development. "The market for printers in

the 15-ppm range hasn't taken off yet, although it is starting to emerge." He holds Xerox Corp. responsible for the growth through its introduction of the 12-ppm Xerox 2700 laser printer and the XP12 OEM version.

Another reason for Dataproducts' decision is that it prefers to employ non-impact printing not as a replacement for line printers in data-processing applications but use it in graphics and word-processing applications. "The print quality is there in this technology for word processing," Harker opines. "Daisy-



wheel emulation is one of the applications we have to look at in developing the interfaces and software for this product."

Harker believes that the printer's ability to mix text and graphics and to select from a variety of fonts will make it attractive to business users. He admits the graphics applications most desired by such customers are not yet defined. Dataproducts is forming a task force to study and



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develop graphics software for non-impact and dot-matrix printers.

Dataproducts and 3M are far from establishing pricing for the product. U.S. and foreign manufacturers have introduced or demonstrated several products printing at 15 ppm or less, but only Xerox and Canon U.S.A. Inc.—with its OEM version of the LDP-10—are making significant-large shipments in the United

States. Dataquest's Wheatley points out that 1982 North American unit shipments in this speed category were 600. Xerox, at 85 percent, dominated.

Some observers suspect that products in the low-end page printer market will command considerably lower prices by the time Dataproducts and 3M bring their product to market. Canon, for

example, is demonstrating a laser printing system based on the company's cartridge copier. The printer's price reportedly will make it competitive with high-performance daisy-wheel products. Other Japanese and U.S. manufacturers also reportedly are developing page printers that will compete with serial printers.

—Edward S. Foster

LSI-11/23-based portable fits in briefcase, runs PDP-11 software

The concept of a portable computer as an adjunct to an office system, popularized in the past year by Compaq Computer Corp.'s IBM PC-compatible portable, is spreading toward higher performance areas as design advances such as half-height Winchester disk drives enable smaller packaging. Q-bus systems house Andromeda Systems Inc., Canoga Park, Calif., has developed the Andromeda 11/M12, a 22½-pound Digital Equipment Corp. LSI-11/23-based system (without a terminal) that fits into a briefcase. Because the Andromeda 11/M12 runs standard PDP-11 operating systems, such as RSTS, RT-11 and TSX-plus, company officials expect the computer to appeal to professionals who can take advantage of the thousands of application packages available for those operating systems. Formal unveiling is scheduled for the upcoming DEXPO show in Las Vegas.

The system measures 4 inches high by 13 inches wide by 15 inches deep. It houses a Q-bus card cage with five dual-width slots. One slot is open. The LSI-11/23 CPU, with a memory-management unit that can address as much as 4M bytes of main memory, occupies one slot. A second card contains 256K bytes of

RAM, a third slot is for the disk controller, and a four-channel serial interface card occupies the fourth slot. RS232 and 20-mA interfaces are available on all four channels, and each channel has 16 individually selectable data rates from 50 to



The Andromeda Systems 11/M12 incorporates an LSI-11/23 CPU, 256K bytes of RAM, a 10M-byte Winchester and a 512K-byte floppy disk drive in a 4-by-13-by-15-inch, 22½-pound package.

19.2K bps. Andromeda president Les LaZar points out that the fifth slot could be used to add 1M byte of memory for other options such as an analog or parallel digital interface card or a video graphics display controller for engineering applications. Storage is provided by a 10M-byte, half-height Winchester disk drive, and a half-height, 512K-byte floppy disk drive pro-

vides backup. The Winchester disk can emulate logical RLO1, RLO2 or RK05 disk drives. The floppy provides RX02 emulation.

A typical single-user configuration might have the serial channels assigned to a CRT, a serial line printer, a letter-quality printer and a modem, while a small business timesharing system might have three CRTs and a printer. By adding a Radio Shack model 100 in terminal emulation mode, the 11/M12 becomes a complete, PDP-11-compatible computer that can fit into a briefcase. The 11/M12 is the first of a family of compact offerings, states LaZar. He expects advances in flat-panel displays and reductions in price to lead to the development of a fully integrated PDP-11-compatible system in a briefcase.

In designing the 11/M12, Andromeda encountered some airflow problems, but solved them by using special baffling and by designing a power supply with a cooling fan.

List price of the 11/M12 is \$8,400, with quantity discounts available. LaZar expects potential users to include field engineers, salesmen and design engineers.

—David A. Bright

VLSI Technology claims its IC-design package for DEC, Apollo is fully integrated

VLSI Technology Inc., San Jose, Calif., has unveiled one of the first completely integrated computer-aided-engineering IC-design packages capable of translating schematics into custom VLSI circuits. Using silicon compiler technology, the system is intended for engineers having little or no previous IC design experience. The software runs on Digital Equipment Corp. VAX and Apollo Corp. Domain workstations.

The package provides the tools to enter a system schematic, verify the accuracy of the design through simulation, build a corresponding physical layout through the use of the company's cell compiler library and verify that the interconnection and function of the physical layout corresponds to the schematic representation. The cell compiler library is said to generate thousands of cell variations rather than the hundreds generated by most other systems.

In addition to the cell compilers, the system includes a schematic editor that provides the basis for design synthesis, network entry and documentation, a logic timing simulator to verify designs created with the schematic editor or directly from the physical layout and a composition editor.

Building a chip with the composition editor consists of placing the configured cells interactively where needed. The composition routines automatically route the cells together from the schematic-derived interconnections. Using the layout-compaction feature, the composition editor also produces design-rule-correct layouts, according to the company. Upon completing a design, the chip database can be electronically transferred to VLSI

Technology's silicon foundry for fabrication via the company's VTnet network.

All tools in the menu-driven package are accessed through windows. Commands are entered via a "mouse," or graphics tablet.

The system will be available in the third quarter. Prices will range from approximately \$50,000 for software to \$100,000 for a system including Apollo hardware.

—David A. Bright

EXCELAN INTRODUCES LAN TESTER

Excelan Corp., San Jose, Calif., will introduce its Nutcracker local-area network (LAN) system analyzer/emulator this month. The Nutcracker is the first commercially available instrument designed for debugging, testing, maintaining and managing LAN-based systems down to the component level. The initial models are intended for Ethernet applications, and support for other networks is planned for the near future.

ANADEX CUTS DOT-MATRIX PRICES

Anadex Inc. has reduced prices 20 percent on its six-member Silent Scribe dot-matrix printer family. The Chatsworth, Calif., company faces increasing competition in the market for multifunctional serial printers, particularly with the recent introduction of NEC Information Systems Inc.'s Pinwriter series. The company reduced prices from the \$1,300 to \$1,600 range to the \$1,625 to \$1,995 range. The price cuts do not affect the DP-6500 and DP-9725 printers, introduced at the National Computer Conference in May. The 500-cps DP-6500 was scheduled for production deliveries in late summer, but the company has postponed production of the four-color DP-9725 pending development.

ROLM INTEGRATES TERMINAL, DIGITAL PHONE

Targeted at managers and professionals, Rolm Corp.'s new personal communications terminal integrates an intelligent terminal with a digital telephone in an 13.5- x 14.6-in. desk-top unit. The Cypress emulates the Digital Equipment Corp. VT100 terminal, and is IBM 3270 compatible via the Rolm IBM Gateway. Computer access, auto-dial, calculator and other functions are handled via soft keys. Both voice and data functions can be performed concurrently. Other features include the ability to store as many as 200 personal phone entries and appointment messaging. Program code is stored in 128K bytes of RAM, and personal data are stored in 8K bytes of nonvolatile RAM. The data interface rate is 19.2K baud. The unit contains a 9-in. screen and has a retractable 68-key keyboard.

EUROPEAN SOFTWARE MARKET TO REACH \$5 BILLION

The European market for office application software may exceed \$5 billion, more than 100 times today's market, according to Frost & Sullivan Inc., a New York market research firm. Frost & Sullivan sees the market doubling each year through 1990 from \$30 million this year. The West German market, at \$1.6 billion in 1990, is expected to be the largest, followed by the U.K. at \$1.5 billion. Highest growth is expected in word processing, spread-sheet planning and electronic mail.

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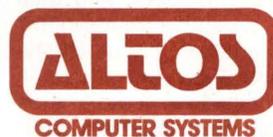
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CIRCLE NO. 32 ON INQUIRY CARD

Two firms aim LISP AI systems at commercial market

Artificial intelligence (AI) is ready to leave the research lab and enter the commercial market, according to two companies that have recently introduced second-generation LISP-based computer systems. LISP software is the predominant language and programming environment for AI applications.

Lisp Machine Inc. (LMI), Culver City, Calif., announced its Lambda system, a successor to its CADR system. Symbolics Inc., Cambridge, Mass., began production shipments of its Symbolic 3600 LISP machine in June. Both companies are targeting emerging commercial applications for systems designed to

run LISP cost-effectively.

"People tend to perceive AI as something great that is going to happen in the future," comments LMI president F. Stephen Wyle. "They don't recognize some of the by-products of AI research that have resulted in such things as timesharing, networking, windowing and some very powerful software tools. In a sense, LISP machines are another such product — a tool developed for AI researchers that is usable for purposes not necessarily associated with AI."

Expert-systems—vertical application programs that essentially imitate human experts performing

their jobs—are the applications for AI that are drawing the most attention. But "AI tools like the LISP machines seem to be furthest along in maturing into a commercial product," says Howard Austin, a consultant specializing in expert-system applications of AI for Knowledge Analysis Inc., Ridgefield, Conn. Both Symbolics and LMI also believe their LISP machines will find a broader market than expert systems in software-development applications. "Virtually any application that requires intensive compiling of program software could conceivably need the software development and maintenance ad-

AI LANGUAGES SIMULATE HUMAN THOUGHT, METHODS

The 25-year effort to develop a software language and programming environment for artificial-intelligence (AI) applications has centered on LISP and its descendant, InterLISP (for Interactive LISP). LISP efforts go back to the 1950s at Stanford University, where limitations in system memory capacities hampered progress. In the late 1960s, with the advent of virtual-memory computers such as the Scientific (later Xerox Corp.) Data Systems 940, Bolt Beranek & Newman implemented a second LISP dialect that used a page-swapping memory scheme. BB&N then implemented InterLISP on Digital Equipment Corp. PDP-10 computers.

Both LISP and InterLISP perform operations on objects, rather than calculations with numbers, and thus render what resemble "intelligent" judgments. In addition, both systems can "learn" and document programs as an author develops them. When Xerox established its Palo Alto Research Center in the early 1970s, it began working with InterLISP on DEC equipment to develop office-automation applications for AI.

About the same time, the company

started work on Alto, an experimental workstation that AI researchers used to run InterLISP. The two research efforts converged in the concept of a personal (single-user) AI workstation with limited local storage, but with access to large disk files via a network (Ethernet). The resulting implementation of InterLISP is InterLISP-D, which Xerox says is upwardly compatible with standard InterLISP. The "D" comes from the Dolphin, Dorado and

Dandelion code names Xerox used.

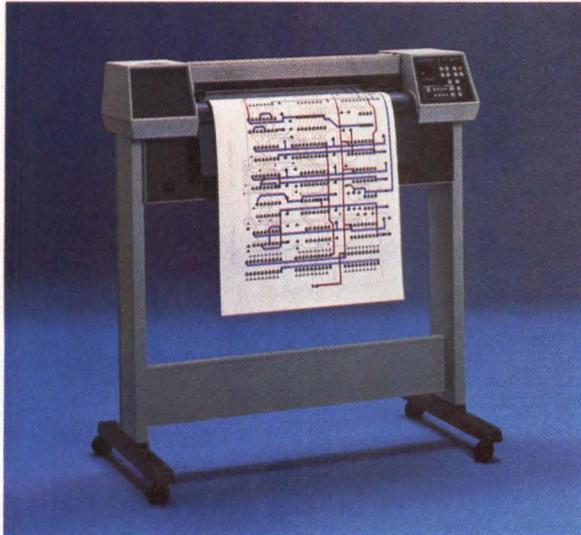
Smalltalk-80 is a separate but similar object-oriented language development at PARC that takes advantage of AI programming in high-resolution display graphics systems with overlapping multiwindow screens. Smalltalk-80 presents a user with a display format that simulates the way one would search through a pile of papers on a desk.

—Geoff Lewis

BASIC CONFIGURATIONS FOR LISP-DEDICATED COMPUTER SYSTEMS

Symbolics 3600	LMI Lambda
36-bit processor with 1.125G-byte virtual memory	32-bit processor with 67M-byte virtual memory (40-bit upgrade has 21.5G bytes)
2.3M-byte physical memory expandable to 34M bytes	1M-byte physical memory, expandable to 5M bytes
169M-byte, SMD-compatible Winchester disk drive	470M-byte, SMD-compatible Winchester disk drive
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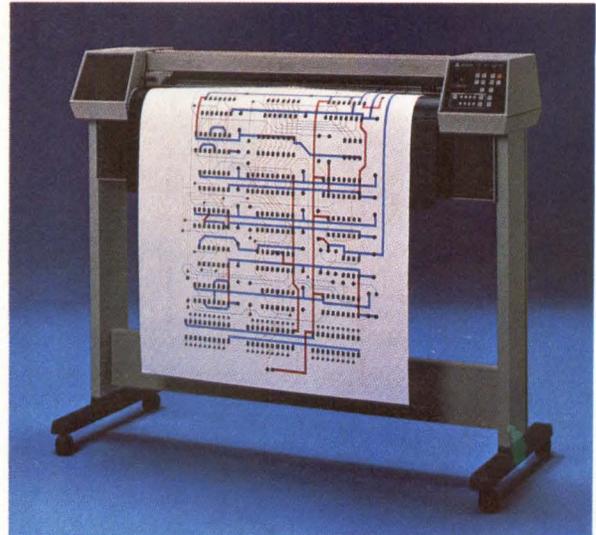
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NEWS

vantages of the 3600," asserts Abe Hirsch, product line manager for Symbolics. "Out of the first 40 customers for the 3600, we have had 40 different applications, including video game design, artificial vision and computer-based training."

Symbolics and LMI share roots dating to the initial development work done in LISP machines at the Massachusetts Institute of Technology in the 1970s. Differences exist, however, in each company's approach to developing second-generation LISP machines. The differences are largely the result of the financing advantage that Symbolics has enjoyed, although the gap narrowed when Texas Instruments Inc. acquired a 25 percent equity position in LMI this year.

Symbolics, with an estimated total of \$14 million in venture capital funding, is one of the best-financed independent AI start-up. The company has taken a total systems approach to the 3600, including the development of communications and peripherals, to optimize the system for LISP. The 3600 features a 36-bit architecture with 32-bit data paths and 4 bits allotted to tagging data by the type of information it represents. Price of a basic configuration operating in a network is \$84,500; prices of standalone and color-display configurations are 15 to 30 percent more.

LMI reportedly had raised \$1 million in venture capital before the TI investment. The 32-bit Lambda LISP processor consists of LMI's four processor boards operating in the 32-bit NuMachine, which Texas Instruments will supply under an OEM contract to LMI. The NuMachine is built around the processor-independent NuBus architecture designed for multiprocessor environments by MIT's Computer Science Laboratory and licensed to TI this year by Western Digital Corp., Irvine, Calif.



LISP Machine's Lambda LISP-based computer system is targeted at a market requiring more efficient software development using LISP programming.

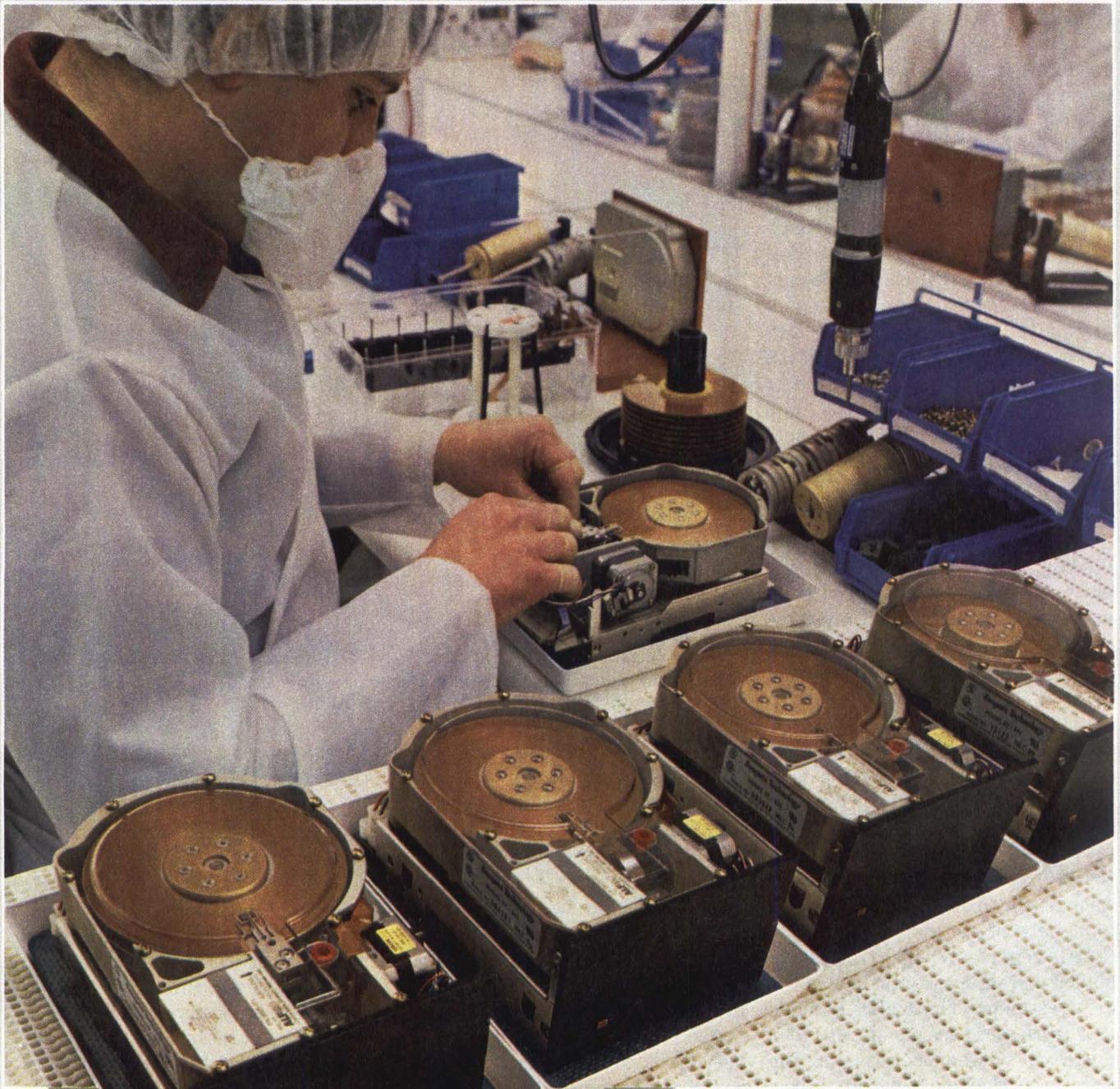
Using the NuBus provides a modular physical design and allows the Lambda to be configured easily for specific applications. With a LISP microcompiler, the Lambda's architecture has a virtual control memory that can be microprogrammed for higher speed and efficiency. The Lambda is expected to run four or five times faster than its predecessor.

The NuBus architecture makes a variety of potential multiprocessor configurations possible. LMI plans to offer a 68000-based UNIX processor to run with the LISP processor. This system will be ready for shipment in November. LMI also plans to introduce an upgrade LISP processor by the second quarter of next year. The upgrade will convert the processor to 40 bits, enabling the machine to implement the IEEE

floating-point standard. Software developed on the 32-bit Lambda should run identically on the 40-bit processor because both architectures use the same 8 bits for tagging data. Single-unit price for the basic Lambda configuration is \$75,500. Price of adding the UNIX processor will be \$10,200 plus a \$7,000 software license. Price of upgrading a basic 32-bit Lambda system to a 40-bit configuration will be \$8,300.

Rather than offer multiprocessor capabilities, Symbolics is concentrating on developing language interpreter kits that will enable users to run existing programs on the 3600 system. The system will initially support FORTRAN-77. Symbolics expects to introduce Pascal and C interpreters over the next year. In July, the company formed a graphics division to develop hard-

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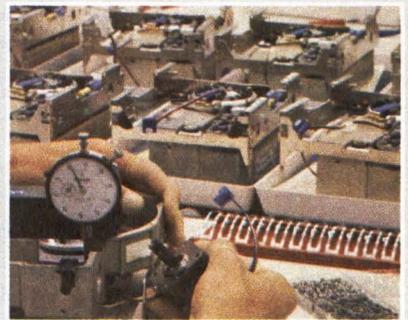
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CIRCLE NO. 35 ON INQUIRY CARD

Mini-Micro World

NEWS

ware and software tools for image-processing, game-design, animation, very-large-scale-integration (VLSI) design, training and simulation applications.

The market for the Symbolics and LMI LISP machines is expected to grow with the spread of AI into commercial applications. At a New York University symposium on AI applications for business, Austin of Knowledge Analysis estimated the market for AI. He projected 1983 AI sales at \$42 million, but said such predictions become obsolete almost as soon as they're made because of new companies entering the field. The figure includes projected sales of \$11.5 million by Symbolics and \$2

million by LMI but does not include Xerox Corp. Xerox has not announced sales figures for its 1100 family of machines running InterLISP-D, a descendant of LISP for use with a single-user AI workstation that accesses larger disk files via a local-area network.

Austin also predicts the market for LISP machines will reach \$100 million within two years, fueled by the growing demand for AI-based products of all types. The overall market growth for AI-based products is a question of definition, he says. He expects AI-related hardware and software to permeate the computer industry.

Austin is not alone in such

expectations, particularly in light of Japan's commitment to AI research in its Fifth Generation computer project. Ken Bosomworth, president of market research firm International Resource Development Inc., Norwalk, Conn., expects the market for AI hardware, software and services to be \$8 billion within 10 years.

Symbolics' target over the next year is \$50 million in sales, representing more than 400 systems, says Hirsch. Wyle of LMI, makes a "conservative projection" that LMI will produce 8 to 10 units a month into 1984.

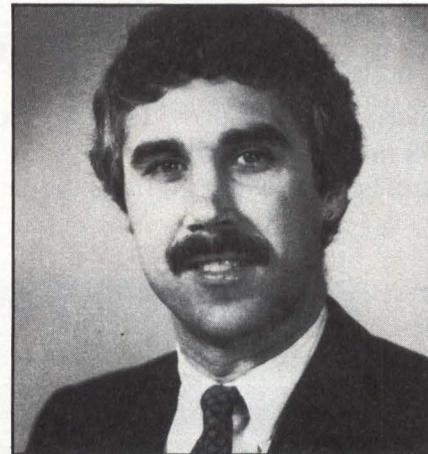
—Edward S. Foster

Microcom proposes standard for micro file-transfer protocol

With the backing of major microcomputer manufacturers and software suppliers, Microcom Inc., Norwood, Mass., has put forth its Microcom Network Protocol (MNP) as an industry standard for remote communications between personal computers and larger systems. The three-year-old firm developed MNP for use with its intelligent modems.

The protocol is based on the International Standards Organization (ISO) reference model for an open systems interconnection (OSI). It has been used in electronic-mail packages for Apple Computer Inc. and Tandy Corp. microcomputers. Apple is one of several companies including Victor Technologies Inc., VisiCorp and GTE Telenet Communications Corp. that have publicly endorsed the protocol.

Microcom president James Dow says the MNP is not intended to compete with IBM Corp.'s Systems Network Architecture (SNA), which is commonly used to link microcomputers to mainframes, or local-area



Microcom president James Dow says his company's proposed network protocol is not intended to compete with IBM Corp.'s SNA, but to provide a file-transfer method that can be used in a variety of environments, including SNA and LANs.

networks (LANs), which are used to connect disparate systems within an office or a campus. Instead, Dow explains, MNP provides a file-transfer method for text and data that can be used in a variety of

environments including SNA and LANs such as Ethernet.

Incorporating five of seven layers in the OSI model, MNP supports either synchronous or asynchronous transmission over voice-grade or leased lines at the lowest (physical-connection) level. At the second, or link, level, MNP supports block data transfer for file transmission or bit-stream data transfer for full-duplex interactive communications, allowing access to public data networks. Microcom has dropped the ISO's level three and four network and transport layers because the initial MNP release covers only point-to-point links. Company officials say these levels can be added later.

MNP has added the OSI presentation and session layers at the fifth level so that handshaking and file translation can occur simultaneously. For dissimilar systems, MNP provides a "network virtual file" to translate files into a universal, machine-independent structure. The final layer provides the actual file transfer.

"The MNP has already become a de facto standard," Dow asserts, citing the support of Apple,

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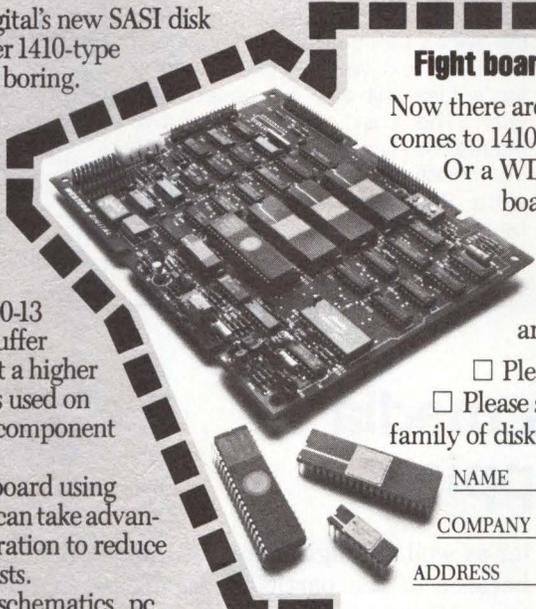
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VisiCorp, Victor Technologies, GTE Telenet, Systar Corp., Comm-Pro Associates and the DMW Group Inc. consulting firm. Microcom officials claim that 15 more vendors, including major minicomputer manufacturers, are planning to support the proposed standard. They decline to comment on reports that

IBM will use the MNP package for its low-end systems. To promote the MNP standard, Microcom is "following Xerox on its Ethernet licensing program," Dow notes. The system is offered at \$2,500 for unlimited-use licenses, and the company hopes that its low-cost licensing will lead to broad acceptance.

VisiCorp chairman Dan Fylstra observes, "Our perception is that the industry is just crying out for this kind of standard." VisiCorp plans to use the MNP format in both its Visi series and Visi^{On} product lines. Noting that VisiCorp addresses the microcomputer-to-mainframe SNA market with products from the recently acquired Communications Solutions Inc. subsidiary, Fylstra adds, "You must recognize that there are millions of (microcomputer) users that have to transfer files among themselves independent of existing 3270 installations."

Apple executive vice president E. Floyd Kvamme, whose company has offered an MNP-based electronic-mail package on the Apple III and plans to use MNP on other members of its line, points out that MNP may prove to be a productivity tool as well as a communications product. "We have seen statistics that indicate as much as 80 percent of work being input into a system already exists in electronic format elsewhere," he says. "With widespread use of MNP, a great deal of redundant data capture could be eliminated."

—Geoff Lewis

SOFTWARE LINKS MIXED NETWORKS

A group of ex-IBM Corp. employees with heavy experience in distributed-data-processing and Systems Network Architecture (SNA) environments claims they have solved the problem of efficiently linking diverse microcomputers, minicomputers and mainframes within a network. Mac Lewis, president of the Systems Center, San Mateo, Calif., asserts that his company's software can connect SNA networks to non-SNA networks such as Corvus Systems Inc.'s Omninet and Digital Equipment Corp.'s DECnet.

Systems Center's software consists of three components. One, the network DataMover, helps personal computer users manipulate information within an SNA. The second, the Network Access Services SNA gate-

way, connects mixed networks. The third, Application Programmatic Interface, links the DataMover and the gateway and manages the connection between the SNA and software from various vendors, such as Informatics Inc. and Cullinet Software.

The Systems Center hopes to attract OEMs as well as large corporations with SNA networks. The company plans support for the IBM 30XX and 43XX MVS mainframes and the Series/1 for this fall and for the IBM PC early next year. Apple Computer Inc.'s Lisa will also be added next year. The cost of connecting two mainframes is approximately \$10,000 per mainframe per year. Service is extra. Prices for microcomputers will be around \$500.

—David A. Bright

Kodak develops media for 10M-byte floppies

Eastman Kodak Co. subsidiary Kodak Spin Physics, San Diego, Calif., is challenging floppy disk drive manufacturers to use its Isomax-coated substrate to give floppies unprecedented capacities as high as 10M bytes. Spin Physics claims it can produce Isomax-coated substrate in high volumes.

Isomax, developed for and used in videotape, is made from a cobalt-enhanced, isotropic particle that permits optimal magnetization. The Isomax media supports perpendicu-

lar as well as longitudinal recording because of the particles' organization. With current cobalt media, particles cannot be aligned as smoothly as they can with Isomax. Consequently, cobalt media does not allow the entire recording surface to be used.

One disadvantage of Isomax, however, is that it necessitates redesigning current drives to handle a different method of disk packaging. Drives using Isomax must incorporate improved error-

correcting devices to handle 45,000-bit-per-inch recording densities as well. Another drawback to Isomax is its high initial cost.

Tandon Corp., which shares dominance of the floppy disk drive market with Shugart Corp., is expected to announce a drive using Isomax media next year. Other manufacturers of 5¼- and sub-4-inch floppy disk drives are working on similar drives.

The 800-oersted (Oe) media provides track densities from 200 to 400 tracks per inch, raising floppy capacities from 5M to 10M bytes. In comparison, some drive manufacturers are stretching current 600-Oe media to 96 tpi for a

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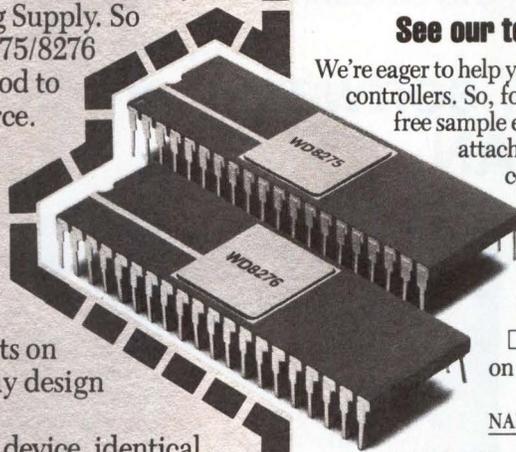
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maximum capacity of 2M bytes on a double-sided, double-density, 5¼-inch drive. "Isomax will serve as a bridge between conventional media and thin-film media for floppy drives," says Ray Freeman, president of Freeman Associates, a Santa Barbara, Calif., market research firm. "The key will be its market acceptance and how widely Kodak plans to distribute it."

Ken L. Thompson, head of magnetic media marketing for the Magnetic Media Division of Spin Physics, says Kodak's plans for Isomax include second-source agreements. Spin Physics expects production to begin in late 1984.

Industry sources believe Kodak will make the Isomax media available to other floppy disk manufacturers such as Verbatim Corp. and Xidex Corp., which now buy conventional floppy media substrates from 3M Co. Wes Rose, director of marketing at

Xidex, agrees that there is a packaging problem with Isomax: contaminants must not be allowed to touch the surface of disks with bit densities of 45,000 bpi and higher. "You almost need a Winchester-type environment," Rose contends.

Spin Physics' Thompson admits that Isomax requires a hard jacket and a shutter assembly, as does Sony Corp.'s 3½-inch microfloppy disk drive. But he asserts that a sealed head-disk assembly like that of a Winchester disk drive is unnecessary. He claims that Spin Physics has tested drives with densities as high as 150,000 bpi and has found no serious contamination problem. Thompson acknowledges that such high densities offer little likelihood of error-free recording, but he believes that the problem lies in the electronics, not the media. "Disk drive manufacturers will simply have to improve built-in error-correction devices," he states.

Isomax floppy disks are likely to challenge the low-end tape drive market for Winchester disk backup. But Freeman notes that this challenge is traditional in the disk drive industry: "The 5¼-inch capacities challenged 8 inches, 8-inch capacities challenged 14 inches and so on," Freeman notes. He expects the market for traditional-capacity floppy disk drives to survive because those drives will still be used for loading software.

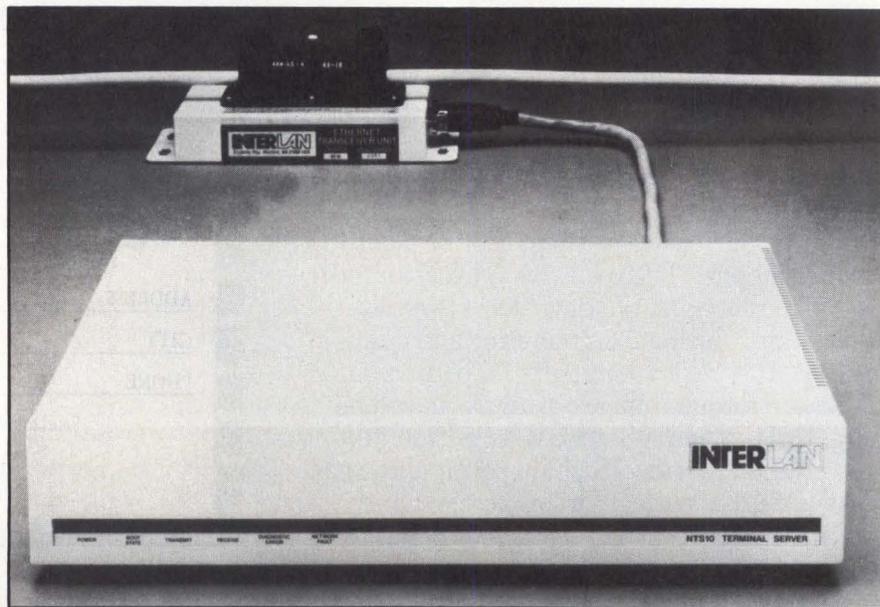
The price of Isomax is another concern. Isomax-coated drives and the media for them will be expensive: diskettes are expected to sell for \$10 to \$12 each as opposed to \$2.50 to \$5 each for conventional diskettes. But, Thompson observes, "As with every other product introduced in this industry, the price will eventually drop. Isomax diskettes will someday be comparable in price to conventional diskettes."

—Robert A. Sehr

Terminal server, software permit file swapping LAN

Interlan Inc.'s terminal server and networking software permit 12 models of personal computers from seven vendors, two microcomputer development systems and four host minicomputers to swap binary and ASCII files over the Ethernet local-area network (LAN).

The Intel 80186-based NTS10 plugs into the Ethernet/IEEE-802.3 LAN and connects to EIA RS232C ports of asynchronous devices. Apparently, because of cost considerations, Interlan opted to use relatively slow RS232C hardware, with a transfer rate of only 19.2K baud. The Westford, Mass., company says the terminal server provides switched "virtual circuit" communication for electronically interconnecting user host and peripheral



Interlan's NTS10 terminal server connects RS232C devices to the Ethernet local-area network. Four- and eight-port versions are available.

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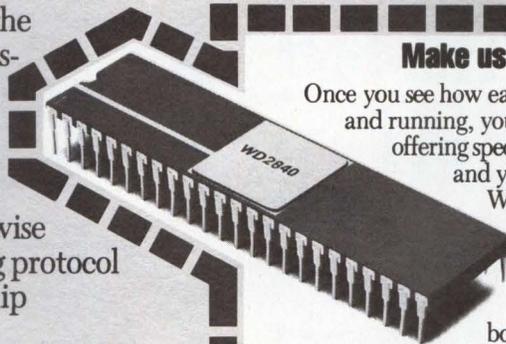
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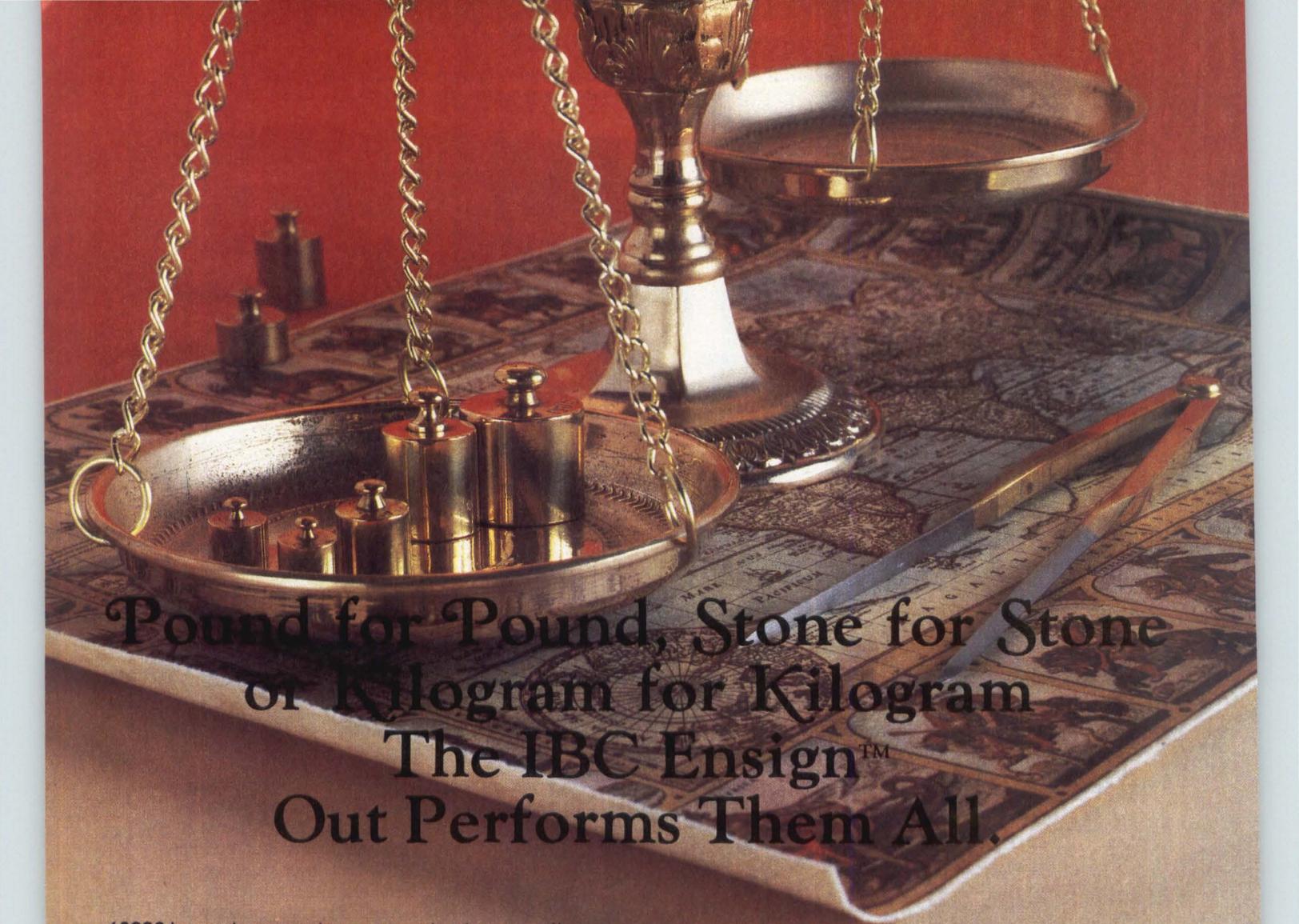
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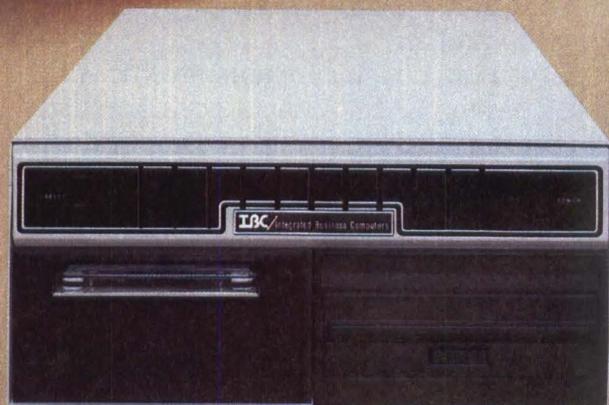
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equipment. The protocols resolve RS232C device incompatibilities transparently. "This means that a hard-copy terminal set to operate at 1,200 baud can be logically connected to a 9,600-baud computer port," explains a company spokesman. Price of the eight-port NTS10 is \$3,200; price of the four-port unit is \$2,500.

The software for the server, developed by Polygon Associates,

Maryland Heights, Mo., has two parts: Poly-TRM and Poly-XFR. The Poly-TRM package essentially converts a personal computer into a terminal; the Poly-XFR permits file transfers over Ethernet. The software supports most personal computers from Apple Computer Inc., Digital Equipment Corp. and IBM Corp., as well as the Osborne Computer Corp. Osborne I, the TeleVideo Systems Inc. model 802,

the Tandy Corp. TRS-80 model II and the Xerox Corp. model 820 microcomputers.

The software also supports the Intel Corp. Series II and III and the Motorola Inc. EXORciser microcomputer development systems. Mini-computer systems supported are DEC's VAX/VMS, RSTS/E, RSX-11M, RSX-11M+ and RT-11. Price of the Polygon software is \$150 to \$200 per computer. —James F. Donohue

Study predicts fiber-optic boom in telecommunications industry

The U.S. market for fiber-optic systems will reach \$2 billion by 1990 from only \$4 million in 1973, according to a recently published study by market research firm International Resource Development (IRD) Inc., Norwalk, Conn.

The telecommunications industry spent \$65 million to \$80 million on fiber-optic systems in 1982, or 40

percent of the total market. The IRD study predicts defense applications such as missile guidance and secure communications to account for fiber-optic sales of \$162 million in 1986 and \$431 million by 1990.

Low data-throughput requirements in distributed-data-processing networks, coupled with computer manufacturers' unwilling-

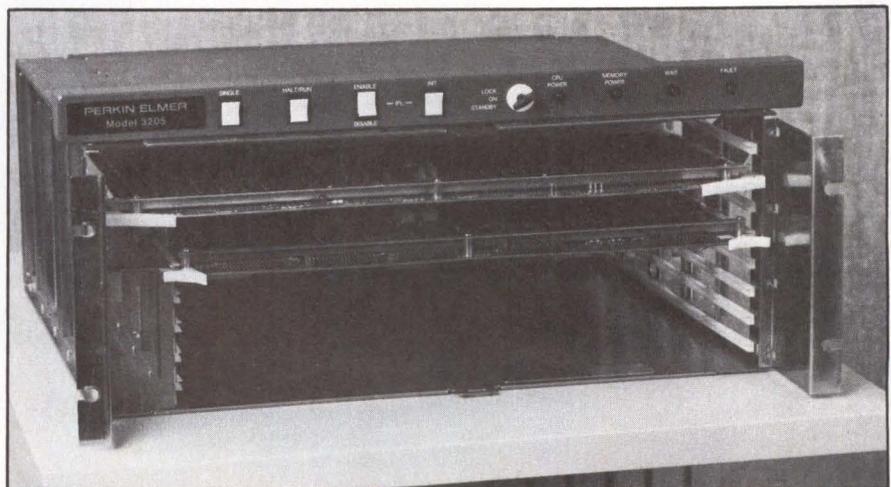
ness to incorporate fiber-optic substitutes in products, however, are restricting the introduction of fiber optics in computer applications, according to the study. The local-area network (LAN) market—once expected to use many fiber-optic components—now is poised to use coaxial cable as its transmission medium instead. —Stephen J. Shaw

P-E, DG lower supermini prices with new models

The continuing price/performance threat of 16-bit microcomputers has helped cause a downward pricing trend in superminicomputers. Perkin-Elmer Corp., for example, recently added a \$9,950 processor to its Series 3200 family. The company bills the new unit as the lowest priced supermini on the market.

Prices of high-end superminis are also deflating. For example, Data General Corp. has replaced the MV/8000 with the MV/8000 II, which sells for the same price as the lower end MV/6000.

Aaron Goldberg, an analyst at International Data Corp., Framingham, Mass., makes the following



The P-E model 3205 low-end supermini is packaged in an eight-slot, 7-inch-high chassis. A multiperipheral controller board and a CPU board with as much as 1M byte of memory are standard. List price is \$9,950.



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observations about the supermini market:

- Microcomputers will continue to force low-end supermini offerings such as the P-E model 3205.

- DG's top-of-the-line MV/10000 is continuing to offset the supermini price structure (MMS, April, Page 17).

- The commercial availability by 1985 of more powerful microcomputers based on the Intel 386 and 432 and on the Motorola MC68020 will further intensify the price competition.

- A need for a new generation of large superminis will develop by 1986. Growing technical markets,

such as computer-aided design/computer-aided engineering, will drive that market, and such applications will require greater word length and parallel pipelining.

P-E claims that the model 3205, which has a single-precision Whetstone rating of 506,000 instructions per second, has a price/performance advantage over microcomputers from Onyx Systems Inc. and Plexus Computers Inc. and Digital Equipment Corp.'s PDP-11/24 and VAX-11/730. The unit is packaged in an eight-slot, 7-inch-high chassis. The processor and 512K bytes of MOS memory are implemented on one board with floating-point and selector-channel capability. A total of 1M byte of memory can be implemented on the board, and memory can be expanded to 4M bytes via an optional board. Single-in-line packaging is used with 64K dynamic RAM chips (see "PE uses SIP 64K memories to reduce minicomputer system price," Sept., Page 58). A third board houses a multiperipheral controller.

A memory manager circuit provides segmentation, full relocation and protection under operating-system control. The CPU is compatible with the full Series 3200 instruction set and has 128 general-purpose 32-bit registers. Built-in features include error-checking and -correcting memory, a hardware error logger, auto restart, CPU- and multiperipheral-controller-board self testing and a remote diagnostics option.

The model 3205 runs PE's OS/32 operating system, so it is compatible with the rest of the 3200 line. The Wollongong Group's Edition VII Workbench version of UNIX is also available. A basic package with 512K bytes of memory sells for \$6,169 in quantities of 100 or more. List price of a system with 512K bytes of memory, a system console, a power supply, a 40M-byte Winchester disk drive, a selector channel and a disk controller is

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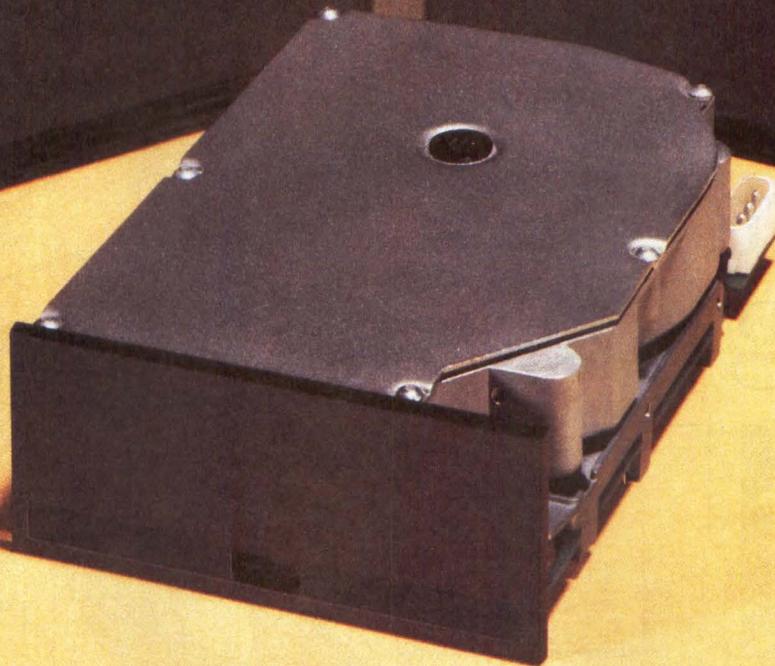
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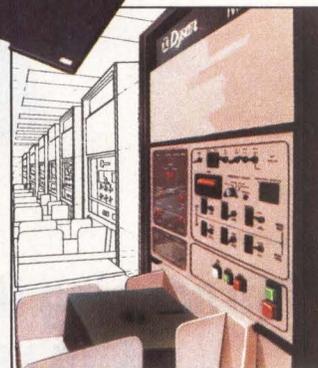
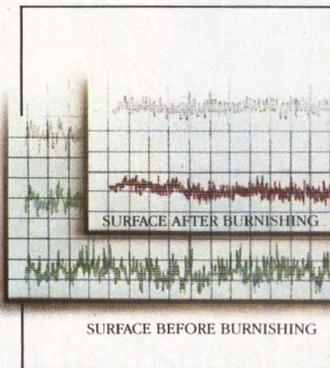
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\$24,950; in 100-unit quantities, it sells for \$15,469.

DG says its MV/8000 II will target the industrial - automation market, particularly CAD/CAE and engineering timesharing, as well as the business and government markets. The system uses the same CPU and memory boards as those used in the MV/8000, which was introduced in April 1980. The MV/8000 II is 39 inches high by 19 inches wide, but has only 13 slots in the chassis. The MV/8000 has 26 slots and measures 60 by 37 inches. To save space, maximum memory on the new system is 8M bytes, while the model it replaces could be expanded to 12M bytes. DG says the new machine meets Federal Communications Commission EMI and RFI emissions regulations. Single-precision Whetstone rating is 1.26 MIPS. Floating-point hardware is optional. The system supports as many as 128 terminals and 8.5G bytes of disk space. Battery backup is optional. List price of a basic system with 1M byte of main memory and the AOS/VS operating system is \$83,000. Customers can still buy the MV/8000, but it is not being marketed.

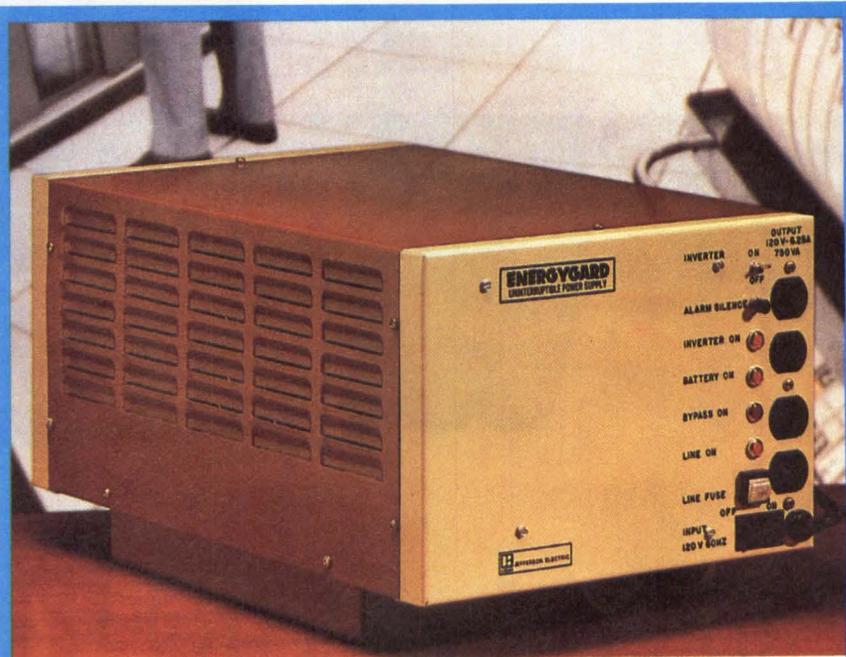
DG has also announced a 354M-byte Winchester disk subsystem with an average seek time of 20 milliseconds, a line of ergonomically designed Dasher terminals, software enabling the D450 and D460 terminals to emulate the IBM 3278 terminals running IBM's APL and memory price reductions as high as 46 percent.

Other offerings from P-E include the model 3250XP high-end supermini and the model 7500 scientific workstation. The 3250XP is a single-processor version of the modular, multiprocessor-based 3200MPS, which was introduced in November. The 3250XP can be field-upgraded to the 3200MPS, and the 3250 can be field-upgraded to the 3250XP. As many as nine

auxiliary processing units can be added to the 3250XP. The system directly addresses as much as 16M bytes of two- or four-way interleaved memory. P-E rates the 3250XP at 3 MIPS in single-precision Whetstones.

P-E calls a 3200MPS with nine

auxiliary processing units one of the world's fastest superminis. It is rated at 21 MIPS in single-precision Whetstones. List price of a 3250XP with 2M bytes of memory, the OS/32 operating system, a system cabinet and a power supply is \$156,000. An upgrade package with one auxiliary



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processing unit and a floating-point processor sells for \$37,800. Targeted real-time applications for the two machines include geophysical exploration and production, warfare simulation and data communications.

The MC68000-based model 7500 scientific computer runs UNIX-like IDRIS and features two RS232 ports; 32 soft keys; and FORTRAN 77, BASIC and C support. List price of a monochrome version with 416K bytes of memory, a 13-inch monitor, two 5¼-inch floppy disk drives and IDRIS is \$8,400. List price of a color version is \$10,800. —David A. Bright

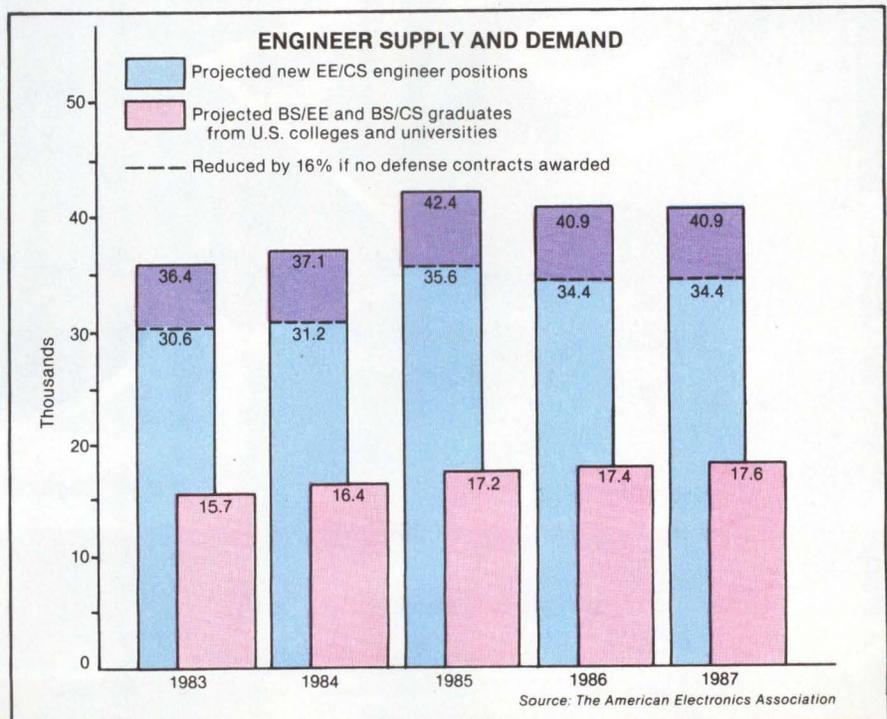
DG's new MV/8000 II is 39 inches high and has 13 slots, compared to 26 on the MV/8000. DG also introduced the new Dasher D210 terminal and a 1G-byte Winchester disk subsystem (right).

Shortage of EEs, computer science engineers to continue in U.S.

Although the United States is the world leader in the electronics and computer-related industries, it continues to suffer a shortage of engineers in those fields. Over the next five years, there will be about 113,500 more new electrical and computer science engineering positions than there are graduates to fill them, according to a study by the American Electronics Association.

Based on survey figures, the projected demand for electrical and computer science engineers through 1987 for the U.S. electronics and information-technology industries is 197,662. The number of new electrical engineers/computer science graduates expected to enter industry from U.S. colleges and universities during that period is 84,256.

In a similar study taken in 1981,



Mini-Micro World

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AEA found the shortage to be 129,000 from 1981 to 1985.

Job categories with the highest projected growth over the next five years are software engineers (115 percent), electronic engineering technologists (107 percent) and computer analysts/programmers (103 percent). The growth levels are generally consistent with the results of the earlier study. According to AEA, the additional need for electrical engineers will drop slightly, but requirements for computer science engineers will increase 0.5 percent when compared with 1981 to 1985.

The current AEA survey is based on data supplied by 815 electronics companies, whose sales represent approximately 30 percent of the U.S. industry total.

The AEA, Palo Alto, Calif.,

recommends that each U.S. company in the electronics industry contribute 2 percent of its research and development budget to engi-

neering education. Toward that end, the AEA has established the Electronics Education Foundation.

—David A. Bright

Six states consider VDT regulations

Concern about health problems associated with video display terminals (VDTs) has prompted six states to consider legislation regulating VDT use in offices. Provisions of the proposed laws range from furnishing pregnant women with anti-radiation jackets to requiring that vendors inform users of potential health hazards.

Currently, Connecticut, Illinois, Massachusetts, Maine, New York and Oregon have bills before their

respective state legislatures. Computer equipment manufacturers and trade associations are marshaling forces in an attempt to stanch the proposed regulations by submitting testimony that debunks the claims of VDTs' harmful side effects.

"The issue is ergonomics, not health hazards," comments Alan Foster, the American Electronics Association's (AEA's) manager of state government relations. Recent studies conducted by the U.S.



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Department of Health and Human Services, the National Academy of Sciences and the National Institute for Occupational Safety and Health (NIOSH) have concluded that radiation emissions from VDTs are well below federal safety standards. "In some cases, there were no measurable emissions at all," Foster states.

The AEA has sponsored industry spokesmen from Hewlett-Packard Co. and Tektronix Inc. to testify against the Oregon bill. Meanwhile, on the East Coast, the Computer and Business Equipment Manufacturers Association (CBEMA) has been vocal in its opposition to the legislation. The association has hired a lobbyist to fight the Connecticut measure. In opposition, a special task force including representatives from Apple Computer Inc. and Tektronix is counteract-



ing the campaign to regulate VDTs.

"If the states want to consider broad work rules, fine, but these measures single out VDT operators," contends Charlotte LeGates, a CBEMA spokeswoman. Some labor unions and women's groups, however, are pushing for nationwide VDT legislation.

CBEMA gives the status of pending VDT legislation as follows:

- Connecticut: S.811 would require sellers of VDTs to inform users of potential hazards and to ensure that users are not exposed to long-term radiation. The measure was passed in a different form by the state senate, which established a study group scheduled to report its findings in February 1984.

- Illinois: H.274 would create an act to provide occupational safe-

Illustration by Jim Carson

A Platter Ahead in Half-Height Winchester

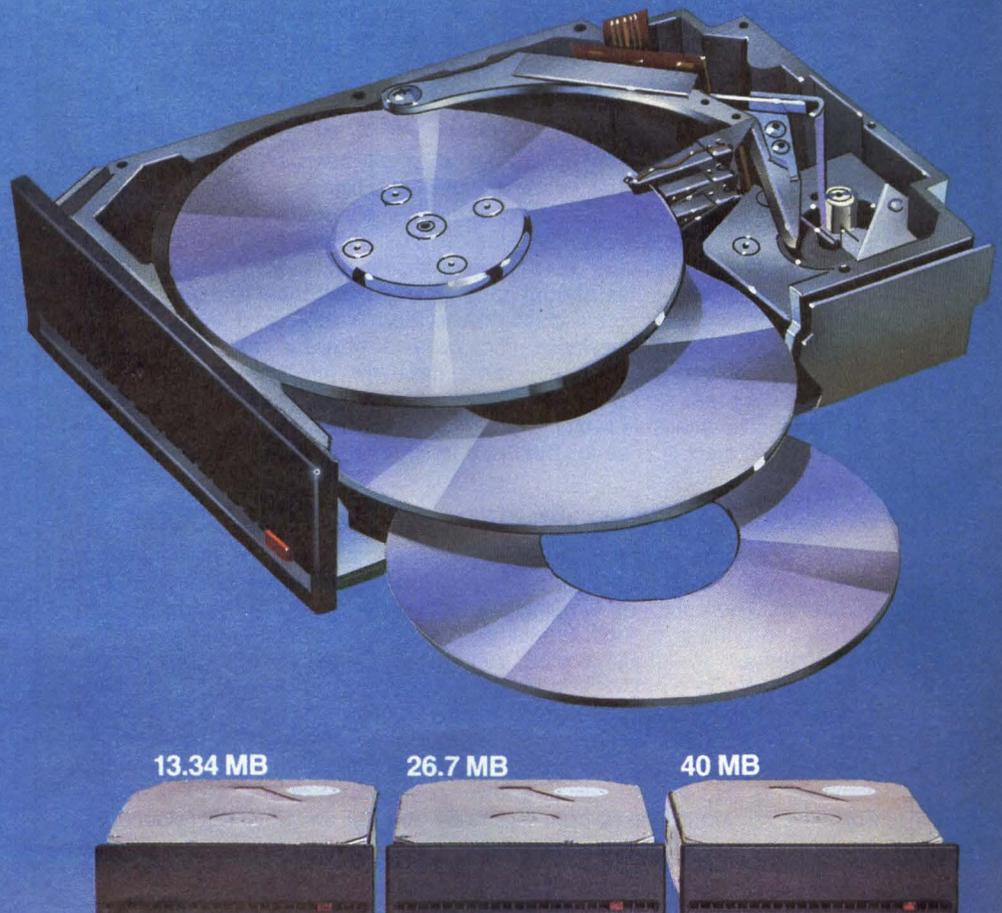
Tulin fits your data storage needs with half-height Winchesters storing 13.34, 26.7 and 40 megabytes (unformatted). But Tulin gives you more than big capacity in a little space. Tulin gives you a higher level of technology, better reliability, and more proprietary features.

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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

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MINI-MICRO SYSTEMS/ October 1983



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MINIBITS

INTEL INTRODUCES PLASTIC EPROMS

Intel Corp. has introduced windowless, plastic, dual-in-line packaging for its 32K- and 64K-bit erasable, programmable, read-only memories (EPROMs). Intel officials say the plastic production EPROMs have the same specifications as the ceramic EPROMs, and users can specify access time for their applications. The units are intended to replace standard EPROMs or read-only memories (ROMs) in a customer's inventory, enabling one production EPROM to serve several product lines, thereby reducing overhead. Intel adds that the plastic packaging lends itself to high-volume automatic insertion because of its resistance to chipping and cracking. Production EPROMs use the same intelligent programming algorithm as traditional EPROMs. The 64K-bit chip sells for \$6.60 each in quantities of 10,000; the 32K-bit chip is \$5.50.

AFIPS WILL COMPENSATE NCC 'TENT PEOPLE'

The American Federation of Information Processing Societies (AFIPS) Inc., sponsor of the National Computer Conference (NCC), will compensate 216 vendors whose booths were in six unair-conditioned tents at NCC '83. Temperatures in the tents reached 113 degrees Fahrenheit. Several of the vendors considered filing a class-action suit against AFIPS, but AFIPS blamed the air-conditioning contractor. AFIPS will pay each company an equal portion of the total cost of the air-conditioning contract for the tents. Each vendor can also obtain a copy of the NCC '83 attendee mailing list. AFIPS places the total value of the offer at approximately \$3,500. An AFIPS spokesman says several vendors have accepted the offer. There will be "no temporary structures" at NCC '84 in Las Vegas, Nev., the spokesman adds. AFIPS will offer 370,000 square feet of exhibit space—57,000 square feet more than NCC '83 in Anaheim, Calif.

INTEL COMBINES 80186, DATACOMM ON ONE BOARD

Intel Corp. claims its iAPX 80186-based, single-board Multibus COMMputer that also includes communications capabilities provides as much as six times the throughput at one-half the cost of some multiple-board configurations. The iSBC 186/51 COMMputer also includes 80131 operating-system firmware, an 82586 local-area network (LAN) coprocessor, an 82501 Ethernet serial interface chip, 128k-bytes of dual-ported RAM, expandable to 256K bytes, as much as 192K bytes of standard EPROM and RS232C and RS422A/RS449 programmable serial interfaces. Software is provided to implement the transport, network-management and data-link interface layers of the International Standards Organizations's (ISO's) network model. The system is expected to be available next month. Price of the COMMputer is \$3,000; price of a single-project license for the INA 960 Network software is \$5,000.

DENNISON REFINES ION-DEPOSITION TECHNOLOGY

Dennison Manufacturing Co. Inc., Framingham, Mass., is demonstrating several refinements of the ion-deposition printing technology that it pioneered. The company is using the technology with a web press for very high-speed printing of tags, labels, bar codes and tickets. Under a contract with Delphax Systems, a joint venture of Dennison and the Canada Development Corp., Dennison is also developing technology for the basic Delphax engine, which now prints 60 pages per minute (ppm) at a resolution of 240 by 240 dots per inch (dpi). Ion-cartridge development work for the Delphax engine is resulting in higher quality print and better reliability. Dennison is also demonstrating a lower cost version of the Delphax engine. The new version prints 30 ppm at 300 by 300 dpi. Delphax will release that product.

guards for VDT operators. It was tabled on the House floor in March

- Massachusetts: H.2267 requires that the Committee on Commerce and Labor investigate the VDT controversy. The measure has been referred to the Joint Rules Committee. H.2658 would require employee notification of health hazards resulting from VDT use. It was referred to the Joint Commerce and Labor Committee.

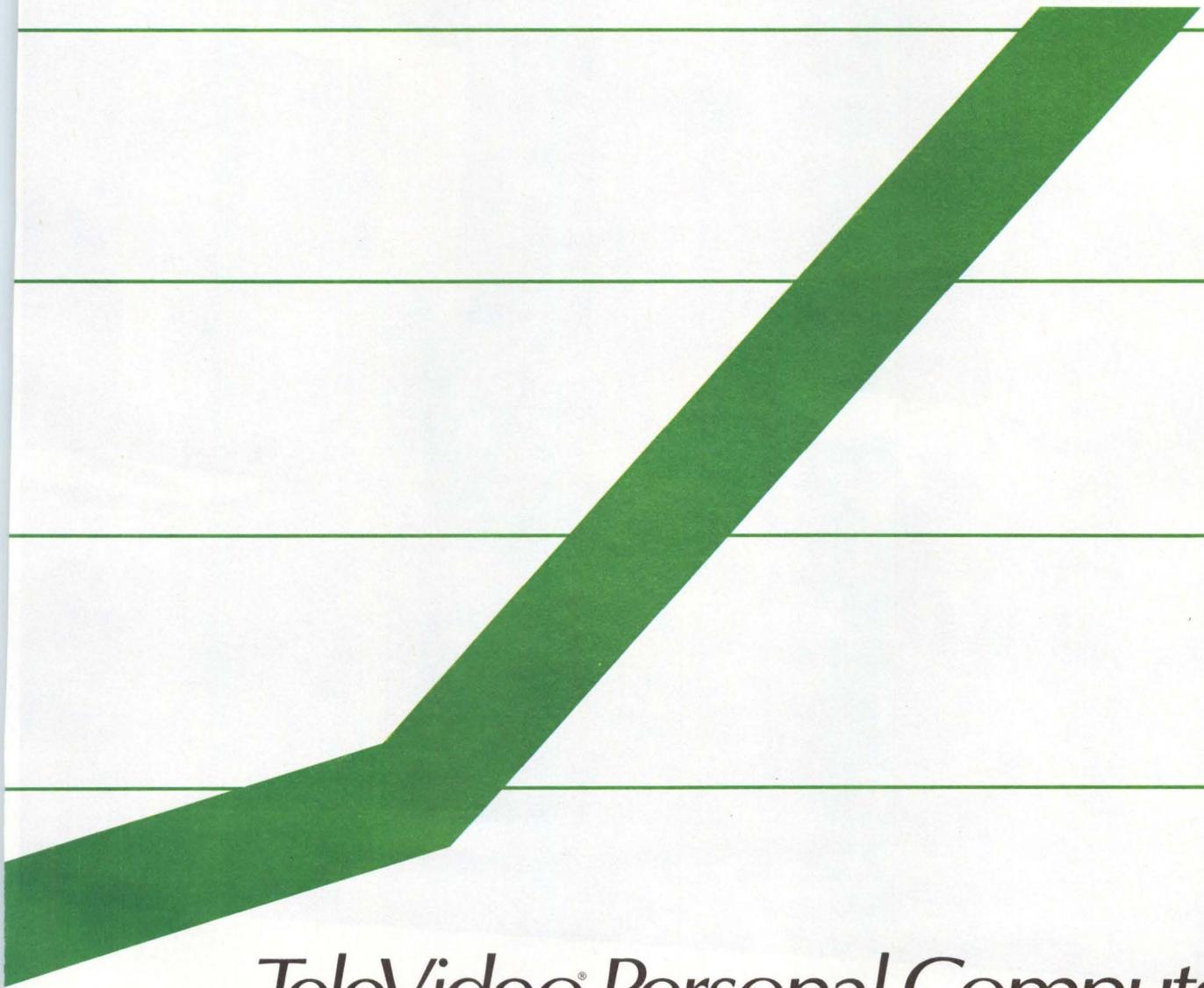
- Maine: LD.831 provides occupational safeguards for VDT operators. The bill has been tabled, and the legislature has passed a resolution requesting a study by the Maine Bureau of Labor Standards.

- New York: A.6260, S.4314 and S.4689 are identical measures calling for every public and private employer using word processors and computer terminals to furnish pregnant employees with radiation-protective jackets or blankets on request. All measures have been referred to committee. Other measures, A.7158 and S.6528, require that employers with VDT equipment provide for the safety and health of all terminal operators. They include provisions that office glare index not exceed 16 and that VDTs be arranged to avoid directing heat exhaust without intervening ducts, walls or insulation to within 4 feet of an operator's station. The bills also require semiannual terminal maintenance, ophthalmological examinations and rest periods. Both measures have been referred to committee. S.568 would require every employer intending to introduce new computer hardware or software in excess of \$5,000 to give 6 months notice in writing to affected employees.

- Oregon: S.568 would establish minimal working conditions for terminal operators. It has also been referred to committee, which has requested a study commission.

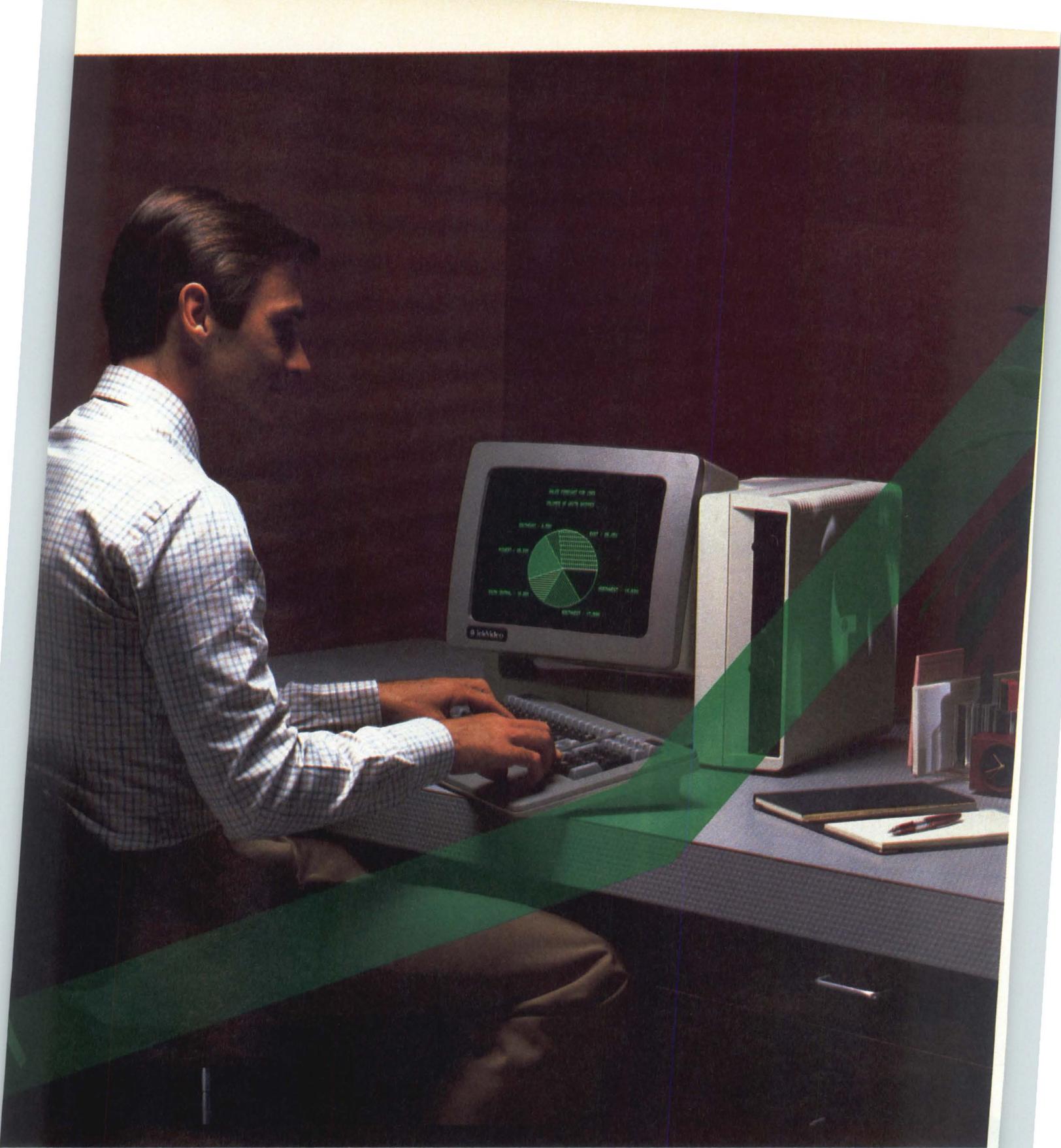
—Stephen J. Shaw

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Want all the software in the business to choose from? TeleVideo's 8-bit computers use the CP/M® operating system. Our 16-bit models use both CP/M and MS™-DOS.

Ergonomic design? Both the 8-bit TeleVideo 803 and the 16-bit 1603 have a sculpted keyboard with natural palmrest and a 14" non-glare tilt-adjusting screen.

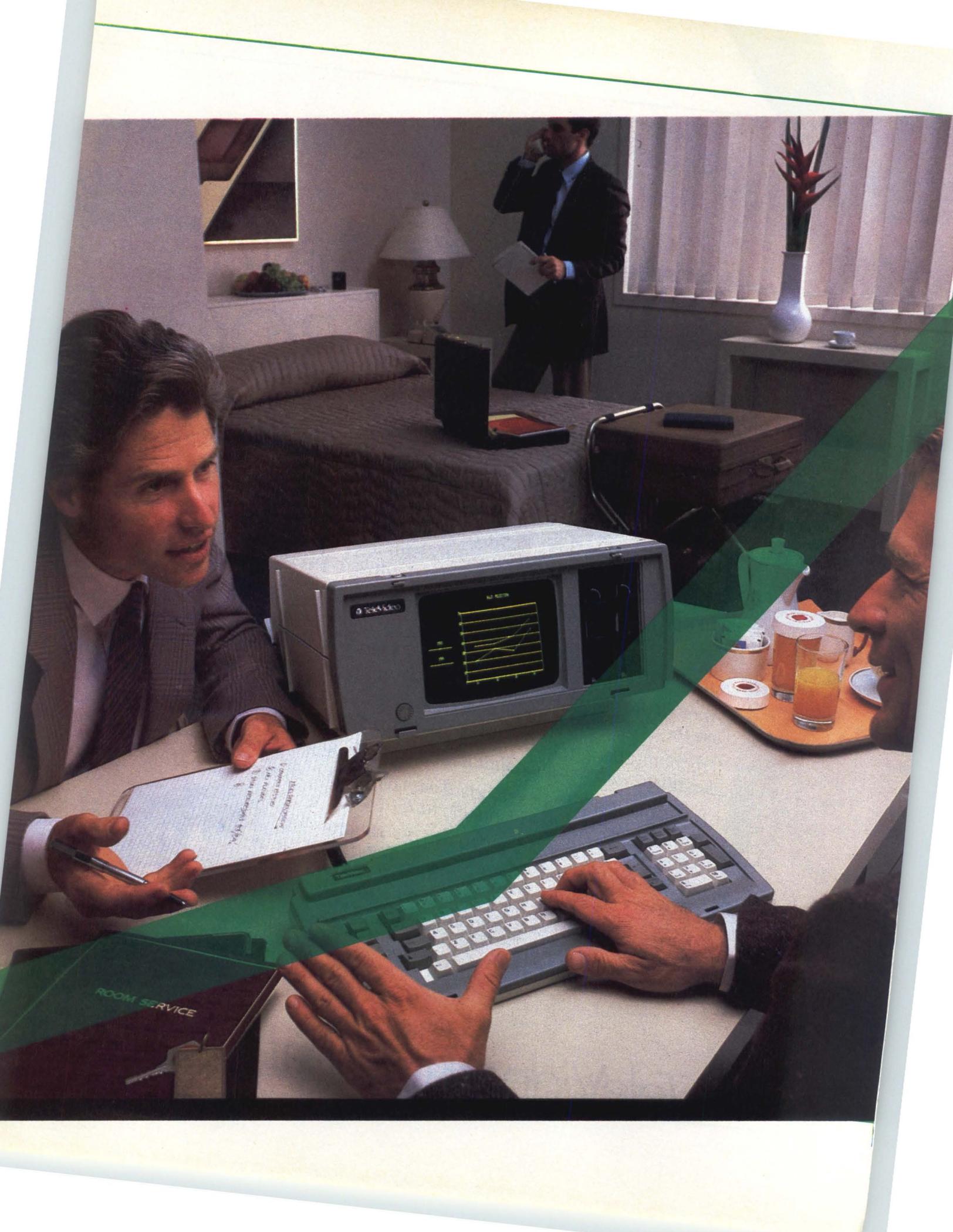
Power? Our 803 comes standard with 64K RAM, expandable to 128K; the 1603, with 128K, expandable to 256K.

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TeleVideo Personal Computers

 TeleVideo Systems, Inc.



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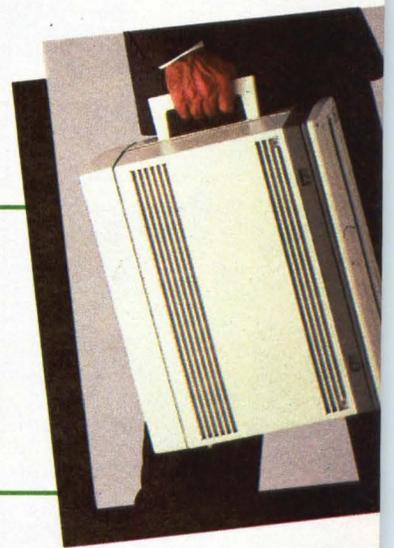
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The TeleVideo Portable has a full 9" yellow phosphor screen and a double-sided double-density 5¼" floppy disk drive. The ergonomically designed keyboard includes a ten-key accounting pad not normally available in a portable.

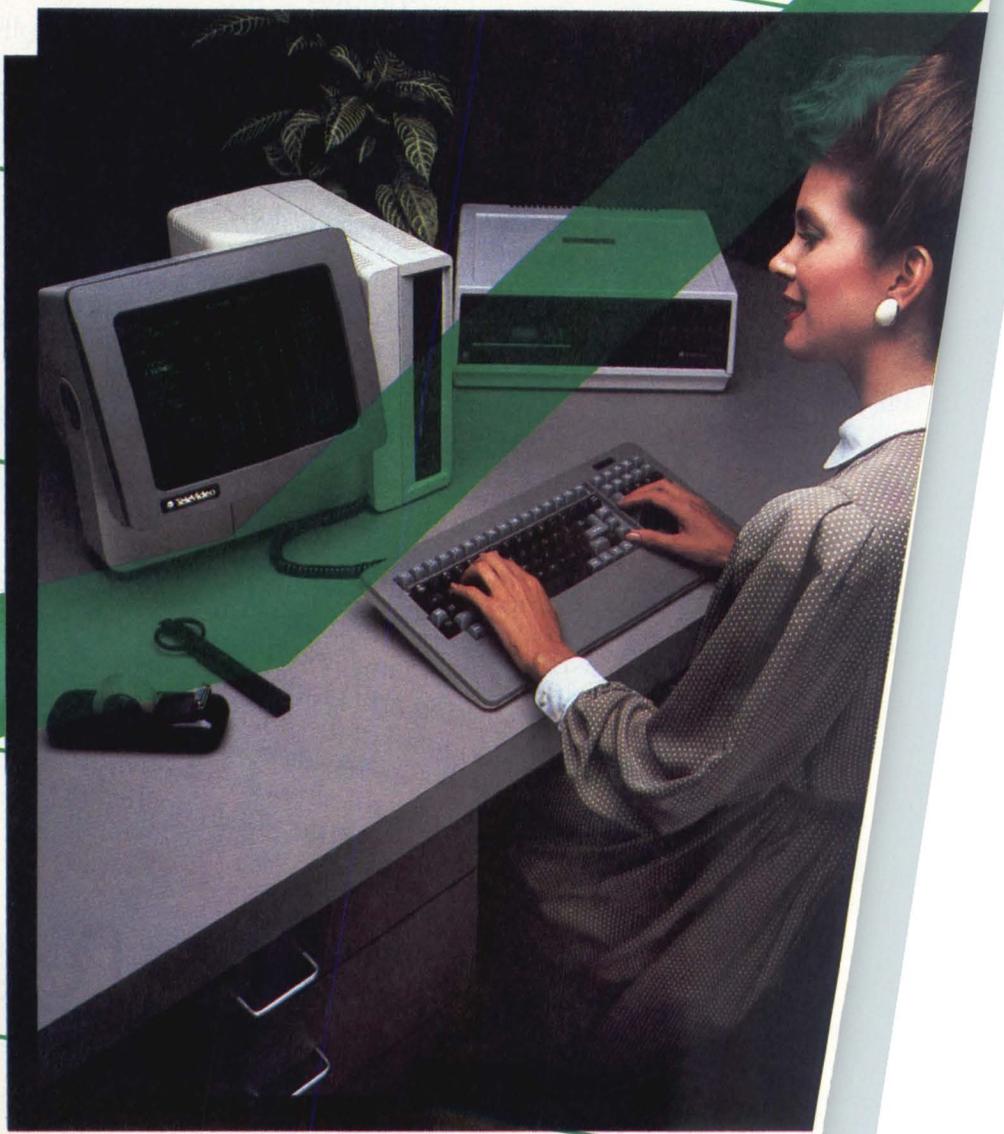
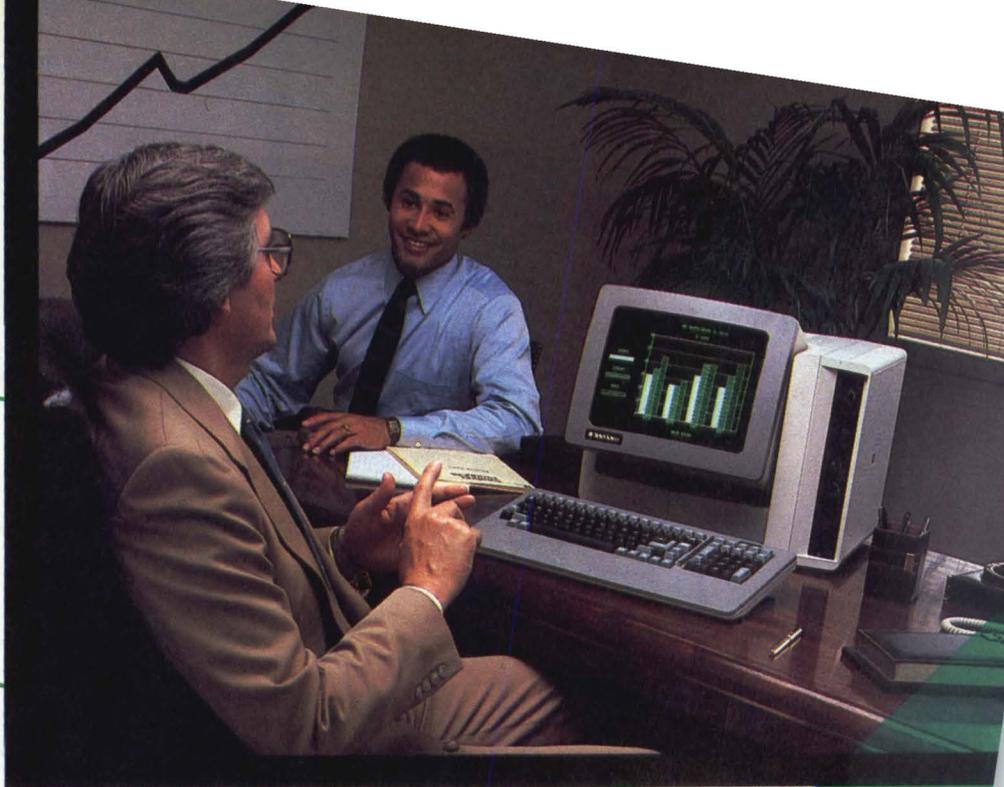
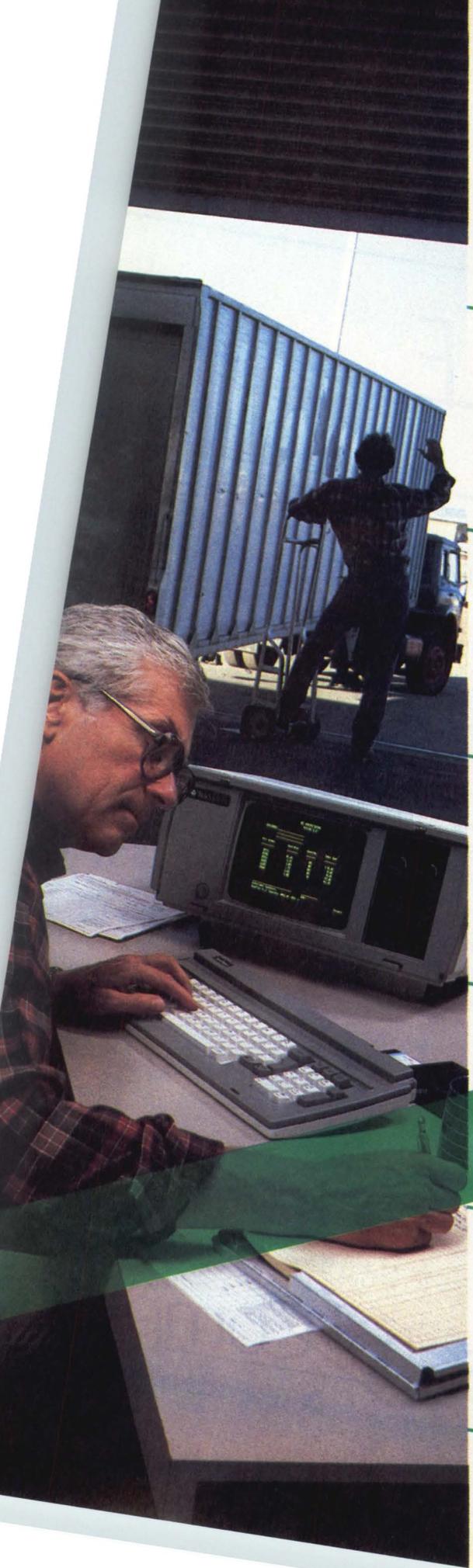
There are 2 communications ports. One for a printer. One for a modem to help your customers keep in touch with both office computers and data base services such as CompuServe and NewsNet.

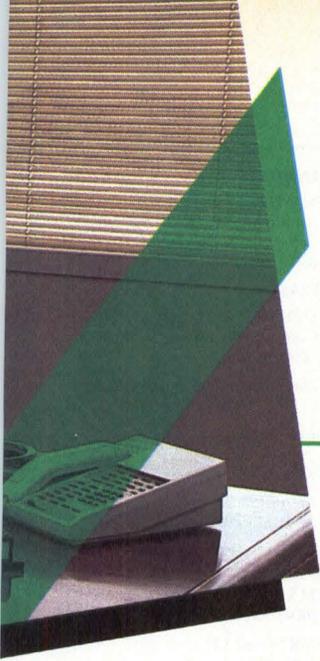
The TeleVideo Portable comes complete with CP/M operating system, spreadsheet, word processing and graphics software. At suggested retail of just \$1,599, it adds portable power at a very affordable price. The power of the portable in network environment. A great way to get you in on the boom.



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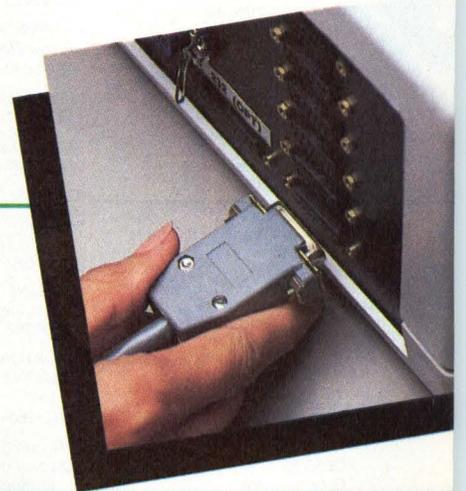
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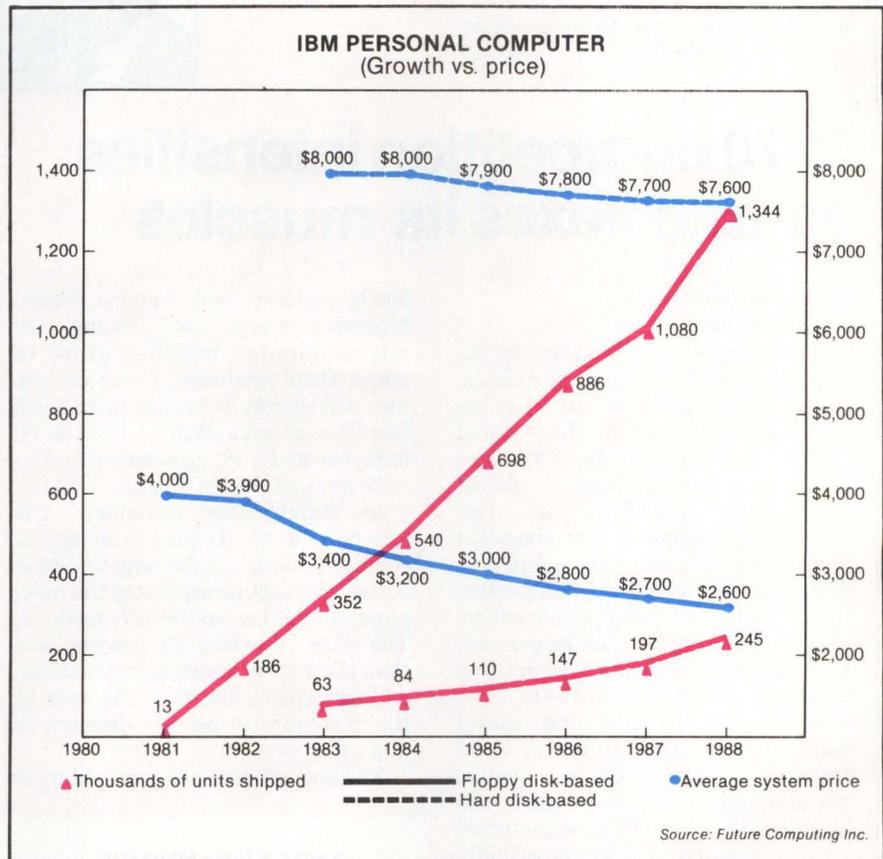
IBM sets up division focusing on PC, other small systems

To establish a single strategic force behind its low-priced, high-volume "personal use" computers, IBM Corp. has created the Entry Systems division in Boca Raton, Fla. Presiding over the new entity's 9,000 employees is Philip D. Estridge, the acknowledged driver behind IBM's Personal Computer.

Although IBM spokesmen downplay the significance of the move, the role of the new division and comments from IBM watchers indicate it may help boost personal computer sales even more. The Entry Systems division combines the products of the office workstation activities in Austin, Texas, and the Personal Computer program in Boca Raton. The new division assumes worldwide responsibility for product development and management for U.S. manufacture of IBM's Personal Computer family, System/23 Datamaster, Displaywriter, 5520 Administrative System, 5280 distributed data system and related software for those products. The division will retain marketing responsibility for the PC, but other product marketing will remain as is.

The Austin site previously was part of the Communications Products division in White Plains, N.Y., and the Boca Raton site reported to the Systems Products division. Both those divisions, in turn, reported to the Information Systems and Communications Group, to which the Entry Systems division now reports.

The new division retains the profit-and-loss responsibility of the Entry Systems unit. Formation of the division indicates a more formal role for the IBM PC and low-end products in relation to the rest of IBM.



An IBM spokeswoman explains the difference between a business unit and a division at IBM by defining a business unit as a fledgling company with a specific product or service. It doesn't go through the traditional approval channels. A division has more formal reporting lines. She adds, however, that the new Entry Systems division should retain the entrepreneurial character of a business unit while increasing the level of integration of its plans with the rest of IBM.

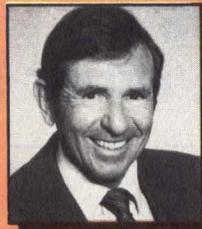
Analyst Donald Brown of Shearson/American Express lauds the move: "The division represents IBM's recognition that low-end products (strategies) cannot be set without reference to the PC (and its

success)." He adds that IBM must recognize that there is a difference in distributing low-priced systems from \$1,000 to \$10,000.

Brown also views the division's creation as representing IBM's disappointment with its 5520 Administrative System, the Datamaster and the Displaywriter. He says the Datamaster and 5520 systems may compete with IBM PC upgrades. In the case of the Displaywriter, Brown comments, IBM found it cannot establish a word-processing strategy without reference to the PC as another form of generalized workstation. "The question is whether the traditional product strategists at IBM have really looked at the PC and decided how to launch off of its success. I

MARKET BAROMETER

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



Robert Sanekoff is director of the display terminal industry service at Dataquest Inc., a San Jose, Calif., market research firm.

3270 competition intensifies as IBM flexes its muscles

By Robert Sanekoff
Dataquest Inc.

IBM Corp.'s 3270 market is the largest for interactive terminals. About one-third of all display terminals shipped in the United States in 1983 will be 3270-type terminals, with a value of almost \$1.25 billion. Dataquest Inc., San Jose, Calif., estimates that about 2.4 million IBM 3270 and plug-compatible 3270-type terminals will be installed by year-end. At a compound annual growth rate of more than 28 percent, this means almost 6.5 million installations by the end of 1987.

In the past, the IBM 3270 market was not for manufacturers of ASCII terminals. However, the introduction of the protocol converter opened this large market to small manufacturers by overcoming the incompatibility between ASCII terminals and IBM host computers in a highly cost-effective manner. Although savings varied according to configurations, it was reasonable to expect an average 35 percent cost reduction.

Dataquest believes that, of the 1.8 million terminals connected to IBM mainframes, more than 40,000 ASCII terminals (about 2.2 percent) were attached via protocol converters, at least one-half of which were shipped in 1982. Therefore, 5 percent of the total number of 3270-type terminals shipped and connected to IBM mainframes were ASCII terminals. Although this encroachment on the market is not alarming, it does strike directly at IBM's market strength.

Additionally, several companies have introduced personal computer functions to their 3270s. For example, Lee Data Corp., Telex Computer Products Inc., Phaze Information

Machines Corp. and, soon to follow, Memorex Corp. are looking for microcomputer manufacturers to adopt their products. These companies are merely following IBM's lead: Big Blue added a 3270 port to the PC last year and a PC attachment to the 3278 product line in March.

In March, IBM introduced the low-cost 3178 display station—a compact, 12-inch, lightweight version of the 3278 that incorporates the most popular functions of the 3278 model 2. The 3178 is priced 37 percent less than the 3278 in single-unit quantities and 62 percent less than the 3278 at the maximum 40 percent discount in quantities of 3,000.

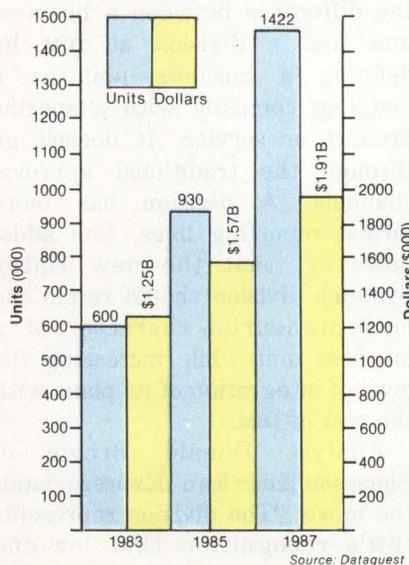
The new product has removed most

of the price advantage enjoyed by both the plug-compatible manufacturers and the protocol converter/ASCII terminal combination. Of the eight leading IBM competitors that responded to the announcement with lower cost terminals, three do not offer a terminal selling for less than the new 3178. The remaining five offer new prices 5 to 15 percent less than IBM's. All competitors except Teletype Corp. offer volume purchase discounts.

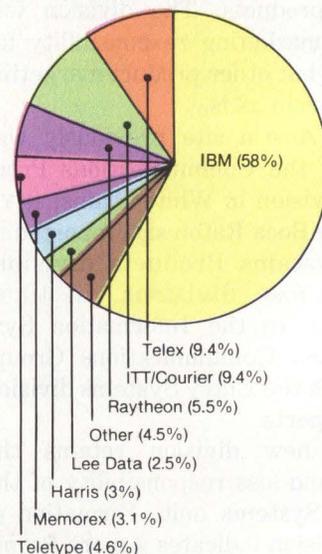
In the protocol converter market, the 35 percent advantage has been reduced to an average of 13 percent.

There is little doubt that there will be an impact on plug-compatible terminal manufacturers' profit margins, forcing many to go overseas to regain that lost margin. Some companies might cease competing in the IBM market altogether, producing both a shakeout and an increased share for IBM in the coming year.

UNITS & DOLLAR VALUE OF DOMESTIC DISPLAY TERMINAL SHIPMENTS



3270 MARKET SHARE (1982 shipments: 474,700 units)



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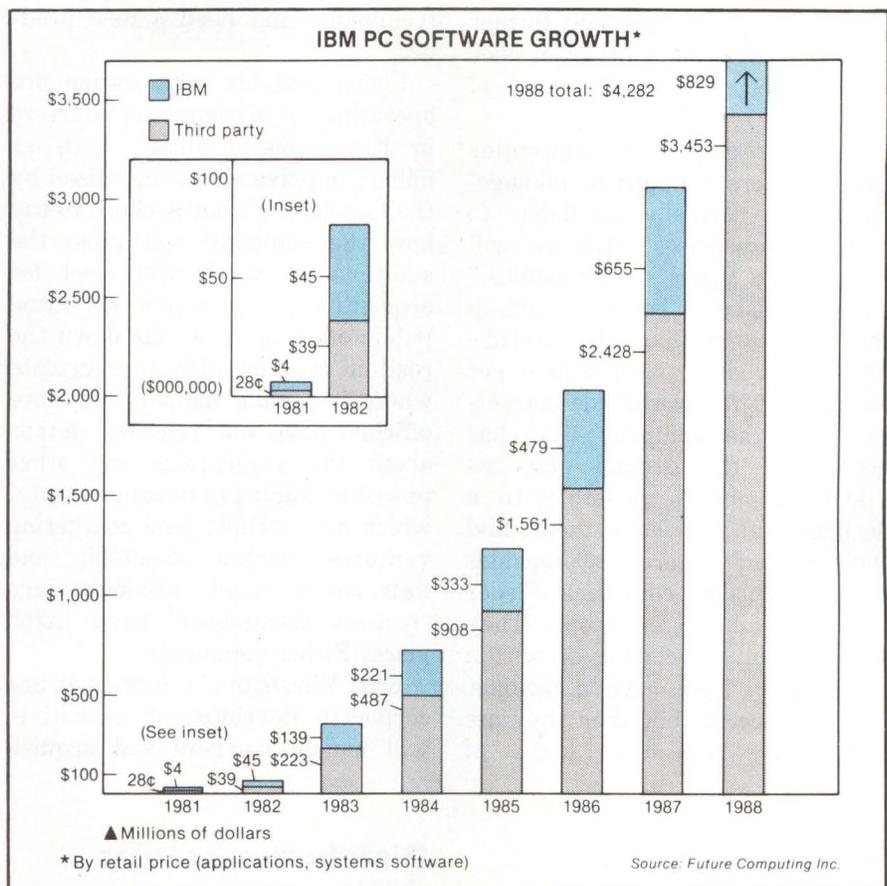
don't think there is evidence they have," he claims.

The leveraging may come in part with new PC product line systems, including the low-end "Peanut" machine, which is expected to sell for about \$900 with a PC-DOS derivative. Also expected from IBM are a portable machine, a \$10,000 machine with the native VM operating system and another very low-end computer.

Another possible adjunct to IBM's mainstream business is the rumored move of its DISSOS distributed information system operating environment as well as local network products to the Entry Systems' umbrella. DISSOS is a basic office-automation product that is used within IBM.

The formation of the division occurred near the two-year anniversary of the PC's introduction, proving that IBM's gamble with outside vendors for hardware and software for the PC paid off. Market research company Future Computing Inc. estimates that about 13,000 PC business systems were shipped during the first five months of its existence. Sales booms coincided with the January 1982 settlement of the government's antitrust case against IBM. Recent estimates show about 350,000 units have been shipped, and that number is expected to reach 540,000 next year.

With a more integrated strategy behind IBM's products, the forthcoming systems will enter a more mature, cohesive development or-



ganization. Many industry watchers still are unsure what impact this unified strategy will have. However, most approve enthusiastically IBM's choice of Estridge to head the effort.

Estridge joined IBM in 1959 as a junior engineer in the Kingston, N.Y., Federal Systems division. In 1969, he joined the General Systems division, at which he held various engineering and management positions. He was the Series/1 program manager within the General Sys-

tems division from 1975 to 1979. In 1979, he joined the Entry Systems unit with responsibility for developing small microcomputer-based systems. In July 1981, just before the PC's announcement, he was appointed director of the Entry Systems unit. Just before being appointed president of the new division, he held joint posts as vice president and general manager of the unit and vice president of the Systems Product division.

—Lori Valigra

Prime, DEC and DG veterans launch holding company

Two years after resigning the presidency of Prime Computer Inc. over policy disputes with chairman David J. Dunn, Ken Fisher is

attempting to thrust himself back into the computer industry limelight as chairman, president and chief executive of Encore Computer

Corp. The new firm, Fisher says, is a holding company expected to combine a variety of start-ups and relatively young enterprises under an experienced senior management team that includes former Digital Equipment Corp. chief technical officer C. Gordon Bell and Data General Corp. co-founder Henry

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Burkhardt III. At least six former Prime executives, mainly from sales and marketing, are also part of Encore.

For the acquired companies Encore offers a depth of management not normally available to nascent enterprises. "Encore will benefit two types of companies," explains Fisher. "For the start-up that thinks it has the world's greatest product, we'll help it get the product into worldwide marketing. For the company that has gotten off the ground and has plateaued—or is possibly in a decline—we will help them find their needed 'encore.'" Companies needing to make a comeback, Fisher says, are all too common. "They have difficulty in coming up with a second act. They have a brilliant flash of success, but then they are caught by the next wave of

technology and need a new product."

Fisher and his organization are operating out of temporary quarters in Framingham, Mass., with \$1 million in private funding raised by the founders. Fisher declines to say how the company will raise the additional funds it will need for acquisitions, but states an initial public offering "is so far down the road it is impossible to speculate when it would happen." Encore officials have not released details about the acquisitions and other possible business arrangements, which may include joint marketing ventures, partial ownership and R&D partnerships, although some "serious discussions" have taken place, Fisher comments.

Karl Wassmann, a former Prime corporate development executive, will handle mergers and acquisi-

tions. He spent the past 18 months at Gould Inc. helping that conglomerate identify high-technology acquisition candidates. Once Encore acquires the companies, the companies gain access to a worldwide marketing organization headed by Robert G. Claussen, former Prime vice president of domestic sales. George Dudley, former vice president of Eastern operations at Prime, will handle sales and service. Bell, who was responsible for early DEC PDP series minicomputers, including the PDP 4, 5 and 6 designs, asserts that his goal is not to build a large engineering group because "that would violate what we are trying to do." He and Fisher stress that Encore will instead attempt to maintain the entrepreneurial spirit that built DEC, DG and Prime, but is often lost as companies grow. —Geoff Lewis

In transition

Lanier Business Products Inc., Atlanta, is expected to become a subsidiary of Harris Corp., Melbourne, Fla. In the proposed merger, Harris will issue 0.525 shares of common stock for each of the approximately 16.2 million outstanding Lanier shares. The estimated merger value is \$415 million.

Financings

Two-year-old local-area-network (LAN) specialist **Interlan Inc.**, Westford, Mass., gained \$3 million in its second round of venture financing. Investors include Oak Investment Partners, Sutter Hill Ventures and New England Capital Corp.

Sterling Software Inc., Dallas, garnered \$8.2 million in private funds from unnamed European and U.S. investors. Sterling produces software for IBM Corp. mainframes and PCs.

Distribution/service deals

Control Data Corp. now markets the **Wang Professional Computer** through its Business Centers. CDC will also market personal computer software from **Chang Laboratories Inc.**, San Jose, Calif., including Chang's popular Micro-Plan. A CDC spokesman says the Chang software, which now runs on the IBM PC and Apple IIe, will be ported to the Wang Professional....In a five-year agreement, Codex Corp. will sell and lease **Ungermann-Bass Inc.'s** Net/One LAN. The agreement also includes the CMX cable multiplexer for connecting 32 IBM 3270 terminals to a 3274 controller.

Wet ink

In an eight-year contract valued at a minimum of \$70 million for the first three years, **Data General Corp.** will provide the U.S. Depart-

ment of Agriculture with an office-automation network for its Forest Service. The service will use DG's MV series of minicomputers in more than 800 sites....Wang Laboratories Inc. and Omron Tateisi Electronics Co. have purchased licenses from **Drexler Technology Corp.**, Mountain View, Calif., for manufacturing rights to the Drexon laser memory card, bringing the number of licensees to nine. License fees for each company were \$250,000....**Quantum Corp.**, Milpitas, Calif., will supply Industrial Micro Systems International (IMSI) with at least 5,000 disk drives over a two-year period. The \$8 million contract covers Quantum's 5¼- and 8-inch Winchester drives to be used in IMSI's small business microcomputers.

Quarterly report

Despite **Texas Instruments Inc.'s** second-quarter home computer operation pretax loss of \$183

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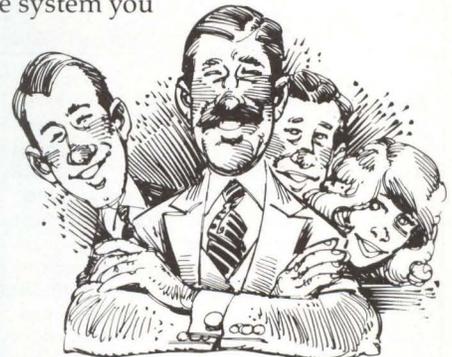
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BOX SCORE OF EARNINGS

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
Apollo Computer Inc.	6 mos. 7/2/83	31,728,000	6,375,000	.32
	6 mos. 7/3/82	5,281,000	(1,026,000)	(.24)
Burroughs Corp.	6 mos. 6/30/83	2,036,161,000	71,923,000	1.71
	6 mos. 6/30/82	2,050,378,000	70,064,000	1.67
Computer Memories Inc.	3 mos. 7/3/83	9,490,000	539,000	.06
	6 mos. 6/30/82	1,962,000	188,000	.02
Control Data Corp.	6 mos. 6/30/83	2,173,800,000	72,300,000	1.89
	6 mos. 6/30/82	2,109,200,000	72,500,000	1.92
Digital Equipment Corp.	year 7/2/83	4,271,854,000	283,622,000	5.00
	year 7/3/82	3,880,771,000	417,155,000	7.53
Gould Inc.	6 mos. 6/30/83	645,700,000	34,800,000	.77
	6 mos. 6/30/82	636,900,000	39,200,000	.90
Honeywell Inc.	6 mos. 7/3/83	2,718,400,000	80,900,000	3.55
	6 mos. 7/4/82	2,582,400,000	141,100,000	6.31
IBM Corp.	6 mos. 6/30/83	17,877,000,000	2,319,000,000	3.84
	6 mos. 6/30/82	15,119,000,000	1,865,000,000	3.14
Intel Corp.	6 mos. 6/30/83	497,099,000	36,844,000	.35
	6 mos. 6/30/82	423,547,000	13,599,000	.15
Lexidata Corp.	9 mos. 6/30/83	17,643,200	(424,400)	(.08)
	9 mos. 6/30/82	22,122,400	2,673,400	.50
Micom Systems Inc.	3 mos. 6/30/83	25,828,000	4,203,000	.28
	3 mos. 6/30/82	18,996,000	2,923,000	.20
3M Co.	6 mos. 6/30/83	3,482,000,000	326,000,000	2.77
	6 mos. 6/30/82	3,353,000,000	311,000,000	2.65
Paradyne Corp.	6 mos. 6/30/83	103,274,000	4,646,000	.21
	6 mos. 6/30/82	93,734,000	12,360,000	.58
Prime Computer Inc.	6 mos. 7/3/83	242,416,000	14,932,000	.31
	6 mos. 7/4/82	208,296,000	21,533,000	.48
Quality Micro Systems	6 mos. 7/1/83	9,990,000	1,698,000	.44
	6 mos. 7/2/82	6,371,000	1,205,000	.38
Storage Technology Corp.	6 mos. 7/1/83	458,188,000	1,500,000	.04
	6 mos. 6/25/82	532,589,000	39,018,000	1.12

Comments: Several vendors continued to experience sharply decreased net incomes, despite gains in revenues. **Digital Equipment Corp.'s** revenues for the quarter were \$1.2 billion, compared to \$1.1 billion a year earlier. Net income for the quarter was \$86 million, or \$1.51 per share, down from \$121.7 million, or \$2.20 per share, a year ago. DEC expects its marketing reorganization to spur increased orders in the future. **Honeywell Inc.'s** second-quarter revenues of \$1.4 billion were about even with the \$1.3 billion of a year earlier. Net income dropped to \$58.7 million, or \$2.57 per share, from \$85.6 million, or \$3.83 per share, a year earlier, but the 1982 figure included a \$30.3 million capital gain from the sale of shares in Cii Honeywell Bull. Honeywell Information Systems Inc.'s orders are slightly ahead of last years. **Paradyne Corp.** suffered a net loss of \$.9 million, or 4 cents per share, for the quarter, against a gain of \$6.6 million, or 30

cents per share, a year ago. Contributing to Paradyne's loss was the \$1 million in legal fees due to the Securities and Exchange Commission's (SEC's) suit against the company. **Prime Computer Inc.** projected third-quarter earnings to be less than last year's because of continuing investments. Prime's second-quarter revenues increased to \$122 million from \$105.1 million a year earlier. Net income was \$6.4 million, or 13 cents per share, compared to \$10.9 million, or 24 cents per share a year earlier. **Intel Corp.'s** quarterly earnings, however, nearly tripled over last year's. Net income was \$24.3 million, or 22 cents per share, compared with \$8.2 million, or 9 cents per share, previously. Revenues increased to \$259.6 million from \$216.4 million a year earlier. Intel said orders are coming from a broader customer base and profit margins have increased.

million, TI chairman Mark Shepherd Jr. states that TI will stay in the home computer business. He expects the decreasing costs of semiconductors to enable TI to rebound.

Total TI sales of \$1.1 billion for the quarter ended June 30 were up slightly from \$1.09 billion a year earlier. Net loss for the quarter was \$119.2 million, or \$5 per share, versus a previous gain of \$36.9 million, or \$1.56 per share. Sales for the six-month period were \$2.27 billion, compared to \$2.17 billion a year ago. Net loss was \$112, or \$4.71 per share, against the previous year's gain of \$64.5 million, or \$2.73 per share.

Industry monitor

A **SORD Computer Inc./Charles River Data Systems Inc. (CRDS)** mutual investment could lead to an exchange of technology, according to CRDS president Rick Shapiro. SORD, Tokyo, will invest \$1 million in CRDS; CRDS, Natick, Mass., will invest an unspecified amount in SORD. CRDS manufactures the Universe 68000-based OEM super-micro. SORD markets personal computers in the United States and Japan and a Universe-based engineering workstation in Japan.

Honeywell Inc. and National Semiconductor Corp. will cooperate in technology transfers involving National Semiconductor M²CMOS gate arrays.

Sun Microsystems Inc., Mountain View, Calif., and **Computervision Inc.,** Bedford, Mass., will cooperate in developing and manufacturing intelligent UNIX-based workstations. Under the agreement, Sun will supply hardware and software to Computervision over the next three years for \$40 million.

ONE OF TANDY'S BEST PROGRAMS IS NOT SOFTWARE.

It's Our Value-Added Resale Program for OEMs and Systems Integrators.

Tandy makes it easy to market the best-selling microcomputers. If you're an established, non-retail, vertically-oriented systems reseller, you'll want to take advantage of this unique OEM program.

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Tandy Corporation

Contract Marketing Dept.
OEM Sales

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(817) 390-3099

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Mail To: Radio Shack, Dept. 84-A-778
300 One Tandy Center, Fort Worth, Texas 76102

NAME _____

COMPANY _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

TELEPHONE _____

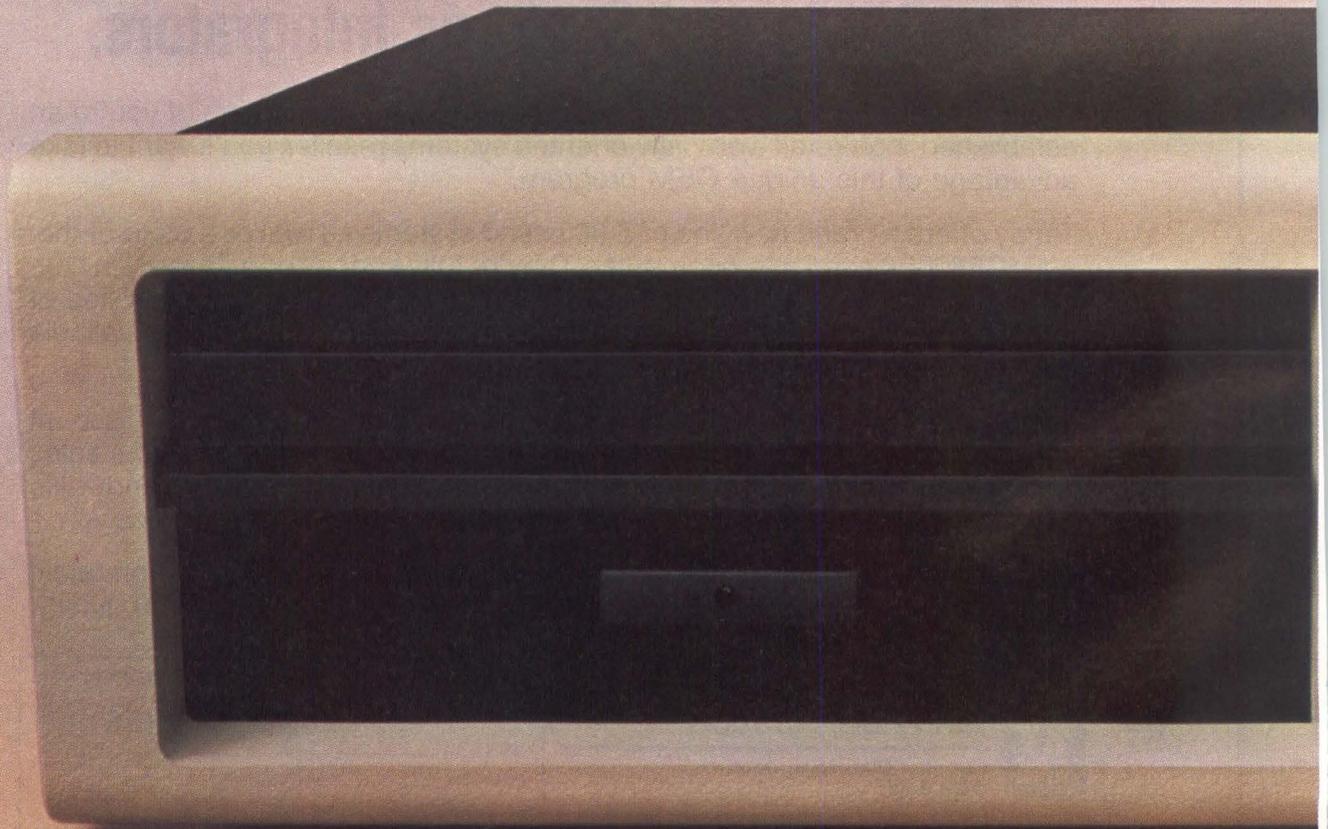
CP/M is a trademark of Digital Research. RM/COS is a trademark of Ryan-McFarland Corp. XENIX is a trademark of Microsoft, Inc.

CIRCLE NO. 51 ON INQUIRY CARD

THE DSD 880 WINCHESTER SYSTEM.

MADE THE WAY
DIGITAL WOULD MAKE IT.

EXCEPT DIGITAL
DOESN'T MAKE IT.



HyperDiagnostics, HyperService and Rapid Module Exchange are trademarks of Data Systems Design, Inc.
PDP is a registered trademark of Digital Equipment Corp.

The people at Digital are a pretty smart bunch. They make some of the finest small computers in the world. So we like to think that if they were to make a new storage system like our 880 Winchester/Floppy, they'd do it the same way we did.

First of all, they'd make it extremely reliable with extensive testing and by using one of the most reliable storage technologies known, the Winchester.

Next, they'd offer it in different capacities, like 7.8, 20.8, and 31.2 megabytes, with a choice of .5 or 1 Mb floppy back-up, or none at all.

These different configurations would, of course, be fully compatible with Digital's LSI-11 and PDP -11 computers.

And the whole package would be extremely compact, just 5¼ inches high, so it would save space and fit in almost anywhere.

They might even add some on-board self-diagnostics, similar to our exclusive HyperDiagnostics," so you could test, exercise, and debug without a CPU. And cut down on your service costs at the same time.

Maybe they'd even institute a module swap program, something like our Rapid Module Exchange," which would be designed to get you

back up and running within twenty-four hours.

Finally, since this system would be so dependable, they'd be able to offer their extended service at a much lower price—much like we do with our own HyperService," which goes into effect when the 90-day warranty expires and covers everything.

And then, as if it weren't good enough already, they'd offer this remarkable storage system at a lower cost per megabyte than any comparable system.

The fact is, though, Digital doesn't make anything like this.

Which is why we make the DSD 880 Winchester system to go with your Digital computer. And, why we make it the way we do.

Corporate Headquarters: 2241 Lundy Avenue, San Jose, CA 95131. Eastern Region Sales and Service: Norwood, MA, (617) 769-7620. Central Region Sales and Service: Dallas, TX, (214) 980-4884. Western Region Sales: Santa Clara, CA, (408) 727-3163.

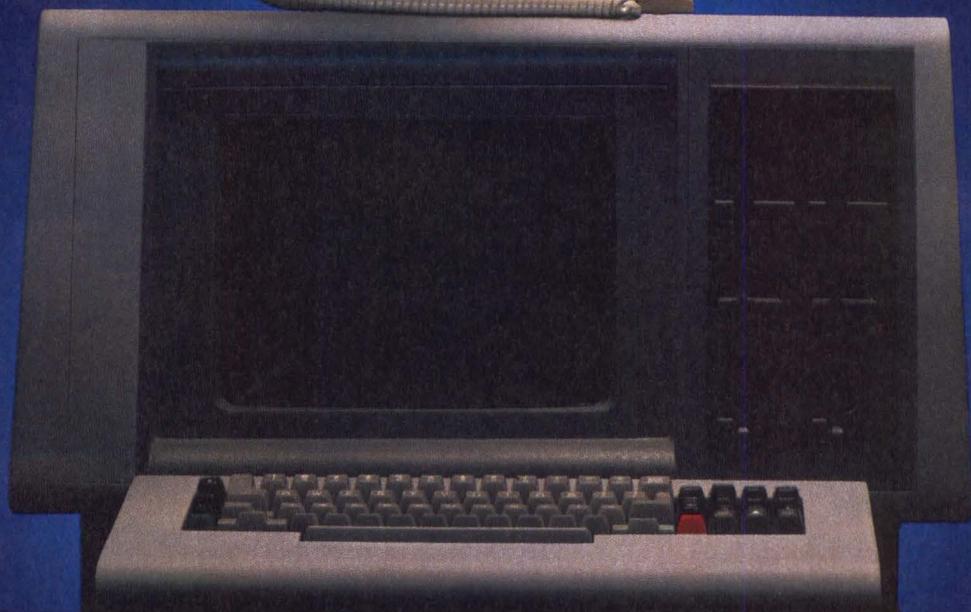
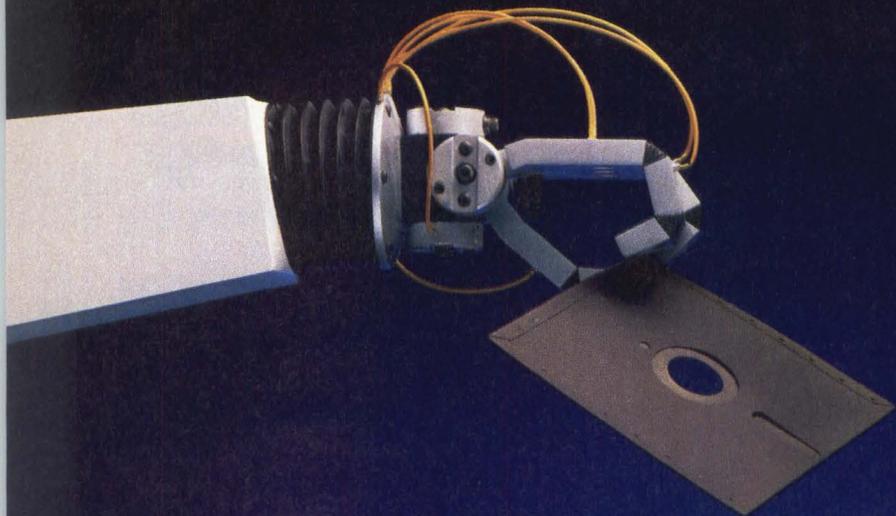
DATA SYSTEMS DESIGN

WP FLPY

READY

INTERNATIONAL SALES: Australia 03/544 3444; Belgium and Luxembourg 02/7209038; Canada 416/625 1907; Denmark 02/63 22 33; Finland 90/88 50 11; France 03/411 5454; Hong Kong and Peoples Republic of China 03/696231; Israel 52-52444; Italy 02/4047648; Japan, Osaka 06/323 1707; Tokyo 03/345 1411; Netherlands 02977-22456; New Zealand 04/693 008; Norway 02/78 94 60; Singapore, Malaysia, and Indonesia 2241077; Spain 01/433 2412; Sweden 08/38 03 70; Switzerland 01/741 41 11; United Kingdom 7073/34774; West Germany and Austria 089/1204-0; Yugoslavia 61/263 261

CIRCLE NO. 52 ON INQUIRY CARD



SPACE BLASTERS

SOME THINGS WOULD BE BETTER LEFT TO MEMORY.

Just think how many products could be replaced, redesigned, or otherwise improved, if only you had the memories to do the job.

Memories you could use in entirely new ways. To open up new applications. And bring old ones back to life.

Those memories are here. Right now. For military or commercial applications. From the people who've pioneered memory technology from the start.

Intel.

For example, you've no doubt heard the term "software in silicon." Well, Intel has an EPROM that can be used as a software carrier. At 256K, it's twice as dense as any EPROM on the market. So it holds a word processing program, an entire operating system, or a game that could blow the doors off the arcade.

We've had similar breakthroughs in bubble memory. Our 1 and 4 megabit bubbles let you put working storage capabilities in places that would shake a disk system to bits. Places like an earthquake monitoring system. Or the portable system in a commuter's briefcase.

What's all this whiz bang technology going to cost you? A lot less than you imagine.

Our 64K iRAMs, for instance, cost less than static RAMs. So they're perfect for smaller systems.

And our electrically alterable, non-volatile E²PROMs can be recalibrated automatically. In-system. So things like robots, medical instruments, and navigational equipment can change with the wind.

For manufacturing, our intelligent Programming™ Method cuts EPROM programming time by a factor of 6. So you save money there, too.

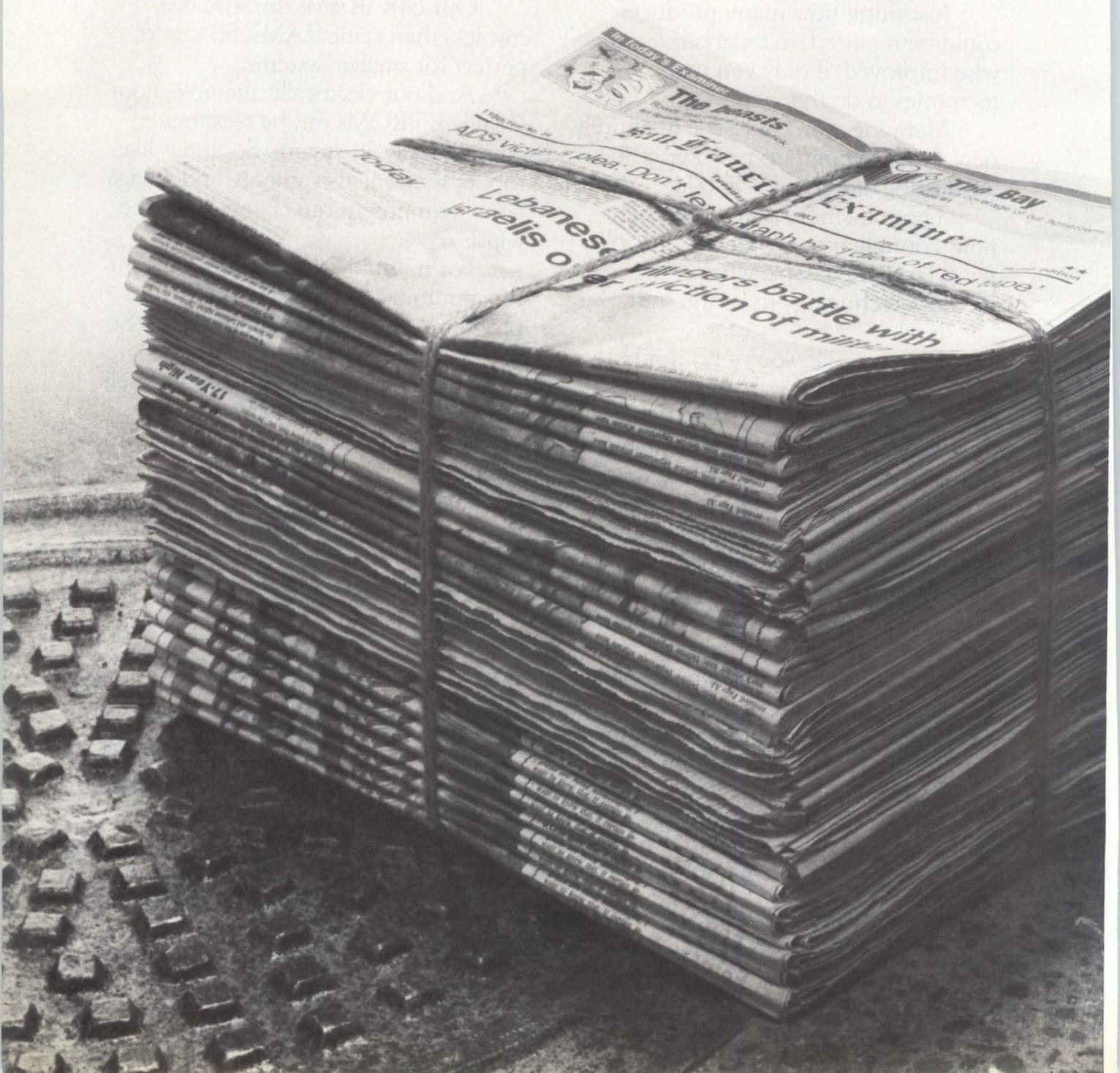
As well as later on, thanks to Intel's Reliability Monitoring Program. This program provides you with vital statistics on each part we make. No one else does that. And our reliability level, as a result of the program, helps you lower your repair costs, reduce maintenance and build a product that's more valuable, longer.

Get a copy of our full line product guide for more details. Call (800) 538-1876. In California, (800) 672-1833. Or write Intel, Lit. Dept.: Z-12, 3065 Bowers Avenue, Santa Clara, CA 95051.

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solutions

Our UNIX Super UPI Cover



Microsystem Helps The World.

We're Dual Systems.

And our 83/20 16-bit super microsystem is a real success story for United Press International.

By appointing our 83/20 as the computer base to their Newspaper Computing System, the people at UPI now enjoy networking journalism on an even larger scale. They transmit stories. They transmit graphics. They transmit photos. And they do it instantly.

Because they know late-breaking news can't be late.

However, UPI isn't alone in its decision to use Dual Systems. On the contrary. Boeing, Sony, Ford, and General Electric are also some of the names you'll find on our blue-chip client roster.

Perhaps the reasons for such a stellar following are the 83/20's minicomputer capability and microcomputer price. And it's backed with a one-year warranty.

And that it's powered by the outstanding Motorola MC68000 which delivers approximately one million instructions per second running at 10MHz.

And that our 83/20 includes full UNIX* System III with Berkeley enhancements like C-shell and Visual Editor.

And that it provides Source Code Control and language options, including BASIC, COBOL, PASCAL, FORTRAN 77, and ASSEMBLER.

Then again, our 83/20's success may be due to the strict conformance of the IEEE696/S100 bus architecture.

Of course, some customers have told us they particularly like the 83/20 for its incredible application versatility. Like graphics. And automatic typesetting. And robotics. And digital plotters. In fact, name an application and the chances are very good you'll find our 83/20 can handle it.

Our track record is also rather impressive — we've been delivering 68000-based systems with full UNIX capability longer than anyone else — that adds up to a 68000, multi-user, UNIX-based super microsystem with proven reliability.

Whatever the reason for our 83/20's remarkable market acceptance, you'll like it because it does all of the above at a price you can easily live with: quantity ten at \$11,662 per system.

So, while it helps UPI, Sony, Ford and General Electric, the good news is that it can help you.

For further information, please write or telephone our Marketing Department at 415/549-3854.

We'll give you the complete scoop.

DUAL

Dual Systems Corporation
2530 San Pablo Avenue
Berkeley, CA 94702

*UNIX is a trademark of Bell Laboratories.



CIRCLE NO. 53 ON INQUIRY CARD

As your terminal needs accelerate, move to Ann Arbor. We make the CRTs used by hard-driving professionals from M.I.T. to Stanford.

Take our Ann Arbor Ambassador, for instance. Nothing about it slows you down. The editing commands use line pointers to virtually eliminate the need for pad characters. The ANSI coding lets you put parameters in your commands to speed up execution.

And that's just for starters. The Ambassador does what no

other alphanumeric terminal can: it gives you a 60-line display with zoom. You choose the format best suited to your software and your comfort—24 lines, 30 lines, 48 lines. Whatever. Then instantly zoom up to 60 to see what a printout will look like. Recapture something that scrolled by too fast. Or simply check for context.

Like all Ann Arbor products, the Ambassador uses a large, easy-to-read screen—either portrait or landscape. The case can

be tilt/swivel or rack mounted. And the detached keyboard provides dozens of programmable keys to save you time.

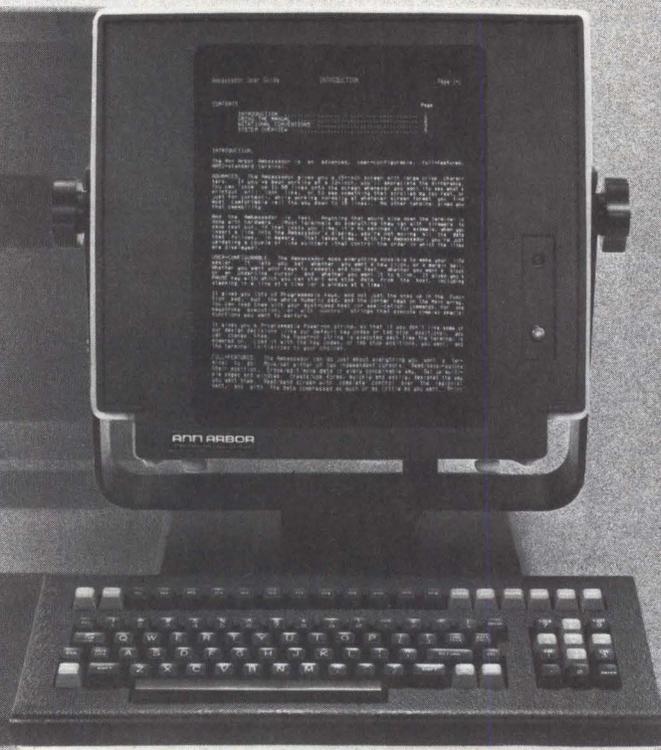
Of course, starting at \$1595, the Ambassador isn't for everyone. Just for the thousands of professionals who really want to move.

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!

ANN ARBOR TERMINALS

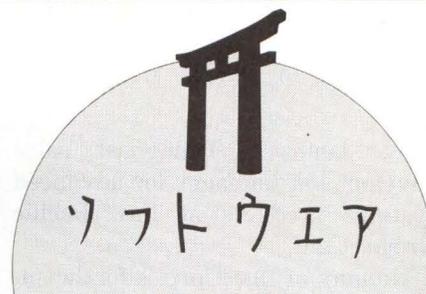
Once you've worked with them, you won't work without them.

0 to 60 in less than a second.



CIRCLE NO. 54 ON INQUIRY CARD

Microsoft, DRI spur software standardization in Japan



Digital Research Inc. (DRI) may find an eager audience for a new version of CP/M and an application-development tool among Japanese users in a market almost devoid of standardized software (MMS, September, Page 97. The introduction of both products, expected in late August, follows the flurry created in June when Microsoft Corp. launched its MSX BASIC in Japan. With that product, which requires closely coupled Z80-based hardware, Microsoft challenged 14 major Japanese hardware suppliers to

abandon proprietary software in favor of MSX. Most of those hardware suppliers indicated interest in MSX, but few have committed themselves to it (see "Japanese approval of MSX may boost exports," Page 112).

While the new products cater to the state-of-the-art Japanese usage patterns—which are three years behind those of the United States and sport cassette-based, TRS-80-type machines—the software companies stand to gain major sales in the consumer, education and limited

business-use market. They will promote standard software concepts in Japan, help improve software quality and gain some follow-on business as Japanese hardware, including the software, is exported to the United States and Europe.

DRI says it has been particularly successful distributing CP/M in this manner. "Our announcement is a response to the emerging consumer market (desiring) better applications and more sophisticated use of microcomputer hardware," com-

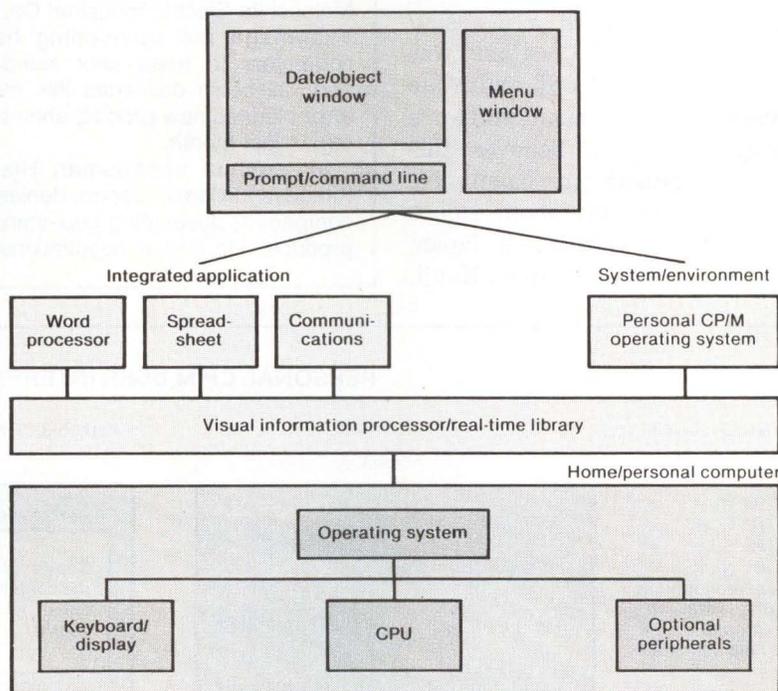
A GLANCE AT DRI'S VIP

Digital Research Inc.'s visual information processor (VIP) application-development and run-time support software is meant to give the application portability of business microcomputers to portable and home computer users, irrespective of CPU, operating system and display characteristics.

The VIP has 60 display and I/O routines for OEM and independent software vendor (ISV) application developers to reference as well as run-time libraries that can be linked. It incorporates a menu-driven, visual interface for application dialogue with an end user. Using this interface, the application program communicates with the end user via a display-independent data window, a menu area and a prompt/command line.

VIP handles messages and diagnostics as a text file, so foreign-language programs can be developed with source-code modification. The VIP thus is said to represent a "visual shell" for integrated applications to communicate with the end user and with each other.

VISUAL INFORMATION SYSTEM



The VIP supports the CP/M, CP/M-86, CP/M-68K, UNIX, VMS, PC-DOS, MS-DOS and Apple DOS operating systems; the VT52, VT100, ANSI, ADM3, TV1 and Z19 CRT/displays; the Z80/808X, 8086/88, 68000, VAX, PDP-11 and 6502 CUPs; and the IBM PC, IBM Displaywriter, Epson, Fujitsu, NEC, Sharp, Lisa, Apple and Otrona microcomputers. (Source: Digital Research Inc.)

Mini-Micro World

INTERNATIONAL

ments James A. Tillinghast, sales development manager for advanced systems products at DRI, Pacific Grove, Calif.

Rumors of IBM Corp.'s forthcoming low-end microcomputer are encouraging DRI and Microsoft: IBM is seen as validating the consumer market as lucrative.

DRI has formed a new U.S. division, Consumer Products, to concentrate on the new Personal CP/M and visual information processor (VIP) software (see "A glance at DRI's VIP," Page 111).

"At least 80 percent of the systems shipping in Japan are still 8 bit," notes Steve Maysonave, vice president of sales and world trade at DRI. He says 8-bit CP/M has gained momentum during the past year, partly because DRI set up its own company in Japan. The company previously had agents, one of whom reportedly established a licensing procedure whereby CP/M 2.2 was sold for \$300 per copy, with no applications. One Japan software industry participant believes this hurt CP/M growth in Japan. He claims there are only about 25,000 CP/M operating systems in Japan, most of which do not support Kanji.

JAPANESE APPROVAL OF MSX MAY BOOST EXPORTS

In mid-June, Microsoft Corp. chairman William Gates assembled a flock of executives representing 15 Japanese electronics companies for a Tokyo news conference announcing the MSX standard software system. When asked whether they had committed themselves to developing hardware using the MSX format, however, many of the executives said they "supported the concept" but had no concrete plans.

Two months later, as many of the companies were preparing to close for the summer holiday, the situation had not changed. Major firms, such as NEC Corp. were still studying the issue.

Despite the lack of commitment to MSX, Susumu Furukawa, vice president of ASCII Microsoft, which represents Microsoft in Tokyo, notes the software's prospects are much brighter than potential clients are letting on. Three companies including Matsushita Electric Industrial Co. and Yamahagn are developing home computers to meet MSX standards and will begin deliveries this month after planned new product announcements last month.

Matsushita spokesman Hishiro Kitadeya in Osaka, Japan, denies the company is developing MSX-standard products. He claims negotiations are

still pending to "reach a suitable standard" for MSX-compatible computers. "We're in complete agreement with the MSX concept," Kitadeya says, "but don't have any concrete plans to produce hardware for it."

Furukawa acknowledges that some "minor" points in standardization are still unresolved after three or four months of negotiation. ASCII Microsoft has tried, Furukawa points out, to provide "a lot of flexibility" in how the "set-in-concrete" schematics of MSX will apply to hardware specifications, but hardware manufacturers can't agree on some peripheral standards. For example, he notes, Hitachi Ltd. and Matsushita prefer a 3-inch microfloppy drive, while Sony Corp. wants to use a 3½-inch drive in its future microcomputer.

Meanwhile, a U.S. industry analyst, who asks not to be named, says standardized software would provide Japanese companies, traditionally weak in software, with a significant boost in entering U.S. and European markets. Software packages such as the MSX, he observes, would "narrow the ballgame down to hardware-manufacturing ability, and, in that game, nobody beats the Japanese."

—Karl O'Hara

PERSONAL CP/M USER INTERFACE

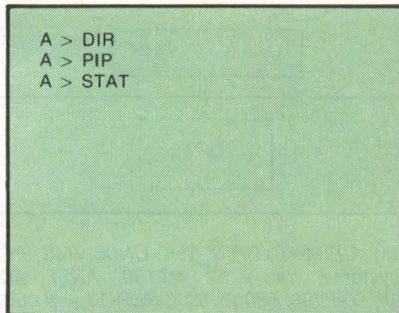
• Traditional CP/M

Keyboard

- CTRL H
- CTRL C
- CTRL S
- CTRL N

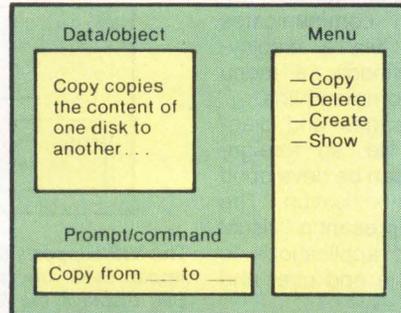
- User monologues with system—no prompts or help screens

Screen



• Personal CP/M

Screen



Keyboard

- Programmable function keys
- User dialogues with easy-to-understand help screens and prompt lines

Source: Digital Research Inc.

Personal CP/M offers portable and home computer users a friendlier, menu-oriented interface with help screens.

Take a Memo:™



Professional quality
blank storage diskette for
personal computers.

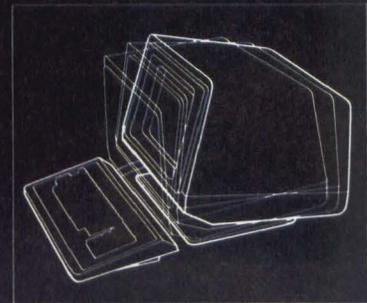
...not just another diskette.

MEMRON

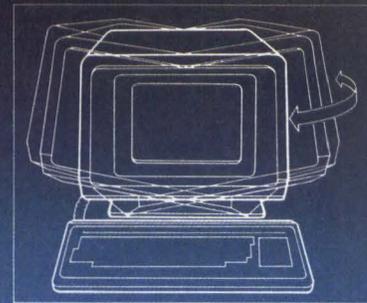
Patents pending on multi-color diskette enclosure fabrication and lamination processes: Memron, Inc. 1756 Junction Avenue, San Jose, CA 95112. (408) 275 0780
© 1983 Memron Inc.

CIRCLE NO. 55 ON INQUIRY CARD

VISUAL presents ergonomic elegance and high performance in a low-cost terminal.



Tilt: 10° forward, 15° backward



Swivel: 270°

VISUAL 50 and VISUAL 55 represent a new approach in low-cost terminals. Although they cost drastically less, they offer features you expect only from the high priced units.

For example, the enclosure is ergonomically designed in lightweight plastic and can easily be swiveled and tilted for maximum operator comfort. A detached keyboard, smooth scroll, large 7x9 dot matrix characters and non-glare screen are a few of the many human engineering features normally offered only on much higher priced terminals.

Another distinctive feature of the VISUAL 50 and VISUAL 55 is their emulation capability. Both terminals are code-for-code compatible with the Hazeltine Esprit™, ADDS Viewpoint™, Lear Siegler ADM-5™ and TeleVideo® 910. In addition, the VISUAL 55 offers emulations of the Hazeltine 1500 and VISUAL 210. Menu-driven set-up modes in non-volatile memory allow easy selection of terminal parameters.

And you're not limited to mere emulation. As the chart shows, the VISUAL 50 and 55 have features and versatility the older, less powerful low-cost terminals simply cannot match.

The VISUAL 55 extends the VISUAL 50 performance by adding 12 user-programmable function keys, extended editing features and selectable scrolling regions.

Both terminals are UL listed and exceed FCC Class A requirements and U.S. Government standards for X-ray emissions.

Call or write for full details.

FEATURE COMPARISON CHART					
FEATURE	VISUAL 50/55	Hazeltine Esprit	ADDS Viewpoint	Lear Siegler ADM-5	TeleVideo® 910
Tilt and Swivel	YES	NO	NO	NO	NO
Detached Keyboard	YES	NO	YES	NO	NO
N-Key Rollover	YES	NO	YES	NO	NO
Audible Key Click	YES	YES	NO	NO	NO
Menu Set-Up Mode	YES	NO	NO	NO	NO
Status Line	YES	NO	NO	NO	NO
Full 5 Attribute Selection	YES	NO	NO	NO	YES
Smooth Scroll	YES	NO	NO	NO	NO
Line Drawing Character Set	YES	NO	NO	NO	NO
Block Mode	YES	YES	NO	NO	YES
Insert/Delete Line	YES	YES	NO	NO	YES
Bi-Directional Aux Port	YES	YES	NO	YES	NO
Columnar Tabbing	YES	YES	NO	NO	YES
Independent RCV/TX Rates	YES	NO	NO	NO	NO
Answerback User Programmable	YES	NO	NO	OPT.	NO

Service available in principal cities through Sorbus Service, Division of Management Assistance, Inc.

VISUAL

See for yourself

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Telephone (617) 851-5000. Telex 951-539

CIRCLE NO. 56 ON INQUIRY CARD

Mini-Micro World

INTERNATIONAL

Maysonave is unsure of the total number of CP/M operating systems because many original licenses were sold on an unlimited basis, and the numbers are difficult to track.

Personal CP/M also does not support Kanji, although forthcoming 8- and 16-bit versions will, Tillinghast states. Personal CP/M is available on floppy diskettes or on read-only memory (ROM) for portables. The CP/M runs on the Z80/8085 and 8086/8088 processors. It is scheduled for availability this quarter.

For more application transportability, DRI introduced the VIP to work alone or with CP/M and other operating systems, including PC-DOS and Apple DOS, Tillinghast claims. That application-development and run-time support environment supports foreign-language

programs. VIP thus supports Katakana, a phonetic Japanese representation.

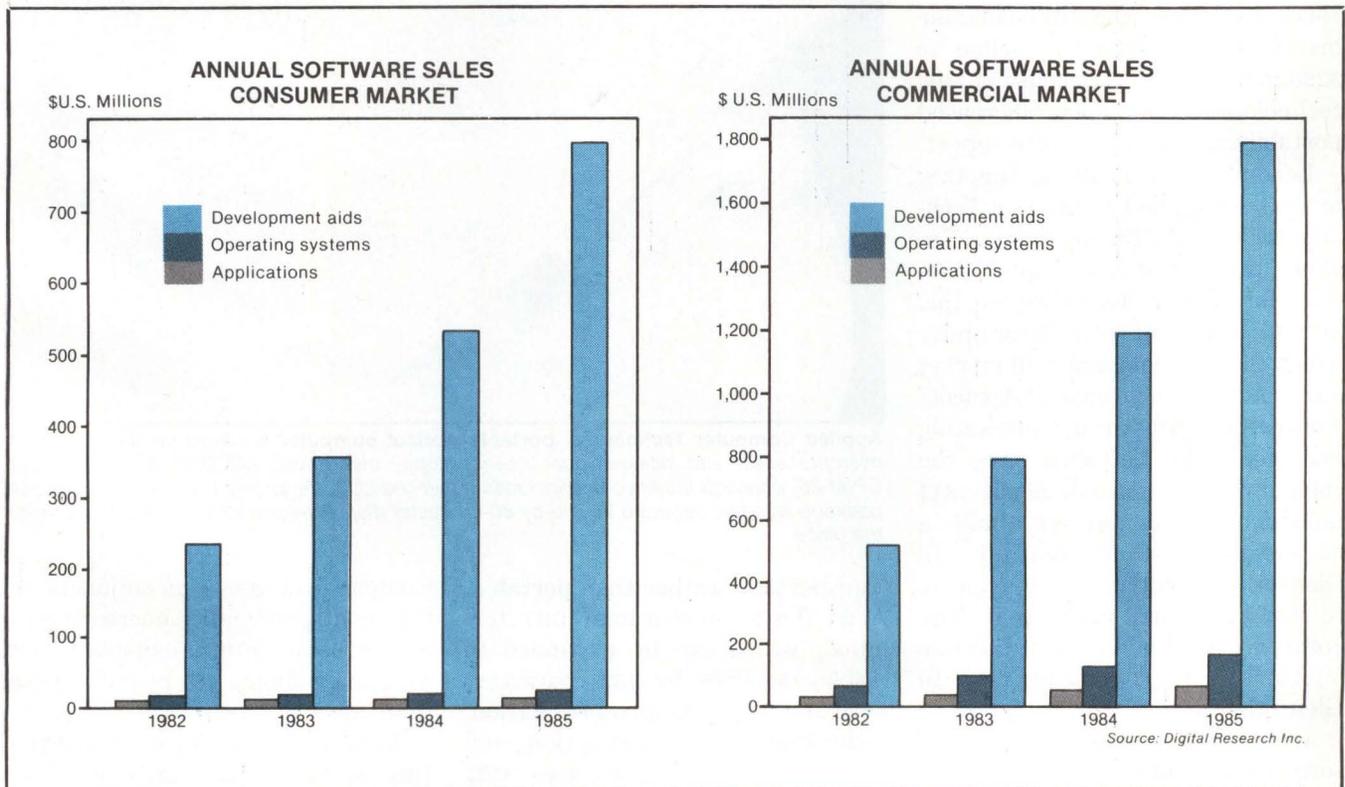
DRI will not initially license VIP in the United States, although it will be available to application developers in Europe and Japan, where DRI does not have a Consumer Products division. OEM price of CP/M is expected to approximate that of CP/M plus.

Microsoft chairman William Gates expects MSX to be a major growth area for the company. He claims sales in Japan have reached \$10 million, about one-fifth of total Microsoft revenues, and he hopes to double that next year. Other high-growth areas for the Kirkland, Wash., company are office-automation applications, such as the IBM 5550, and hand-held computer software. Gates says 120,000 En-

glish and Kanji MS-DOS versions have been sold in Japan. Five Japanese vendors, led by Sony Corp. and Matsushita Electric Industrial Co., have adopted MSX. However, market leader NEC Corp. has yet to sign the proposed standard.

MSX is optimized for hobbyist/game machines using video graphics and selling for less than \$300. It employs Microsoft's GW (Gee Whiz) BASIC, which is closely tied to low-end hardware. Gates notes that one of three of MSX's former opponents have recently endorsed it. That supporter is Soft Bank, a leading vendor in the Japan Micro-computer Software Association, which also supported the standard. The remaining opponents are Sord Computer and DRI.

—Lori Valigra



Digital Research Inc. expects development aids to be a strong growth area in both its commercial and new Consumer Products division. The company planned to help spur growth in the consumer group with the introduction in August of the visual information processor (VIP), an application-development and run-time software tool that supports foreign-language programs.

Mini-Micro World

INTERNATIONAL

European firms poised to enter U.S. portable computer market

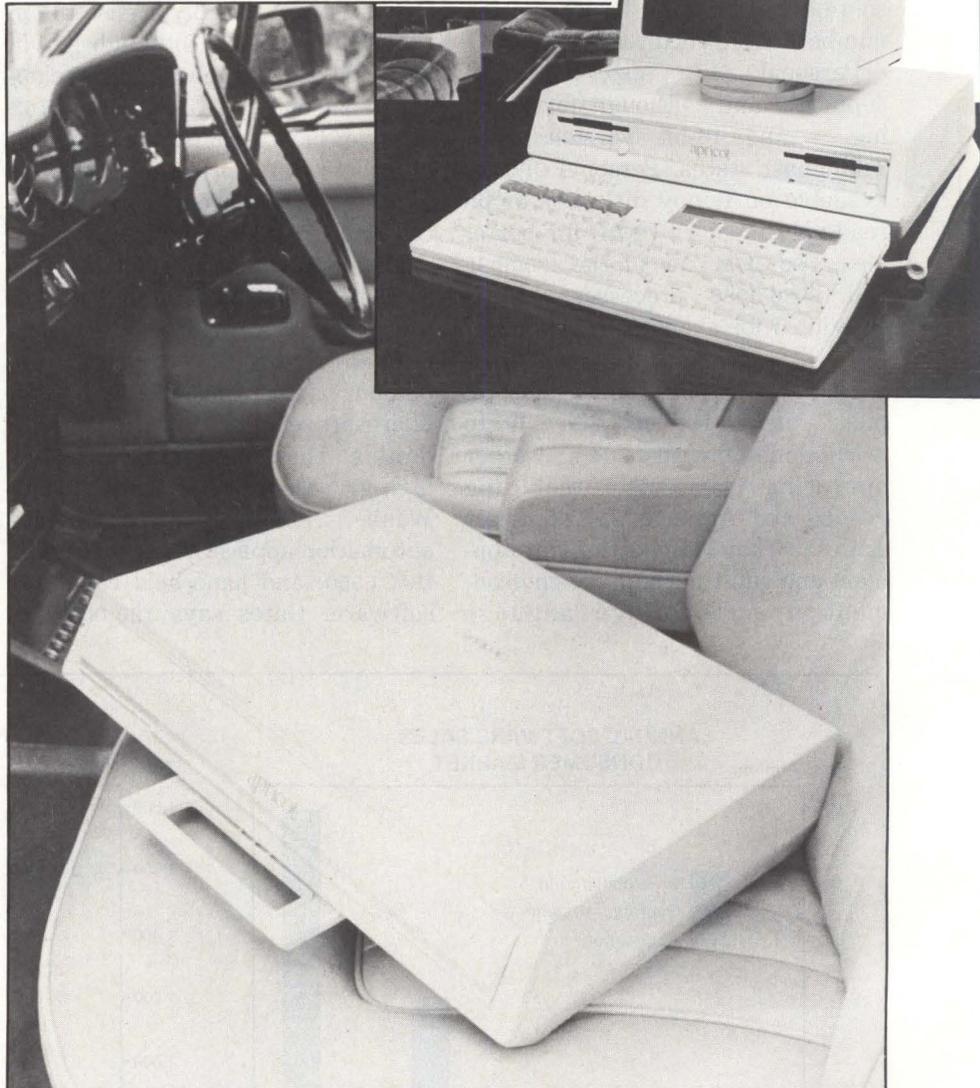
At least six European firms are aiming for a share of the burgeoning U.S. portable computer market, with others ready to fall into line soon. They will join such established suppliers as Compaq Computer Corp., Osborne Computer Corp., and Kaypro in addressing the rapidly accelerating worldwide portable computer market.

Portable computers are expected to grow from \$11 million in 1982 to \$2.3 billion by 1987, representing a unit growth rate of 2,000 to 750,000 pieces, according to a recent study from market research firm Infocorp, Cupertino, Calif. Relatively heavy transportable computers such as the Osborne 1 and Compaq should grow from \$225 million in 1982 to \$442 million in 1984. However, the transportable market is projected to decline to \$225 million by 1985 because of new technologies that allow increased portability, according to the report.

Leading the assault on the U.S. market is Applied Computer Techniques (ACT), Birmingham, England, the largest European distributor for Victor Technologies Inc. ACT has an accord with Victor under which the U.S. company will market a new ACT portable called "Apricot" worldwide. ACT group marketing manager John Leftwich says the company has poured about \$17 million into the project, built a 55,000-square-foot factory in Glenrothes, Scotland, and expects to ship 75,000 units next year. The company will also manufacture Victor's microcomputers in Glenrothes.

ACT claims that Apricot is software compatible with the Victor 9000 microcomputer.

Weighing 17½ pounds, including keyboard, the Apricot is considered



Applied Computer Techniques' portable Apricot computer is based on the Intel 8086 microprocessor and includes dual 3½-inch floppy disk drives, MS-DOS and Concurrent CP/M-86. Although the keyboard includes a two-line LCD, the product is sold in a briefcase package with two separate 25-line-by-80-character displays—one for the home and one for the office.

transportable rather than portable. A 25-line-by-80-character CRT terminal, which can be expanded to display 50 lines by 132 characters with an 800-by-400-pixel resolution, is available as a \$1,200 option. ACT expects users to buy two CRT terminals, one for their offices and another for their homes. In contrast, U.S. portables such as the

Compaq can serve as adjuncts to fully configured office microcomputers, housing internal displays but weighing about 10 pounds more than Apricot.

Apricot is configured around Intel Corp.'s 8086 microprocessor and an 8089 I/O manager. An 8087 math coprocessor is optional. Operating systems include MS-DOS 2.0

Our new multimode: Correspondence quality. High-speed drafts. Graphics. Attractive pricing. And up to 500 cps.



Anadex rapidly moves a head.

High quality correspondence.
High-speed drafts.
High-resolution graphics.

Whatever your application, they're all built into the exciting new multi-mode printer: Rapid/Scribe™ Model DP-6500 from Anadex.

But the built-in feature that's got everybody talking is Rapid/Scribe's speed ... 500 characters per second at 10 Pitch in the high speed draft mode; and 110 cps in the proportionally spaced, Dual Pass Correspondence Mode.

The accompanying chart summarizes the speeds. (Notice that at 10 Pitch and 80 Columns, Speed is 275 Lines per Minute).

Equally exciting are the impressive array of features that have become the Anadex hallmarks...friction and tractor feed, sophisticated communications capability, emulation packages, character font downloading, alternate character fonts, bar codes, and of course, a reputation for reliability.

Couple those features with Rapid/Scribe's interfaces – Parallel, Centronics compatible and RS-232-C Serial – and you have a solid, high-speed printer that fits virtually any computer and computer application...including yours.

Printing speeds (cps)

10 Pitch 500 cps
12 Pitch 540 cps

Enhanced

Proportional 275 cps
10 Pitch 250 cps
12 Pitch 300 cps

Condensed

15 Pitch 375 cps
16.4 Pitch 410 cps

Dual Pass Correspondence Quality

Proportional 110 cps
10 Pitch 100 cps
12 Pitch 120 cps

10 Pitch Printing Speed (lines/minute)

40 Columns 430 lpm
80 Columns 275 lpm
132 Columns 180 lpm

Call (800) 792-7779
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FOR THE WORLD

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Mini-Micro World

INTERNATIONAL

and Concurrent CP/M-86. Main memory is expandable from 256K to 768K bytes. The unit comes with one or two Sony Corp. microfloppy disk drives. The drives can be single-sided, 315K-byte units or double-sided, 720K-byte units. Maximum disk capacity is 1.44M bytes.

Chris Buckingham, managing director of ACT International, claims Apricot can run software written for IBM Corp.'s PC, except for graphics programs. Apricot uses

the same graphics standard as the Victor 9000.

Victor officials cannot say when the Apricot will be launched in the United States, although ACT's Leftwich suggests early 1984. Victor officials also plan to offer Victor 9000 users the "fourth-generation" keyboard that is standard on the Apricot. The keyboard incorporates a 40-column, two-line liquid-crystal display, called Microscreen, which enables a user to

enter information from the keyboard to the main screen of the computer without constant eye motion.

Microscreen's main role is to support such functions as word processing and calculating without the Apricot's full display. Leftwich acknowledges that the Microscreen is not useful for graphics and spreadsheets.

Electronics giant N.V. Philips, Eindhoven, the Netherlands, is about to launch a portable computer with an integral CRT display. If N.V. Philips sells the unit in the United States, it will be sold by Philips Information Systems Inc., Dallas.

Italy's Olivetti S.P.A also plans to enter the portable market but does not say when.

Triumph-Adler, Nuremburg, West Germany, offers the Alphatronic P.C., which runs under CP/M and aims at professional users. European price is approximately \$500. The system lacks an integral CRT and disk storage. Company officials state it will be available in the United States through Royal Business Machines Inc., Hartford, Conn. Like Apricot, the transportable Alphatronic P.C. is designed to plug into a television set. Dual

ALTERNATIVES TO DISK STORAGE IN PORTABLES

Robust mass-storage methods are required for portable computers used in hostile environments. Nomad, a portable computer weighing only 3 pounds and manufactured by Immediate Business Systems, Plc, Milton Keynes, England, uses as much as 256K bytes of magnetic bubble memory instead of disk storage.

Company managing director Tony Goodfellow notes that Nomad will soon be available from Immediate Business Systems Inc., Birmingham, Ala., a majority-owned subsidiary that sells Immediate's PBM 500 portable billing machine.

Nomad can be programmed directly in Microsoft M-BASIC or loaded with programs from a CP/M-based computer. Goodfellow notes that the portable is watertight and claims it can operate

in temperatures from -30 to +70 degrees Celsius. Goodfellow acknowledges that bubble memory costs more than magnetic storage. He quotes European prices ranging from \$2,900 to \$4,350, depending on the amount of bubble memory.

An alternative technology has been adopted by dvw Microelectronics, Coventry, England, which sells its Husky portable computer through Sarasota Automation Inc., Sarasota, Fla. Husky comes with as much as 144K bytes of CMOS memory with three levels of battery backup, comments sales and marketing manager Rex Blagg. He adds that Sarasota is selling Husky to large end users in areas such as defense, automotive manufacturing and the liquor industry.

A LOOK AT THE NEW WAVE OF EUROPEAN PORTABLES

Company	Applied Computer Techniques	Triumph-Adler	SKS	Compaq Computer Corp.
Product	Apricot	Alphatronic PC	Pico, Nano	Compaq
Processor, internal memory	8086 (plus 8089 I/O processor), 8087 (optional); 256K bytes, expandable to 768K bytes	Z80; 64K bytes	Z80A (80186 board is optional); 80K bytes	8088; 128K bytes, expandable to 256K bytes
Display (lines x characters)	25 x 80 (option)	can plug into T.V. set (option)	20 x 80	25 x 80
Operating system	MS-DOS 2.0, Concurrent CP/M-86	CP/M	CP/M, MP/M, OASIS, MS-DOS	MS-DOS
Mass storage	Dual 3.5-in. floppy drives	Dual 5 1/4-in. floppy drives (option)	3.5-in. floppy drive (Pico); 3.5-in. Winchester drive, 3.5-in. floppy drive (Nano)	Dual 5 1/4-in. floppy drives
Weight	17.5 lbs. (with keyboard)	7.7 lbs	18 lbs. (Pico), 25 lbs. (Nano with Winchester drive)	28 lbs.
Tentative U.S. availability	Early 1984 (projected)	Fall, 1983	Now	Now
Price	\$1,495 (Europe) with single floppy drive; \$2,748 (Europe) with dual floppy drives, CRT	\$500 (Europe)	\$2,495 (Pico) with dual 3.5-in. floppy drives; \$4,496 (Nano) with Winchester, floppy drives	\$2,995 (with one floppy drive)

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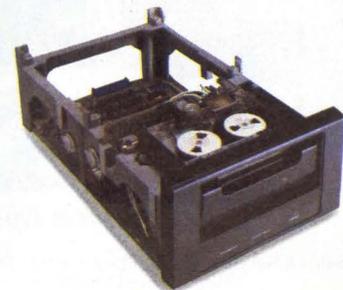
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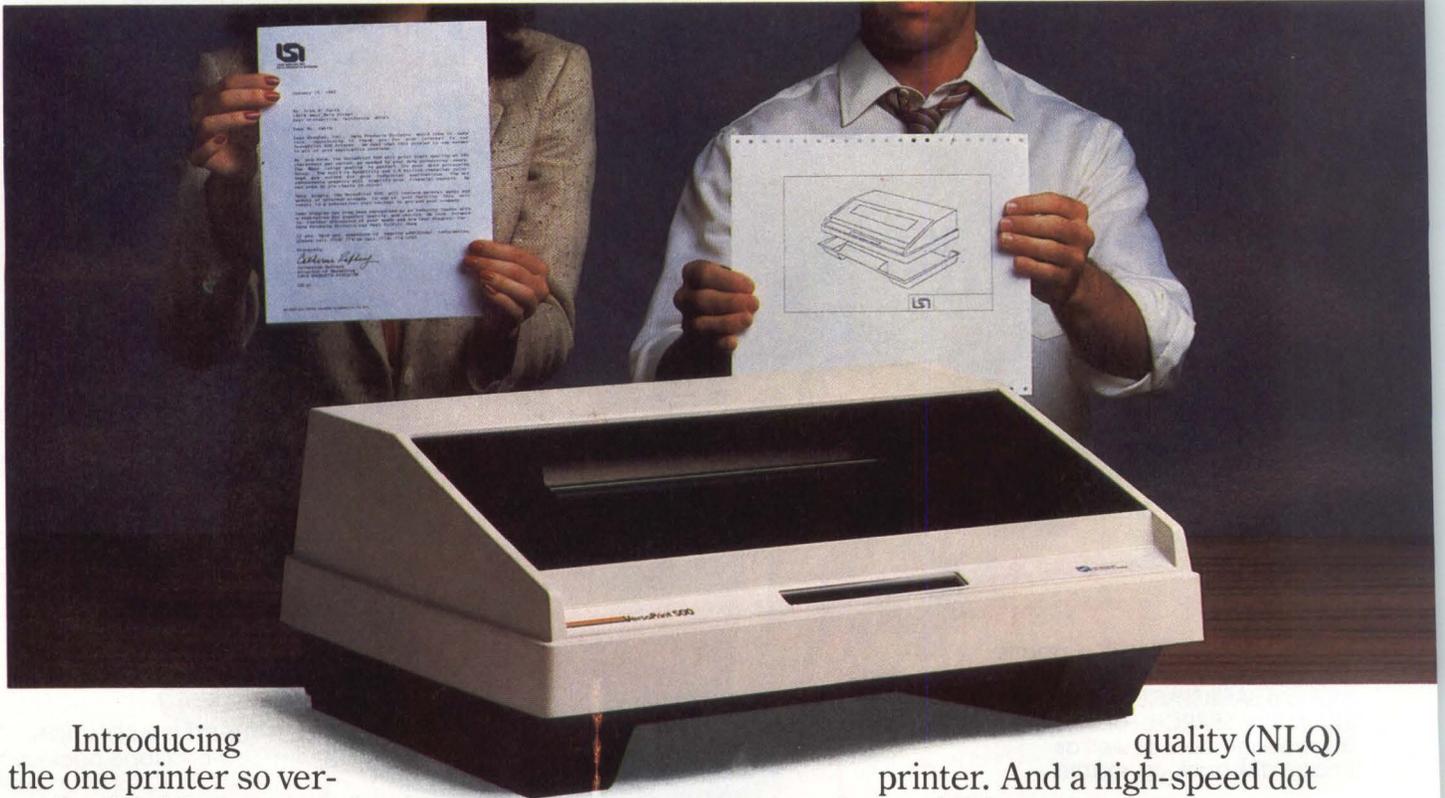


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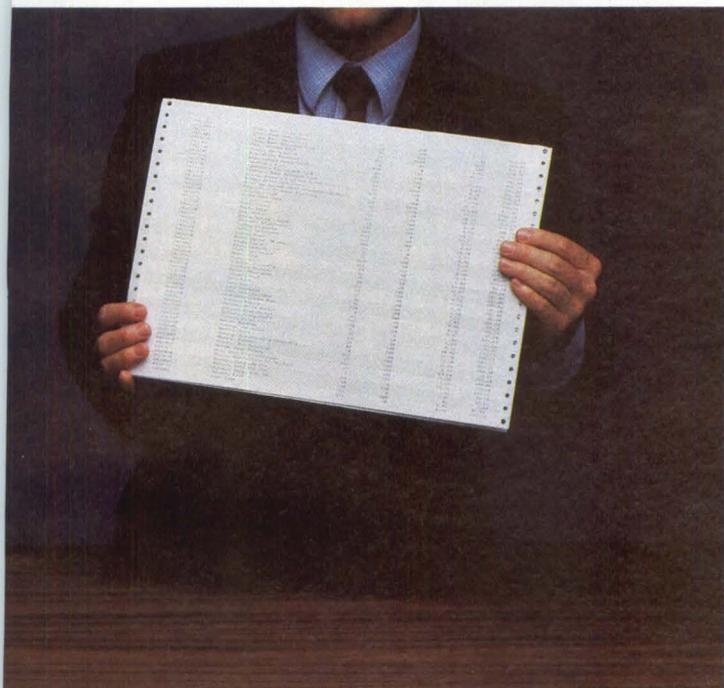


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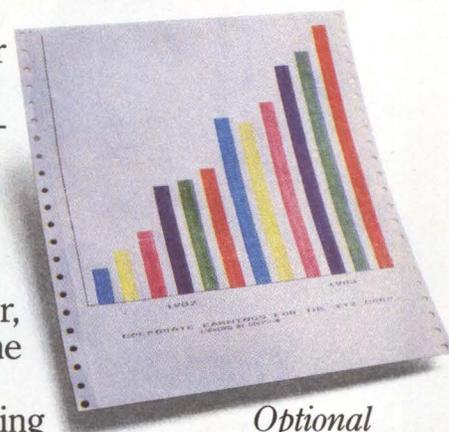
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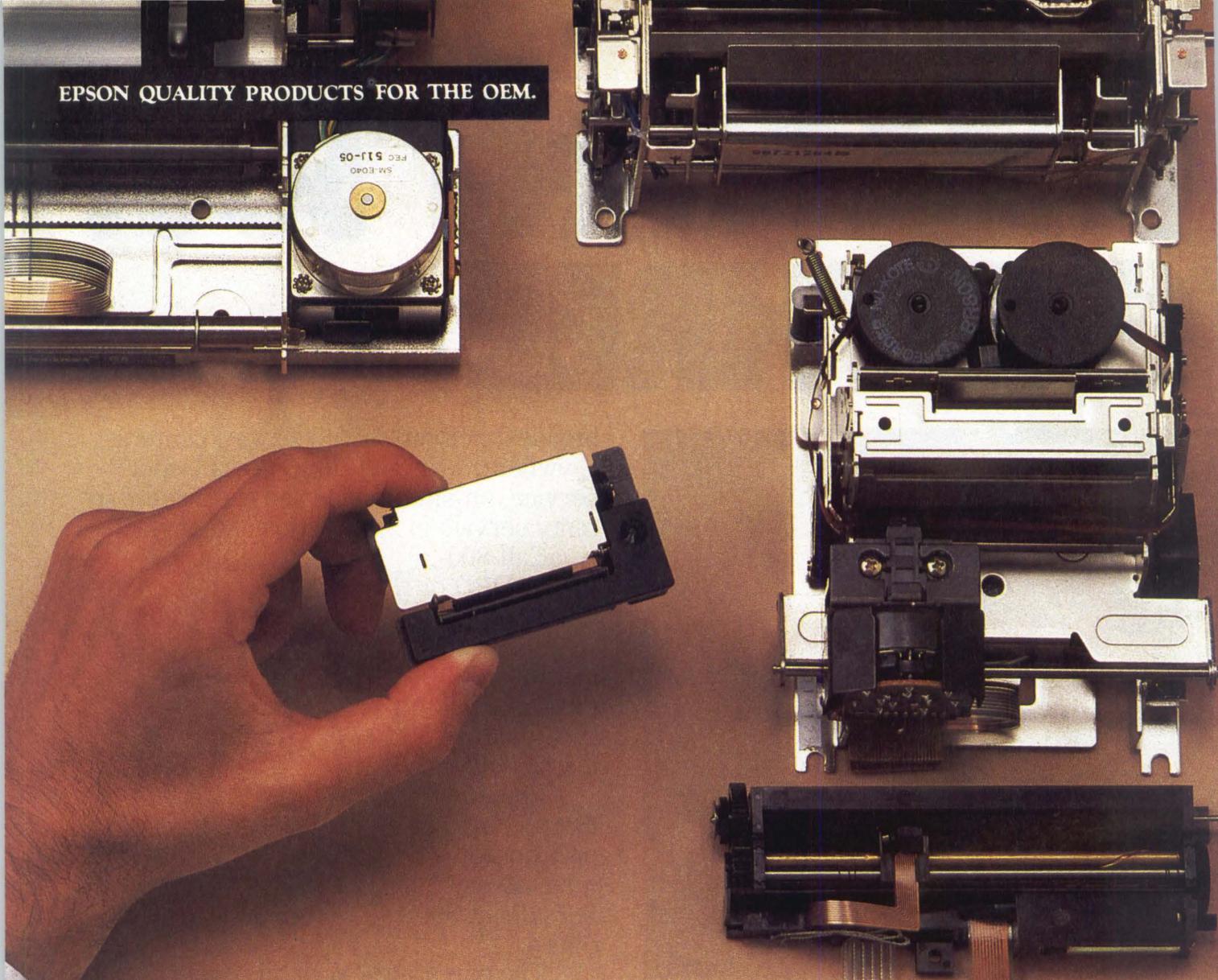
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M12XX	Thermal	40	0.5 LPS	5.2 oz
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320K-byte, 5¼-inch-floppy disk drives are optional.

Another company active in the U.S. portable computer market is Steinmetz, Krischke Systemtechnik GmbH, Esslingen, West Germany, which sells the Pico and the Nano portables through SKS Computers Inc., Hilliard, Ohio. Both Z80A-based machines come with an integral 25-line-by-80-character display and have an optional plug-in board based on the 16-bit Intel 80186 processor. Operating systems include CP/M, MP/M, OASIS and

MS-DOS. The Pico comes with dual 3½-inch floppy disk drives; the Nano incorporates a 3½-inch Control Data Corp. Cricket Winchester drive, says SKS Computers technical vice president Tony Lewis.

He explains that the Cricket allows use of a solid-state switching power supply rather than a conventional transformer-based power unit and dramatically reduces heat generation. Lewis cites power-supply transformers as the major culprits in overheating a portable machine with an integral Winches-

ter disk drive. The SKS portable also includes a fan.

Like ACT, SKS is aiming for a high degree of IBM PC compatibility to get a foothold in the U.S. market. Lewis notes that the Pico and Nano computers use a Z80 processor for I/O when the 16-bit plug-in board is in place and thus operate faster than the PC or the Compaq. He claims that the Z80 can intercept output commands generated by PC software running on the SKS machine and make them acceptable to SKS hardware. —Keith Jones

OVERHEARD OVERSEAS

German high-tech growth stymied by financiers

By Maureen O'Gara
Contributing Editor, West Germany

Imagine, if you can, a world without venture capital. It would be a world filled with bankers who see no profit potential in high technology and think that steel, machinery, chemicals and cars are the only sound investments. Such a world would have no spin-offs, no equity positions, no going public and no payoffs.

This might sound grim. But it's not merely a product of imagination: it is a description of Germany, one of Europe's largest computer markets.

Some may construe the situation, which is fairly representative of all Europe except Britain, as a hidden blessing. It surely keeps competition down. But it also doesn't encourage entrepreneurs or foster a financially sound reselling base to handle U.S. imports. Most local European distribution vehicles are severely undercapitalized mom-and-pop outfits with little to cushion them from failure.

The lack of financing in Germany also hinders consumers' desire for computers. In contrast, much of the customer demand for computers in the United States was generated by the industry itself.

The Germans are finally realizing they're missing the high-tech bandwagon. But it is now evident that they may be preparing to hop aboard.

This summer, for example, two small German computer companies went public. One is Tewidata AG, Munich, a \$1.3 million-a-year, scientific/industrial Digital Equipment Corp. systems house. Tewidata issued 56,000 shares and was oversubscribed by a factor of 14. Shares jumped to \$115 each soon after opening, netting the company \$4 million —\$3 million for growth and the rest for repaying the company's backers.

Another company, SM Software AG, also went public, making an initial offering of 5,000 shares.

Analysts contend that usually conservative German investors are anxious to back high technology. Moreover, a few manufacturers are preparing to follow the example of Tewidata and SM Software.

Other German firms have grown impatient of German ways and are tapping American resources. For instance, microcomputer maker Peripherie Computer Systeme GmbH, Munich, recently lined up U.S. venture capital to expand into the American market via exclusive

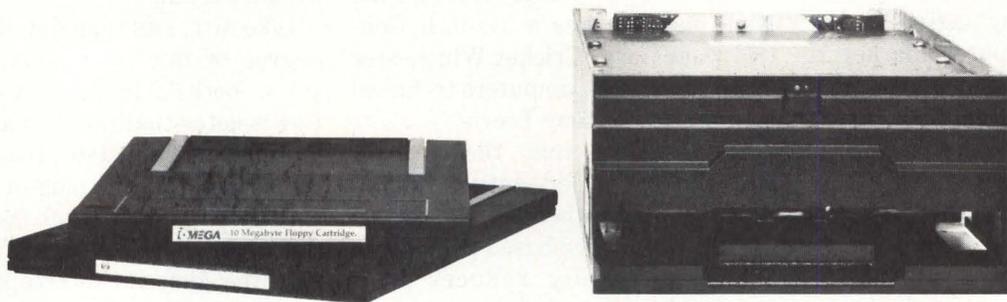
distributor/cross-licensee Cadmus Inc., Boston. Part of the funding will return to Germany to underwrite further development at Peripherie Computer.

U.S. venture capitalists are also taking the hint. Reports indicate at least three American banks, including Citibank, will come to Germany over the next year with venture-capital funds totaling \$100 million.

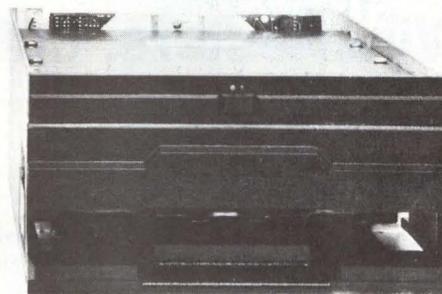
Some Germans are also attempting to create homegrown venture operations. Newcomer Rauch & Rosenbeck, Munich, employs an ex-director of Nixdorf AG and a founder of David Computer Systems GmbH. The company is trying to garner \$40 million from a group of institutional/industrial investors, most of whom are German, by year-end. At end of the summer, Rauch & Rosenbeck had invested \$5 million to \$6 million in first-round capital in a handful of companies.

CPI International Partners GmbH, Munich, is taking another approach. It raises money from private German investors on a venture-by-venture basis. Its first high-tech undertaking raised \$3 million, or approximately one-third the amount recently invested in Auragen Systems Inc., a computer manufacturer in Fort Lee, N.J. CPI also helped arrange Auragen's cross-licensing pact with Nixdorf. CPI president Joe Frank, however, says he's interested in underwriting U.S. firms only.

FRONT.



BACK.



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Front View: High Reliability Primary Mass Storage.

There are several powerful reasons to seriously consider the Alpha 10 as a primary mass storage device. First of all, each cartridge stores 10 Mbytes of data—easily matching capacity with today's Winchester.

But just as important, the Alpha 10 matches the Winchester in reliability, thanks to several IOMEGA innovations in flexible disk and removable cartridge technology. As for versatility, the unique cartridge format of the Alpha 10 speaks for itself—a straightforward approach to library management and data interchange.

Back View: High Versatility Back-Up And Archival Storage.

The Alpha 10's advantages for back-up and archival storage are just as impressive. For instance, a 10 Mbyte Winchester file can be dumped onto a single Alpha 10 cartridge in literally minutes, not the usual hours. You can look forward to a new standard of reliability that is integral to our design. And, because our cartridges are the most inexpensive on the market today, archival storage doesn't cost you an arm and a leg.

Overview: The Careful Evolution, And Immediate Availability, Of A Drive Design Revolution.

Any way you look at it, the Alpha 10 is a breakthrough in data storage device design. Actually, it's a series of breakthroughs, including non-contact head-to-disk interface, high linear bit densities, a run-length limited code that compresses the data stream from the host, and closed servo control of the head positioning, all to achieve the economy and versatility of flexible disks with the capacity and reliability of hard disks.

But the best part of the technology is that it's here, now, packaged and available in OEM quantities. Get the whole story, today, on the Alpha 10 from IOMEGA.

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European clean rooms service U.S. Winchesters, cut turnaround times

Increasing sales of Winchester disk drives throughout Europe are prompting serious maintenance considerations. Until recently, U.S.-manufactured drives with head/disk problems had to be shipped back to clean rooms in the United States for maintenance, resulting in a turnaround time of two months or more. But now, Pan-European maintenance services are appearing. They offer a compromise between these long turnaround times, which force European distributors to keep large stocks of replacement drives at considerable cost, and U.S. manufacturers' own clean rooms in Europe, which also are costly.

Four U.S. manufacturers—Seagate Technology, Kennedy Co., Computer Memories Inc. and International Memories Inc. (IMI)—already use Kode Services Ltd., Calne, England, to repair their Winchesters. Kode, one of the first to offer such Pan-European service, may open a second clean room center in Munich, Germany. A new company, Memory Maintenance Ltd., Swindon, England founded by former Kode staff members, is seeking a similar arrangement with U.S. manufacturers. Several other such firms are expected to appear in Europe, states Memory Maintenance managing director John May, a former managing director of Kode. He adds that the cost of establishing a clean room with five laminar-flow benches and air conditioning is about \$80,000, not including specialized test equipment.

Memory Maintenance is not seeking deals with all U.S. Winchester builders. "A lot more U.S. manufacturers are offering devices than can survive in the market," he

5 1/4-inch Winchester head/disk maintenance fees		
	Under warranty	Out of warranty
Kode Services Ltd.	N/A	\$200 + parts
Memory Maintenance Ltd.	\$75	\$200 + parts

declares. "It is difficult to say who will be the winners." The company is seeking three-year agreements that will then be renewed each subsequent year, May explains. He adds that manufacturers must train Memory Maintenance's engineers and sell spare parts at low prices. He also expects manufacturers to replace spare parts for free if a device is under warranty. Memory Maintenance charges the manufacturer a fixed \$75 rate for labor on a 5 1/4-inch unit. If the warranty has expired, the distributor in Europe must pay a fixed \$200 fee, including parts.

"We will turn around a Winchester in five to 10 working days," May promises, citing eight weeks as a typical turnaround time for drives shipped back to the United States for repair. U.S. manufacturers, he observes, take a risk in setting up their own European Winchester repair services. "If they lose one or two engineers, they are in big trouble. If we lose one or two, we do not suffer in the same way," he comments. Memory Maintenance can call on the staff resources of its sister company, Micro System Maintenance, located in the same building. Micro System provides on-site maintenance for large micro-computer users throughout Britain.

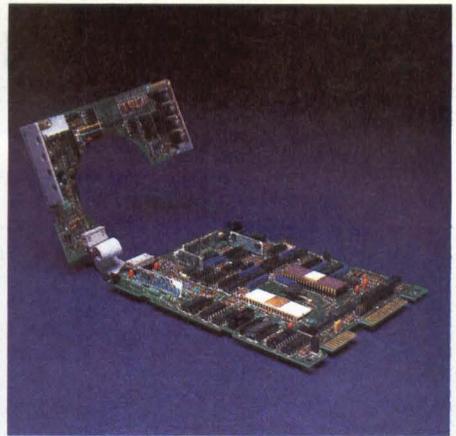
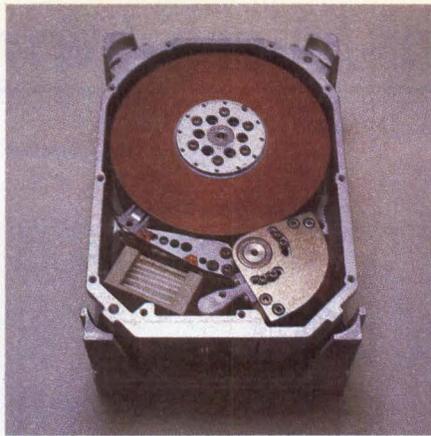
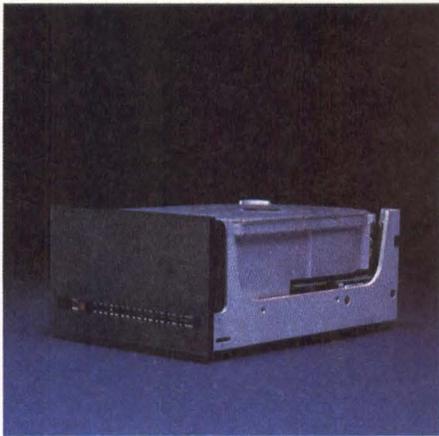
Memory Maintenance's clean room in Swindon has five laminar-flow benches. It conforms with U.S.

Federal Standard 209B Class 100, which specifies that a clean room must have fewer than 100 particles of less than 0.5 μ m. in diameter in a random cubic foot of air. May claims Memory Maintenance's particle count is less than five per cubic foot over the work benches.

The company also plans to offer a Pan-European maintenance service for several other types of advanced magnetic-storage devices, including cartridge-tape backup units, micro-floppy disk drives and floppy drives with capacities greater than 3M bytes. May believes U.S. manufacturers are unhappy with many European distributors' repair work on high-capacity floppy disk drives.

While May works to get Memory Maintenance off the ground, his former company, Kode, has doubled the size of its clean room from four to eight benches. Kode general manager Brian Brown refuses to quote figures for current total repair volumes. He explains that distributors normally accumulate a batch of 10 faulty Winchesters before sending them to Kode. The biggest batch has been 250. Large batches are delivered by land, while small consignments come via air freight.

Brown believes fast turnaround is the biggest advantage of a European service like Kode's. He dismisses the notion that European labor is cheaper than American labor as a



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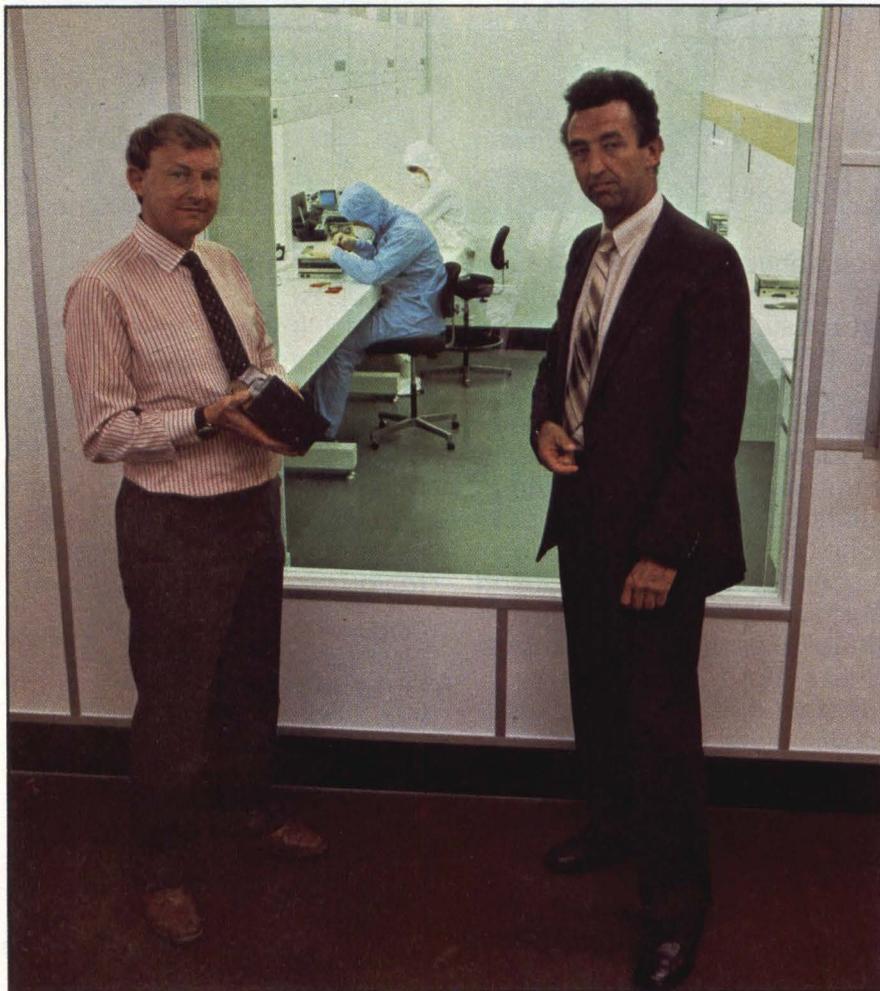
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Memory Maintenance Ltd.'s managing director, John May (left), says the company can turn around a Winchester disk drive in five to 10 working days. Memory Maintenance executive director Clive Markew is at right.

myth. He quotes the same fixed price as Memory Maintenance—\$200—for repairing a 5¼-inch drive that is past its warranty but is reticent about quoting charges to manufacturers for units still under warranty.

Brown insists that users' mishandling of Winchesters is the major cause of damage. He notes that heads and platters can be damaged by just bumping or moving the host computer. The normal clean-room procedure is to replace damaged heads and platters rather than repair them.

Keith Young, Kennedy's European senior service engineer, says

turnaround time at Kode for Kennedy 14-inch drives is three weeks "and improving." He adds that Kode is not prepared to install the special equipment needed to remove the motor pressed onto the shaft in Kennedy's 8-inch units.

Tandon International, a division of Tandon Corp., Chatsworth, Calif., has installed its own clean room with one laminar-flow bench and plans to open a second at its Frankfurt, West Germany, headquarters. Tandon International products support manager Ron Hale reveals that the company considered using Kode service but decided to handle its own repairs.

"We know more about our drives than any third party," Hale asserts.

But Tandon's biggest competitor—Seagate—is "very satisfied" with Kode's service, states Seagate European sales manager Christian Schmitt. He explains that Seagate's distributors deal with electronic failures, whereas Kode is used to dealing with faults inside the head/disk assembly.

Philip Hadwell, European sales manager of Computer Memories, is also satisfied with Kode's service. He says that most of the Computer Memories units in Europe are parts of systems shipped from the United States by customers such as Intel Corp. and Convergent Technologies Inc. He quotes a "dead-on-arrival" rate of 2 percent for failures within 30 days of installation.

Hadwell predicts that manufacturers of Winchesters that have servo information written on disk surfaces could encounter problems. The information is written on one side of one platter (dedicated) or beside the data on each side of each platter (embedded). Hadwell points out that Computer Memories does not use either method. He adds that a maintenance operation needs extremely expensive equipment to write dedicated servo information, and each family of drives requires different servo-writing equipment. Brown at Kode acknowledges that the cost (about \$250,000 per machine) has discouraged Kode from buying servo-writing equipment but adds that the company can buy replacement platters with dedicated servo information pre-written by U.S. manufacturers. He cites IMI drives as devices with the embedded servos that Kode is successfully handling. IMI's embedded servo is written by the controller and does not need a special servo writer, comments Hank Crossan, IMI's European sales manager.

—Keith Jones



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Designed for the most demanding CAD/CAM applications, the Tektronix 4115B features a high-resolution color raster-scan display. This 60-Hz, non-interlaced, flicker-free display provides resolution of 1280 × 1024 pixels. Up to 256 colors can be displayed at one time from its palette of 16 million colors!

System-wide cost savings

By upgrading from four 16K devices per single in-line package to one TMS4416 ByFour* DRAM (see photo), Tektronix cut costs by more than 50% and memory part count by four times.

System costs also were lowered, due to fewer interconnects and support circuits. This reduced inventory, cut power requirements, and enhanced reliability.

Lower power, higher reliability

With one 5-V power supply at 130 mW per 64K, the TMS4416 significantly cut power consumption. This increased power supply margins and reduced noise. Plus, lower heat dissipation and fewer interconnects improved system reliability.

Equally important, TI met Tektronix's critical delivery schedule.

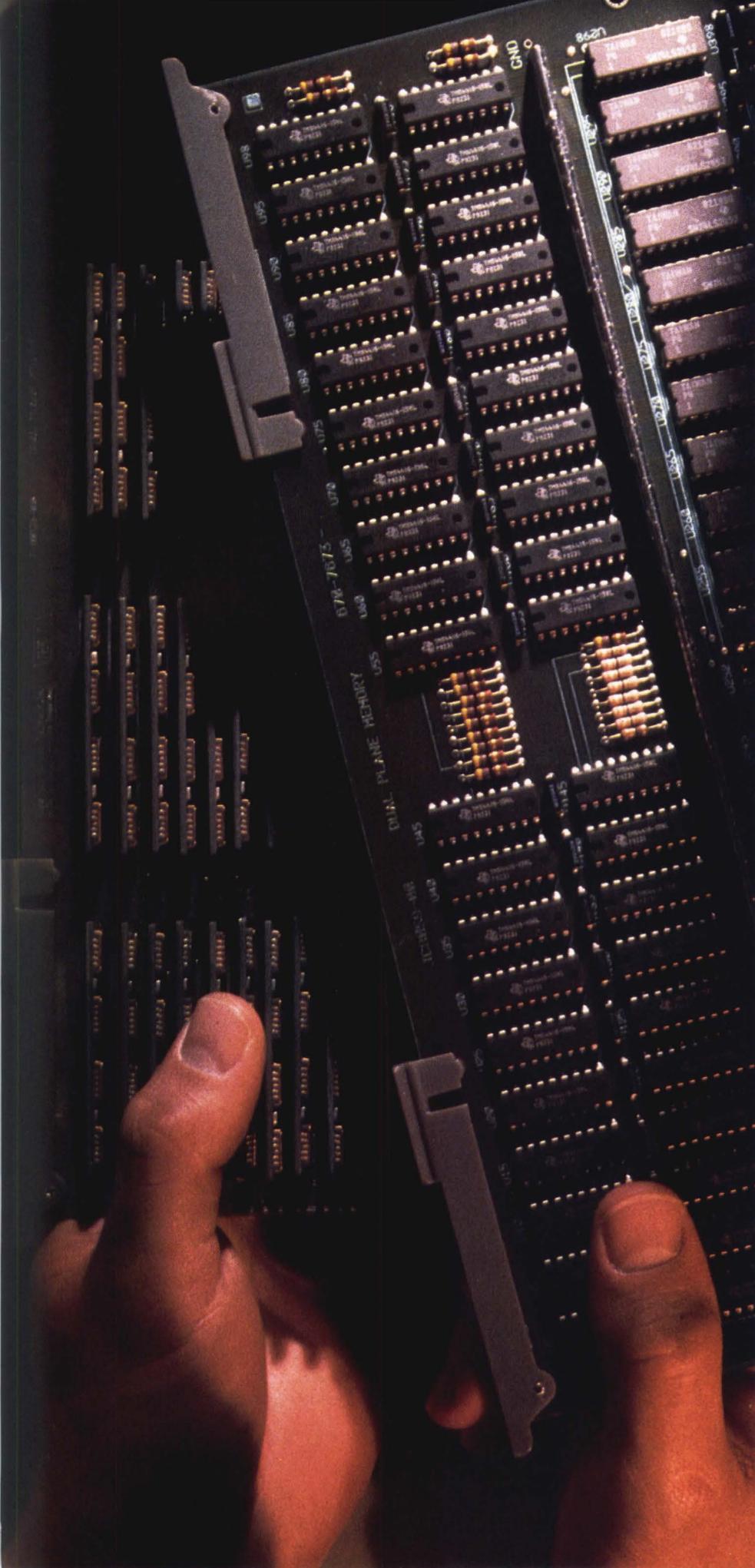
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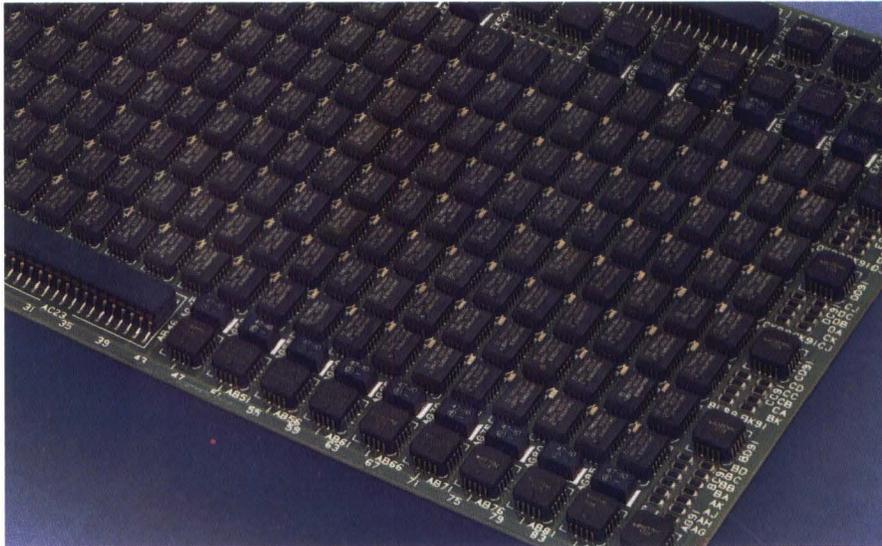
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- ◀ **An exceptionally "clean solution,"** TI's TMS4416 16K × 4 DRAM enabled Tektronix to reduce memory component count by four in its new 4115B Computer Display Terminal. Each TMS4416 replaced four 16K devices mounted on a single in-line package.

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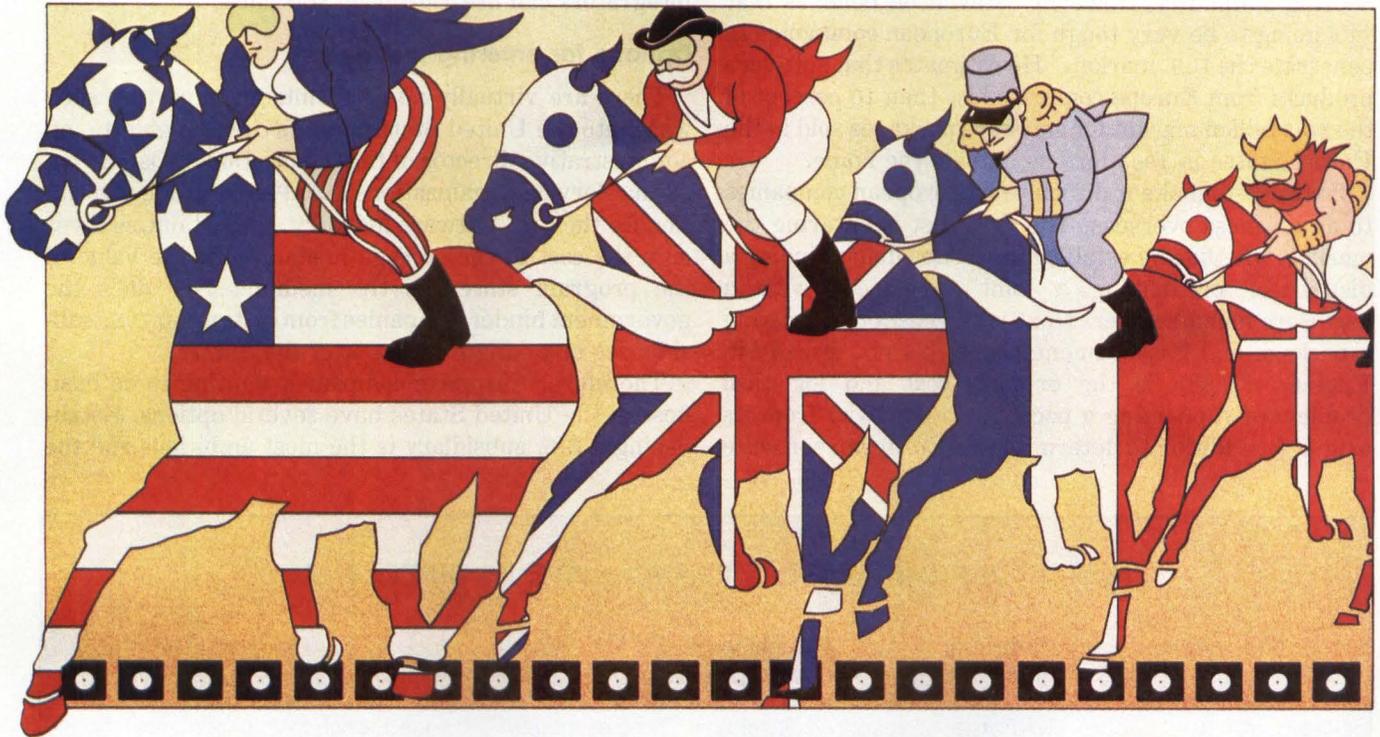
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An analysis of news, issues and trends affecting the computer industry



European software houses pursue the U.S. market

By Sarah Glazer

Long considered the world's biggest market for computer hardware, the United States absorbs components and systems from many European countries. It's no surprise, therefore, that European software houses should try to sell their wares here, too. But for most of these companies, entering the U.S. market means modifying their products and their business style.

If the lure of the U.S. market isn't enough to make European software houses look abroad, problems in Europe add incentive. "The European market is segmented," says Mirek Stevenson, chairman of New York management consulting firm Quantum Science Corp. Although Europe's total population exceeds that of the United States, its people speak a dozen languages. Even for utilities and system software, prompts and on-screen messages can erect a language

barrier, Stevenson explains. And documentation is also a major problem.

For much application software, barriers between countries consist of more than language. Problems are especially severe for business applications. For example, banking in the United Kingdom differs radically from banking in France and Germany, Stevenson notes. Similarly, different laws and practices would make an accounting or payroll package designed for one country useless in another. Manufacturing and engineering applications, such as CAD/CAM packages, pose fewer problems. Stevenson cites systems and utilities software as "the most transferable." But even for these, "you still have to provide documentation in other languages," he says.

It's no wonder that, faced with modifying products to sell outside their national borders, European software houses soon start considering the United States. In

The Interpreter

addition to its size, the United States has uniform language, business practices and scientific and engineering standards. However, Stevenson believes that "it's going to be very tough for European companies to penetrate the U.S. market." He estimates that software products from Europe comprise less than 10 percent of the \$3.5 billion market for software packages sold in the United States in 1983 for use outside the home.

Extra costs make it difficult for European companies to do business overseas. The first cost is entering the market, whether by establishing a subsidiary, finding a distributor or making a joint agreement with a hardware manufacturer. Next is the cost of translating a package and its documentation if it's not already in English. Finally is the ongoing cost and logistical problem of supporting a package so far away from its origin. In addition to determining a European software

company's chances for success in the United States, these factors decide how easily end users and system integrators can use European software.

Options for entering the market

There are virtually no restraints on importing software into the United States, states Glen Hughlette, an administrative director of the Association of Data Processing Service Organizations (ADAPSO), a trade association for the U.S. software industry. Import duties cover only the cost of the storage medium, not the value of the program stored in the medium. Nor does the government hinder companies from setting up U.S. subsidiaries or taking profits out of the country.

Therefore, European companies wanting to do business in the United States have several options. Establishing a U.S. subsidiary is the most ambitious and the

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MARKETING SOFTWARE IN FRANCE: VIVE LA DIFFERENCE!

French methods of marketing software are so different from U.S. practices that they change the product itself, remarks John E. Forge, president of United Software Systems and Services Corp. (u3s), Los Angeles, the U.S. distributor for several French software houses. He compares it to the difference between restaurants in France and in the United States. U.S. restaurants have elaborate menus, some even containing photographs of the food. But in France many restaurants don't even have menus, he continues. Instead, a waiter tells patrons the dishes available and assists them in choosing. This service à la française also extends to selling software. "When you want to know about a product, an engineer will come to you," Forge explains.

Because French software support engineers routinely spend so much time at a user's site, "documentation is generally just a reference manual," Forge says. However, U.S. customers expect a user's manual to go into much greater depth.

Bringing a French software package to the U.S. market requires redefining the product for documentation in terms American users can understand. "It's a very costly difference," Forge emphasizes. In

u3s's arrangements with the French companies it represents, all U.S. versions of documentation are the responsibility of u3s. Forge estimates that doing the U.S. documentation for one of the database-management

products his company handles costs \$800,000.

The dramatically different approach of the French to marketing may stem from France's lateness in developing a software packages industry, believes Philippe Levi, international development manager for the computer services company Compagnie Internationale de Services en Informatique (CISI), Paris. Until recently, the French used custom software and "were satisfied with it," he says. Therefore, customers expect personalized service even for off-the-shelf software packages and are not used to turning to a manual for help.

The European software packages industry lags behind its U.S. counterpart, says Mirek Stevenson, chairman of the New York management consulting firm Quantum Science Corp. Unlike the United States, Europe hasn't spawned the large number of software houses financed by small amounts of venture capital. "That kind of financing environment doesn't exist in Europe," Stevenson says. Also holding back the industry, he believes, are poorly developed methods for software distribution in Europe. But the lack of venture capital is the main problem, he claims: "No financing means small companies aren't growing up."



Illustration by Michael G. Cobb



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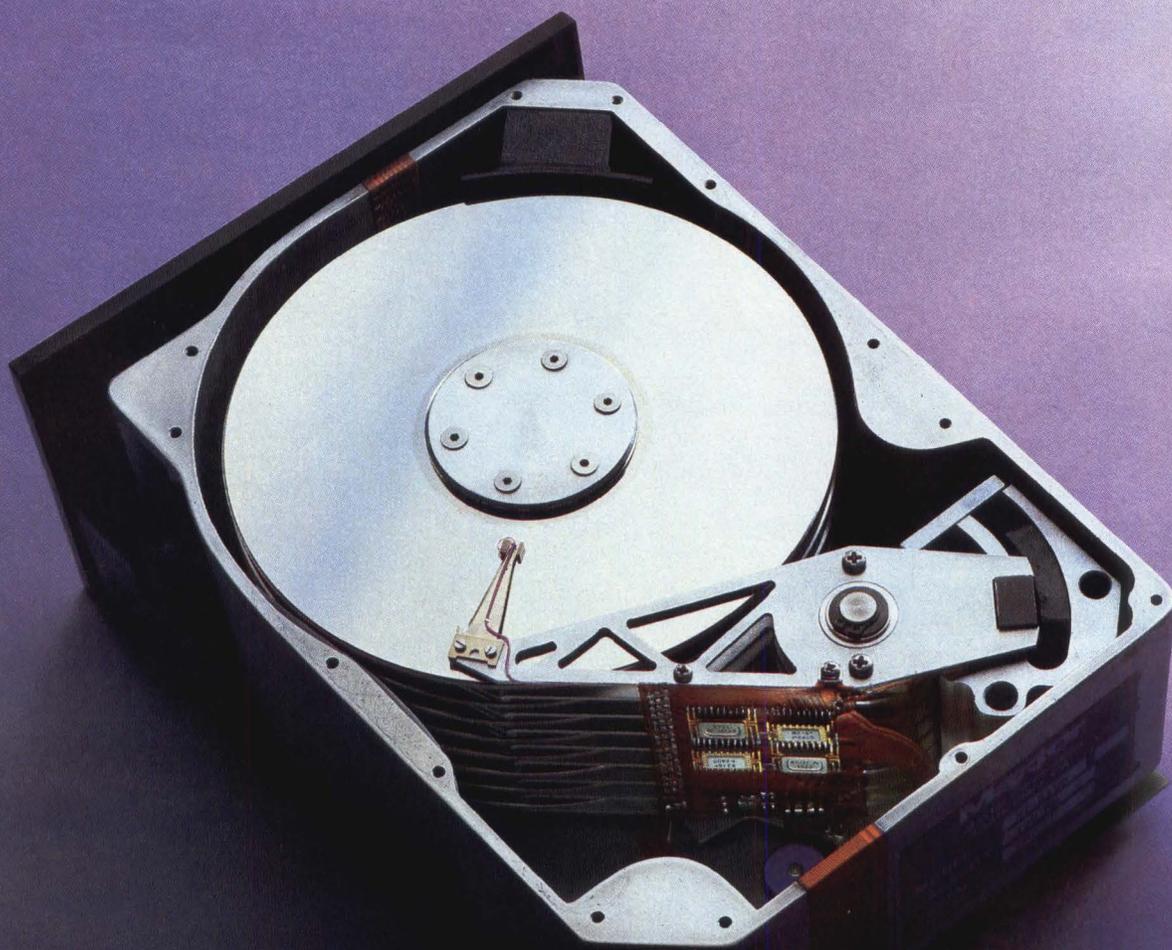
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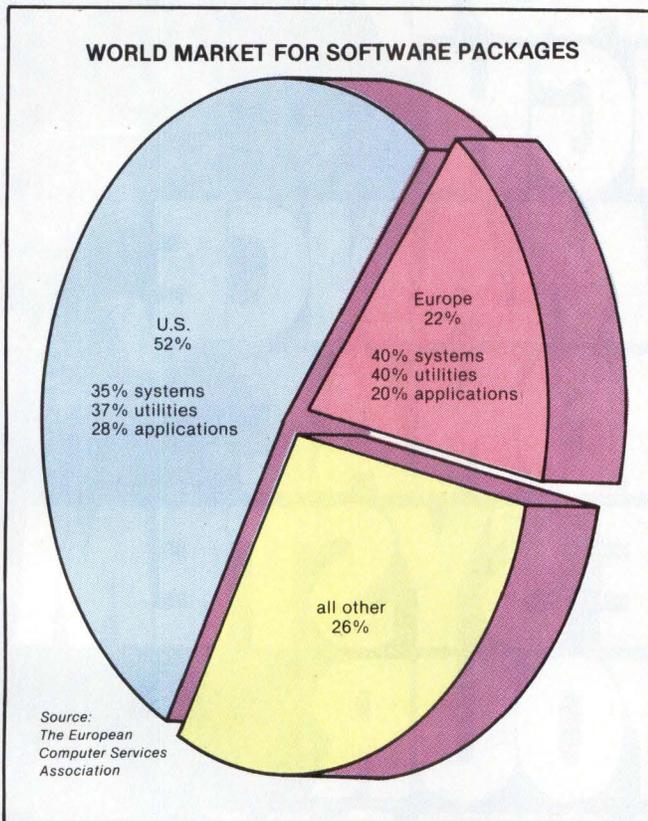
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Software packages that lend themselves to export are systems and utility programs. Business application packages have the most difficulty crossing borders because regulations, business customs and even accounting practices differ widely among countries.

most expensive option, asserts Yves Revault d'Allonnes, marketing engineer for Compagnie Generale d'Informatique, Paris. His company set up a U.S. subsidiary, CGI Systems, in McLean, Va., to market a mainframe-based program generator called PAC. Even after the French parent company decided to launch the venture, "it took two years to study the market and find people," d'Allonnes comments. In addition, a year-long project was needed to translate the documentation and environment for the package.

Although such a large capital outlay was possible for CGI, which d'Allonnes describes as one of the biggest French software houses, it may not be possible for small firms. It may also be impractical unless the potential return is high enough—either through a product's high price or through high-volume sales, says Philippe Levi, a delegate to the European Computing Services Association, a 14-country trade group. Levi is also international development manager for computer services company Compagnie Internationale de Service en Informatique (CISI), Paris. He believes high initial

cost explains why so many European companies selling software successfully in the United States base their business on expensive products, very often on large packages for mainframes. Start-up costs alone can keep a low-priced product on the other side of the Atlantic forever.

A less costly option is working through a U.S. distributor. Levi says that CISI is considering this method for marketing one of its products in the United States. The product—a software package for electronic-circuit simulation that runs on a small Digital Equipment Corp. VAX, for example—sells for about \$40,000 in France. As Levi sees the situation, CISI would have to invest money to investigate the market, translate the program, prepare documentation and training programs and distribute updates to the package. "Say you give the distributor one-third," Levi explains. "You have to decide whether the profit margin will be worthwhile."

Working with hardware firms is popular

The option requiring a software house to make the least investment is for the company to work with a hardware manufacturer, either through a joint marketing agreement or by having a product listed in third-party software catalogs. Dallas Kirk, a manager at DEC's European headquarters in Geneva, Switzerland, describes DEC's Qualified Software Program as an effort to encourage such relationships. Although the program is less than a year old, a catalog available to DEC equipment users has already been published.

Other than listing products in the catalog, DEC negotiates its relationship with each software house. A contract might specify joint marketing or a commitment by DEC to help with translation. "Generally, the third party would translate," Kirk says. "If a product is very attractive, we would probably do it," he adds.

Some European software houses complain that DEC's promise to help them reach an international market—particularly the U.S.—is empty. "DEC Europe doesn't have the reputation for marketing European software in the United States," comments Michel Benveniste, marketing director of software house DIAL, Annamasse, France. DIAL developed a production-control package that runs on the DEC VAX and computers from Philips and Texas Instruments Inc. Benveniste believes that his contract with DEC typifies many others; it includes listing in a catalog, but no advertising help.

Several other hardware manufacturers, including TI, Hewlett-Packard Co. and Apollo Computer Inc., have programs with European software houses. Some software packages are listed in catalogs of several hardware manufacturers.

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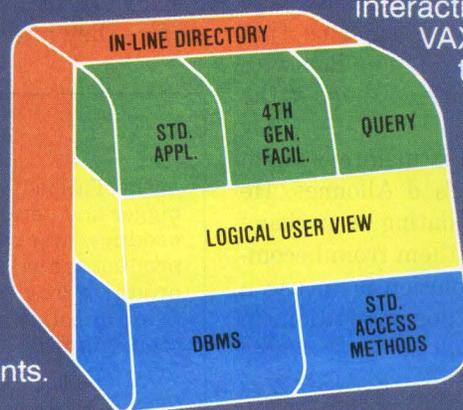
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The Interpreter

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Translating manuals costs a bundle

A major expense for many European software companies is translating products into English—an area in which British companies have an obvious advantage. The magnitude of a project depends on the software package, says Quantum Science's Stevenson. He calls translating prompts and base documentation "minimal" for a utility and "significant" for a database-management system—a systems package. For an application package, it requires translating "very detailed instructions on usage," he explains.

Some companies in continental Europe also find it worthwhile to write products in English. Products developed by Software AG, Germany, are written originally in English, says Mike Gallagher, a marketing manager for the company's U.S. arm, Software AG North America, Reston, Va. Software AG's Adabase, one of the leading U.S. database-management packages for mainframes and available in a version that runs on the DEC VAX, was developed in Germany for the international market, Gallagher says. "From the first, the documentation is in English."

However, if translators aren't fluent in idiomatic U.S. English, a further translation, or Americanization, may be necessary. "Documentation is normally sent to us in English, and we translate it into what we call 'American English,'" says Kathleen Meserve, a marketing executive at Matra Datavision, Burlington, Mass. The company's parent, Matra S.A., Paris, does all software development, documentation and subsequent translation for the Euclid 3D solids-modeling graphics package that runs on the DEC VAX. Meserve explains that several members of the technical staff, familiar with both the product and U.S. idioms, work out bugs in the translation.

"Translation is a problem, but so is maintenance of two versions of a product," says CGI's d'Allonnes. He believes the biggest danger in updating a package available in two versions is keeping them from becoming two separate products. CGI's solution is to use a bilingual documentation team. "All documentation, in both French and English is simultaneous," states d'Allonnes.

Support is key

When selling European software, availability of support in the United States is perhaps as important as the product itself, admits Alice Taylor, sales manager for Uniras Inc., Woburn, Mass. Uniras is the U.S. representative for European Software Contractors (ESC), Copenhagen, Denmark, which makes a 3D graphics package that runs on minicomputers. The company has

exhibited the package at U.S. graphics trade shows for two years. "The response to the graphics has been very good," says Taylor, "but the response to dealing with a European company hasn't been so great."

Taylor estimates U.S. sales at only 10 percent of the total for the product. The DEC VAX third-party software catalog and the Apollo Domain application software catalog list the package, but neither implies support. To increase U.S. sales, ESC plans a larger U.S. organization. The people who can support the software best are those who wrote it, observes Taylor. Although they're in Denmark now, ESC will send one of them to the United States, "in the very near future," she says.

Having a specialist in the United States for software support is one of the ground rules in this business, maintains John E. Forge, president of United Software Systems and Services Corp. (U3S), Los Angeles. The U.S. representative of several French software houses, U3S "handles the Americanization of a product," Forge says, including producing documentation. But the French company must send a specialist who can stay in the United States until all problems are solved.

Product developer Groupe SYSECA, St.-Cloud, France, will supply a permanent specialist for U3S's biggest product, the Clio database-management system, which runs on mainframes and DEC's VAX. Filling this position now is one of Clio's designers. Forge contends that customers cannot get needed support unless the company provides a permanent U.S. specialist. He claims U3S has a very good relationship with customers, who don't mind the fact that the product is French. He adds, "As long as we can give the good service they are expecting, there is no limitation." □

PERIPHERALS DIGEST

The Fall edition of MMS's Peripherals Digest is bigger and better than ever. It combines staff-written product/market overview articles with MMS-style product tables covering more than 1500 peripheral products from roughly 500 companies put together from questionnaires distributed and compiled by MMS editors.

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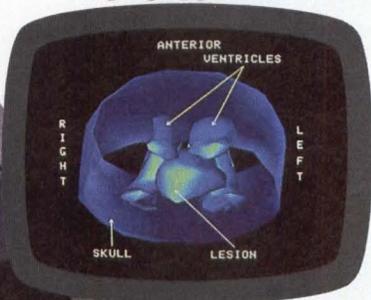
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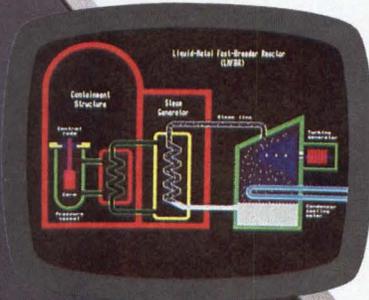
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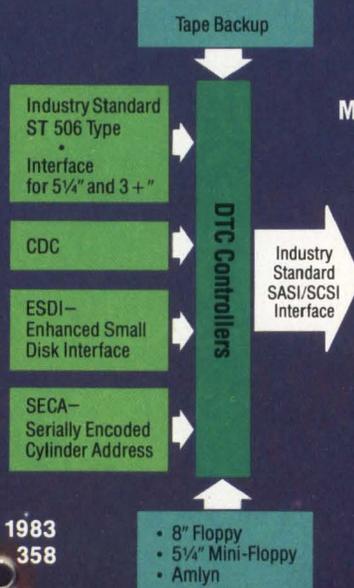
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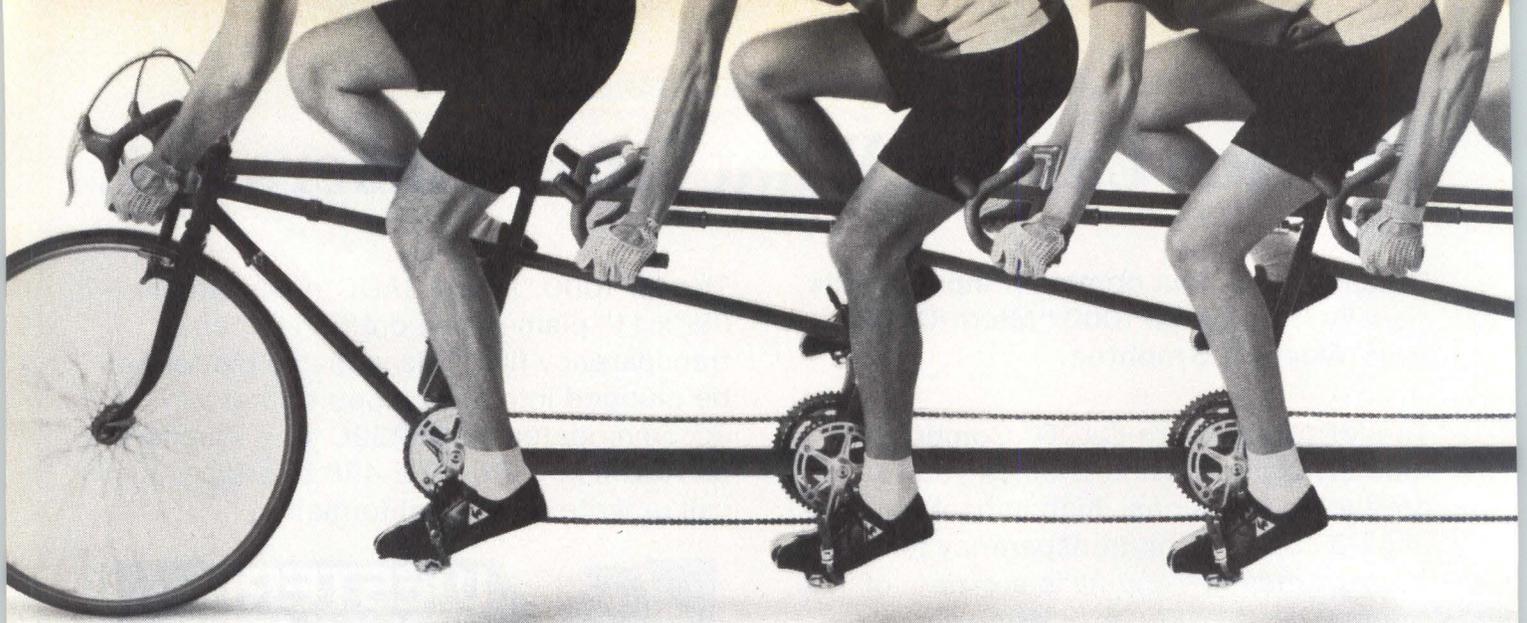
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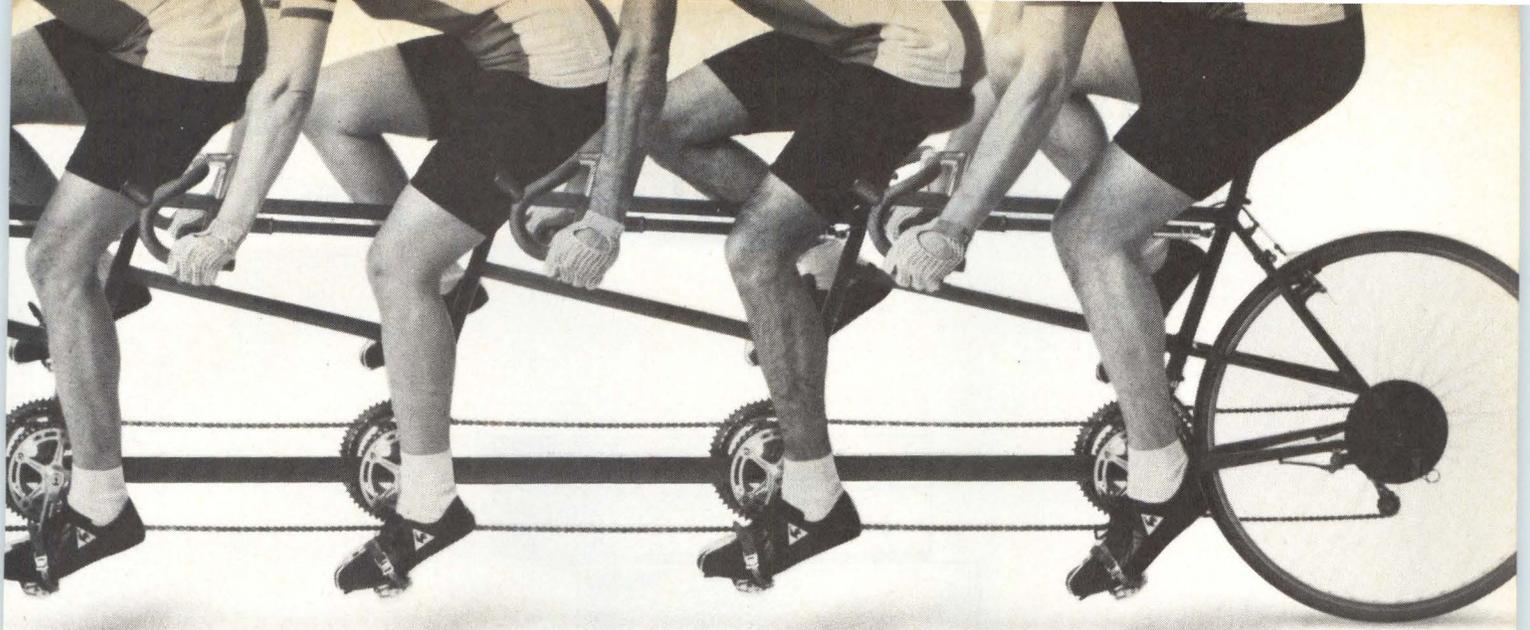
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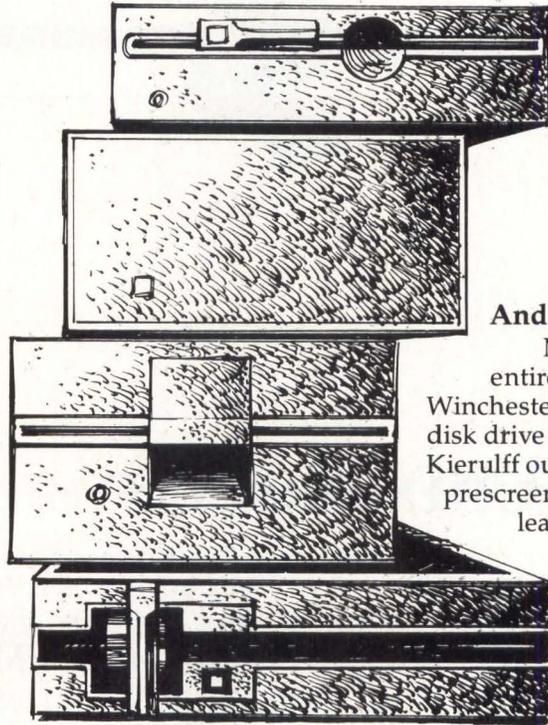
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CIRCLE NO. 73 ON INQUIRY CARD

The Interpreter

Communicating with computers in English: the emergence of natural-language processing

By Dwight B. Davis

Despite the plethora of computer products that attempt to exude "user friendliness" to attract non-technical buyers, people must still interact with their machines using highly structured, computer-imposed techniques. Even products that allow the use of standard English words to communicate with computers typically require that only specific words be used in specific formats. The ability of computers to accept information in English sentences is increasing, however, as techniques for natural-language processing begin to move from research laboratories into the commercial world.

As it has often done in the past, IBM Corp. is providing the clout to lift a relatively obscure technology into a secure market position. IBM administered its shot of adrenaline to natural-language processing this June by signing a contract to market Intellect, a product developed by tiny Artificial Intelligence Corp. (AIC), Waltham, Mass. Intellect translates typed English requests into formal database query languages, locates and organizes the requested information and presents its findings to a user. Even if requests are written in diverse ways, Intellect can respond to them.

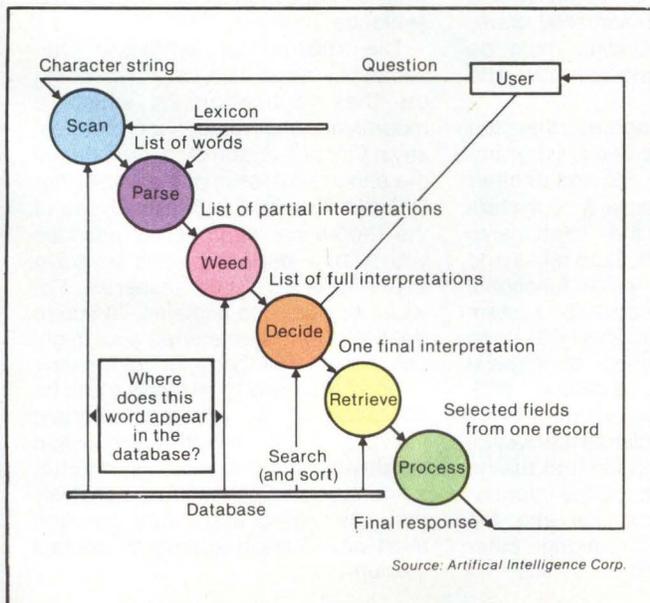
Since its introduction in early 1981, Intellect has been installed in about 150 sites. Other companies, including Cullinane Database Systems, Honeywell Inc., Informa-

tion Sciences and Management Decisions, also sell the Intellect software, along with AIC and IBM. AIC president Larry Harris says marketing Intellect "has been a missionary sell from day one. But with the IBM arrangement, it's now accepted."

IBM or no IBM, other companies are poised to enter the natural-language market. Two of the most active are Cognitive Systems Inc., New Haven, Conn., and Symantec, Sunnyvale, Calif. Several large companies, including IBM, Xerox Corp. and Hewlett-Packard Co., are also researching natural-language, but none will comment on when products based on this research will appear.

Core artificial-intelligence technology

Because many industry observers expect wide application of natural-language interfaces to computers, they consider natural-language processing a fundamental technology within the realm of artificial intelligence. Aside from querying databases, natural-languages can also be used in machine translation and for interaction with "expert" systems—computers programmed with knowledge from a human expert, including the processes by which the expert reaches conclusions. Flexible natural-language interfaces with such systems would make them more accessible to a wider range of users.



Intellect's data-flow diagram illustrates the processing steps through which each user request passes. The request character string is broken into word pieces by the Scan function, which relies on information from both the lexicon and the database. The Parser takes these words and grammatically diagrams the sentence, passing on as many possible interpretations as it can generate to the Weed function. Weed, the first step in determining the correct interpretation from the several that may exist, attempts to "fill in the holes" of the partial interpretations. Any interpretations that emerge as complete thoughts that have some relationship to the database pass to the Decide process. Decide attempts to choose the proper interpretation based on preference values that have been generated for each completed thought. Preference values are based, in part, on the respective difficulties the system had in collecting the data required to generate complete interpretations. If Decide has difficulty in choosing the final interpretation, it first uses the database to resolve the question; if this approach fails, Decide queries the user for additional information. Once the final interpretation is processed, the requested data is retrieved from the database and is then organized and displayed to the user.

The Interpreter

Although the outlook for natural-language systems is bright, those now available do not approach human language comprehension. Natural-language processing falls at the intersection of many disciplines, including

computer science, linguistics and philosophy. Advances in all these fields must occur before the comprehension capabilities of computers can surpass a rudimentary level (see "Turning computers into linguists," below).

TURNING COMPUTERS INTO LINGUISTS

If people had to comprehend all the complex methods and background information of natural language, few people would have much to say. Researchers in natural-language processing only partly understand the techniques and information speakers routinely employ in communication, which involve all the senses. A multitude of language-comprehension theories exist, many of which are supported by the mathematical algorithms required to implement the theories on computers. Companies entering the natural-language processing market must choose from the available approaches the techniques they will implement in their products.

There is no universal agreement on categorizing elements of language understanding. But most computational linguists cite syntactics (syntax), semantics and pragmatics—three overlapping areas that must be addressed before full comprehension can occur. **Syntax**, the study of word placement and sentence structure, is the most widely researched and best understood of the three elements. **Semantics**, the study of meaning and relationships, is less evolved but plays a leading role in some natural-language processors. **Pragmatics**, the study of the use of language under widely varying circumstances, is still embryonic in computer implementation.

Most natural-language systems consist of a mix of syntactic and semantic rules that typically work independently of each other. For instance, a system might first syntactically parse a sentence in several ways and then apply semantic rules to each parse to determine which interpretation is correct. Although this method can work, it can also waste time and computer resources, comments Ron Kaplan, a research scientist involved with natural-language processing at Xerox Corp.'s Palo Alto Research Center

(PARC). "Having the syntactic and semantic processing separate can result in certain inefficiencies," Kaplan observes. "If you don't do the semantics on the fly as you're doing the syntax parsing, you're liable to accept bad analysis paths in the syntax," he explains. "You can do a lot of work on these bad paths only to discover later, when you apply the semantic constraints, that it was total nonsense."

One type of language processing—semantic grammar—combines syntactic and semantic constraints. Symantec, Sunnyvale, Calif., is expected to employ semantic grammars with its future software products, but company spokesmen decline to comment on the techniques they are using. One problem of semantic grammar, says Larry Harris, president of Artificial Intelligence Corp. (AIC), Waltham, Mass., is that it necessitates writing a new grammar for each application within which a system operates. For example, one word might have different meanings in different application domains, and, because syntax and semantics are so closely intertwined in semantic grammars, the entire package must be reworked to accommodate new and unusual meanings.

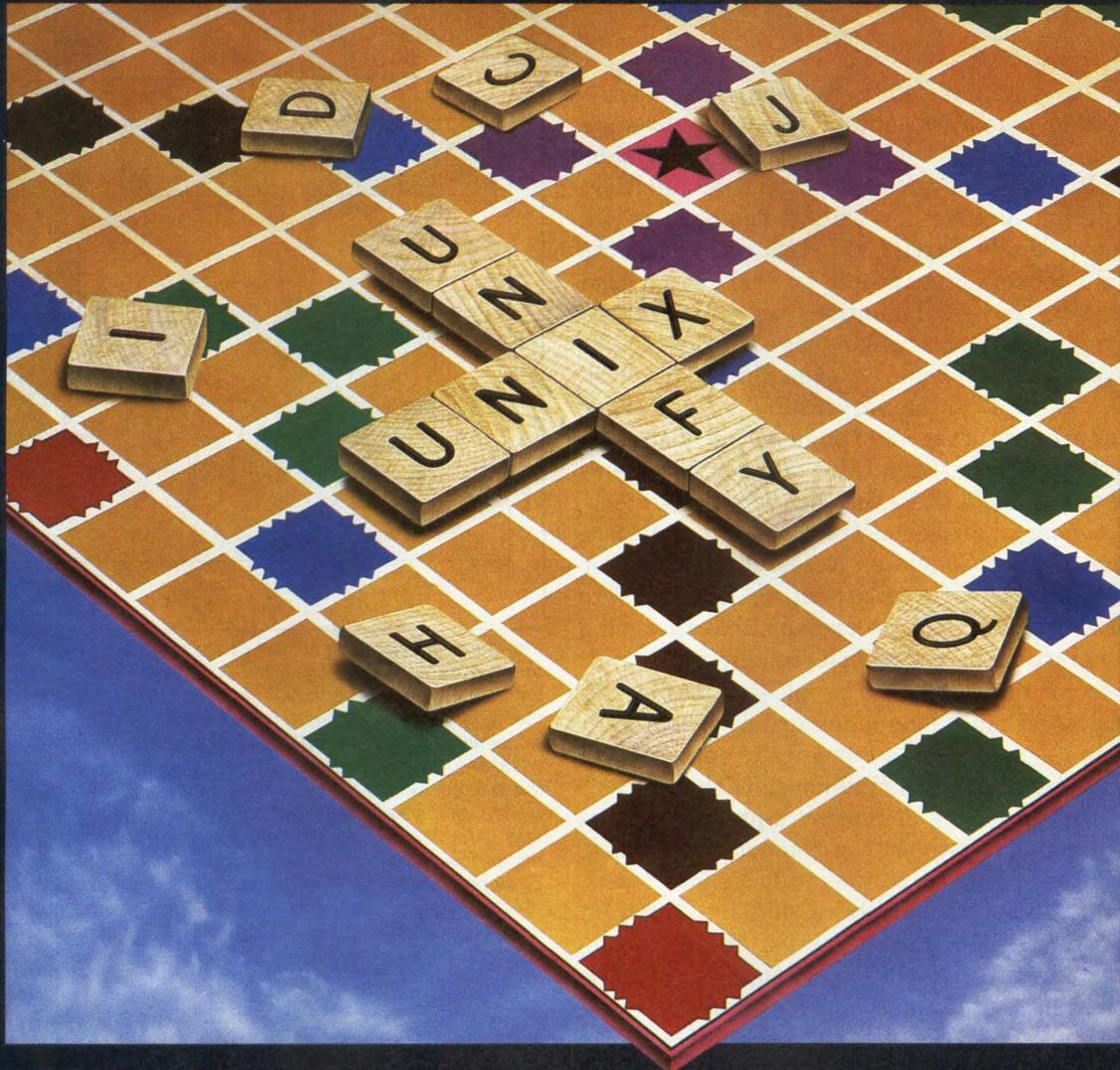
Xerox's Kaplan agrees that the domain specificity of semantic grammars is a drawback. He and another researcher have devised a system that better maps the relationship between the form language takes and its meaning. Called "lexical functional grammar" (LFG), Kaplan's system "combines the advantages with none of the disadvantages" of several existing approaches, he claims. "With LFG, a user can take a grammar of English and the selectional (semantic) restrictions of a database and run an algorithm that distributes the information about the semantics into the syntactic grammar." Among other benefits, this algorithm avoids the

need to handwrite a new grammar everytime a database is changed, Kaplan comments.

Disagreement still exists, however, about whether syntax should be emphasized more than semantics. Cognitive Systems Inc., New Haven, Conn., doesn't use grammar or syntax in its programs, claims Abraham Gutman, assistant vice president. The company's products are based on an underlying theory of "conceptual dependency representation" developed by company president Roger Schank. This theory essentially categorizes events and actions into a few "primitive" acts and scripts of situations, producing a conceptual representation of a sentence's meaning.

Many participants in natural-language processing question the purity of Cognitive Systems' semantic approach. "Roger's method is highly semantic," admits Harris, "but he uses more syntax than he's willing to admit." Kaplan agrees: "You must rely somewhat on word order and the organization of phrases to discover what semantic guidance there is in a sentence."

The mixture of syntactics and semantics must also vary depending on the application in which a natural-language processor operates, says Vincent Giuliano, a member of the senior professional staff at Arthur D. Little, Cambridge, Mass. "None of the theoretical approaches provides you with a perfect means to solve every problem," he asserts. For example, Giuliano explains, "If you're dealing with law material, you might ask 'Does that body of information support the notion that larceny can be attributed to a group of certain individuals?' Answering that question requires much deeper syntactic, semantic and contextual analysis than answering a geology question such as, 'Does that mineral contain calcium?'"



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CIRCLE NO. 74 ON INQUIRY CARD

The Interpreter

To a layman, Intellect's ability to answer a request—such as “Would you please subtotal all salaries by state for people in the West?”—might imply that the system can equal human comprehension, comments Barbara Grosz, program director for natural language at SRI International, Menlo Park, Calif. But this is not the case. “It's important for people to understand that there are very severe limitations on what can be provided right now in natural-language interfaces,” she asserts. While Grosz believes even limited natural-language interfaces can be very useful, she cautions, “Such interfaces require a lot of engineering of all sorts to ensure that their constraints don't cause the systems to fail in ways that will make the user very frustrated.”

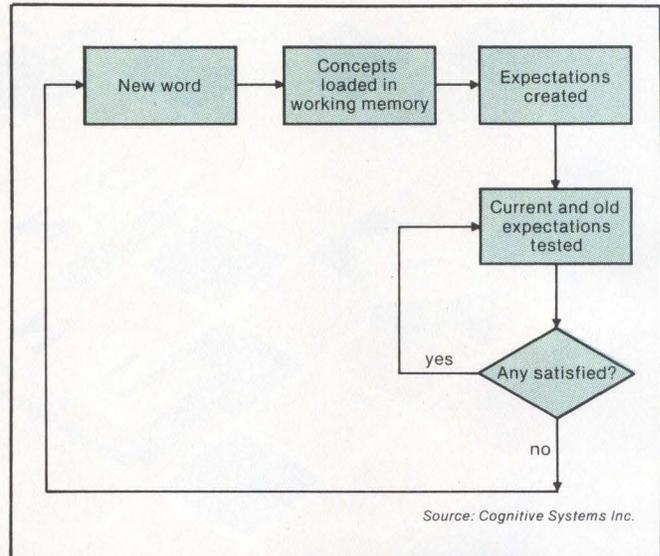
Egon Loebner, manager of the Cognitive Interface Department in HP's Computer Research Center, Palo Alto, Calif., uses the term “quasi-natural languages” to describe today's products. He explains that through a natural linguistic process people readily alter their language to communicate with people—or machines—that don't possess much language capability. “An adult speaking to a child will automatically simplify his language to conform to a mental image of the hearer,” he says. Likewise, users employing a product such as Intellect to communicate with a computer will easily adapt their use of English to the product's limitations.

Although it's easy for people to shift into different “registers” of English, Loebner says, “People sometimes forget themselves and expect the system to be smarter than it is.” If this happens regularly, what appeared to be a very flexible and useful system can become disappointing and frustrating.

Intellect: keeping users happy

Harris at AIC says an acceptable natural-language system must correctly answer users' requests “well over 90 percent of the time,” and he claims Intellect easily meets that requirement. Failures do occur, primarily because users sometimes pass the boundary of Intellect's functionality, but Harris notes, “No one cares why it doesn't work. When people sit down to use the system, it's got to deliver.”

Like all natural-language systems now available or in development, Intellect operates within relatively narrow domains. The system consists of fundamental grammar rules that work in conjunction with a parser, which resolves sentences into their component parts of speech. On these basic elements, each user writes a lexicon—a dictionary of relevant terms and data corresponding to the database to which Intellect must interface. The lexicon establishes the boundaries of Intellect's functions.



Source: Cognitive Systems Inc.

The general operation of text processing on a Cognitive Systems Inc. natural-language system begins when a word from a sentence enters the working memory. The word may at this point have several meanings based on concepts associated with the system's model of a domain and on stored definitions of the word. Given particular situations, the system expects to come across certain words, and these expectations help resolve the meaning of ambiguous words. In testing, the system essentially asks itself, “Have I heard something I was expecting to hear?” Every time the answer to this test is “yes,” the process returns to the testing box with this new knowledge. Equipped with this knowledge, other expectations can now be realized, and the testing cycle continues until no new expectations are fired. At this point, the system pulls another word from the sentence for examination.

Harris claims that having each user write his own database lexicon is the key to marketing the system off the shelf. Writing Intellect's lexicons is simple enough for non-linguists, he asserts, and, as a result, Intellect's market is very broad. “We're in the business of selling software—not technical services,” he notes.

Although some perceive Intellect as nothing more than a product that translates English queries into a database-query language, Harris sees the product actually doing much more. “If all you do is translate into a formal query language, then you're limited to the functional capabilities of the underlying system,” he explains. Currently, Intellect can interface to several mainframe database systems of varying capabilities. AIC set a required operational level for Intellect to ensure consistent performance. “If the database system provides the functions we need, fine,” Harris says. “If not, we provide them as part of Intellect.”

Intellect can also interface simultaneously with multiple software systems, acting as the hub among them. A single request might require Intellect to use the capabilities of several systems. For example, the re-

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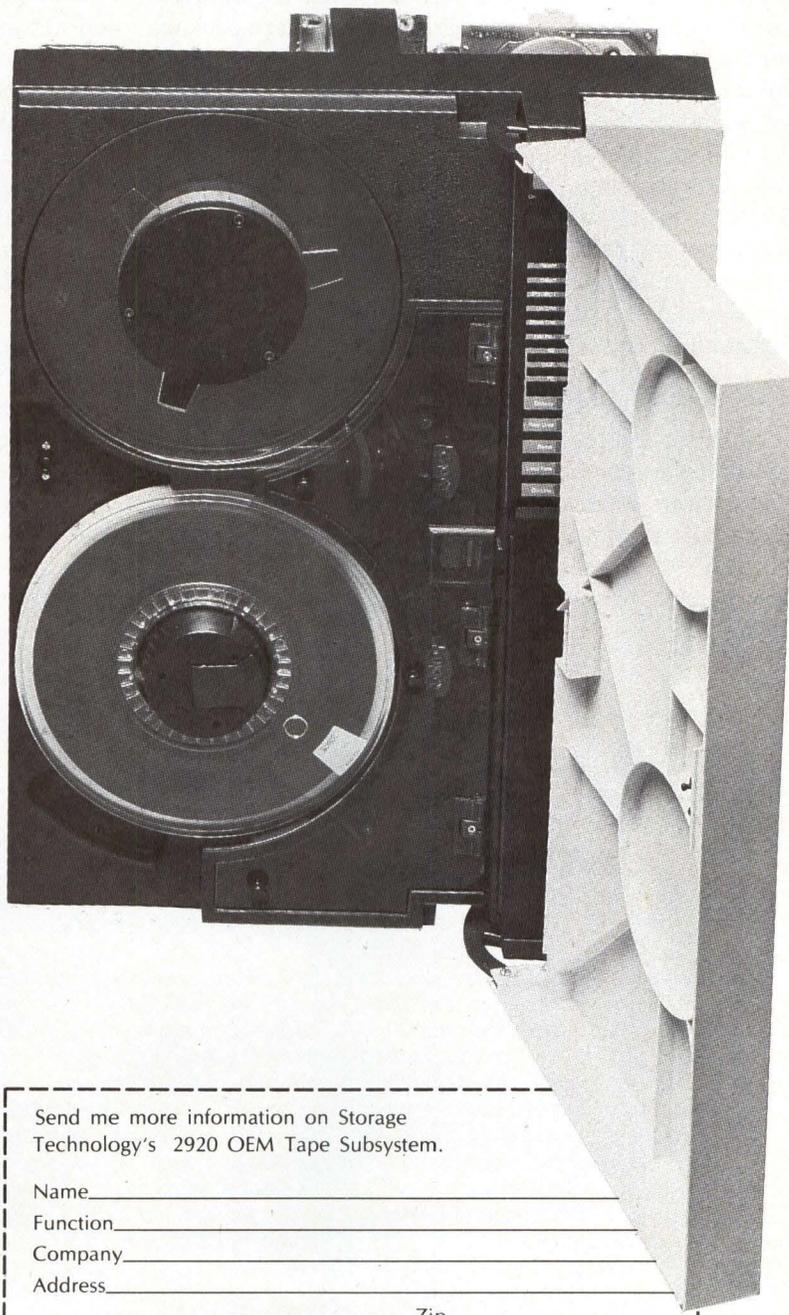
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MINI-MICRO SYSTEMS/ October 1983

CIRCLE NO. 75 ON INQUIRY CARD

The Interpreter

quest "Draw me a bar graph comparing the 1981 actual sales with the 1981 estimated sales by region" would require Intellect to obtain the sales information via the database-query language and then format the information for presentation using a graphics software package running on the system. AIC also plans to offer interfaces linking Intellect with financial-modeling and statistics software.

Intellect also questions ambiguous user requests before processing. Harris explains that the system performs many parsings of a sentence rather than accepting one as correct. Multiple parsings help Intellect determine whether more than one interpretation of a sentence is possible. In such cases, Intellect requests further information from a user to avoid the ambiguity.

Scaling down to microcomputers

Most natural-language systems, including Intellect, run on large-scale computers. But the nature of natural-language processing—its ability to let non-technical users interact with computers—makes it very attract-

ive to the microcomputer market. Some English-recognition methods that aren't true natural-language processing already exist at the microcomputer level (see "Pattern recognition interprets text," below), and AIC expects to offer a low-cost version of Intellect to the microcomputer market within 18 months.

Intellect now runs only on IBM Corp.'s 4300 and larger mainframes (except for one version that operates on Prime Computer Inc.'s superminicomputers). It requires approximately 0.75M to 1M byte of memory for the load module. Still, Harris believes Intellect will not have to sacrifice much of its power to run on microcomputers. He notes that large-volume sales will help cut the price—now \$70,000—and points out that microcomputers work with fewer and less-complex data than their mainframe counterparts. Nevertheless, Harris says, "I don't want to downplay the amount of technological shoehorning it will take to get Intellect down to the level of 16-bit microcomputers."

Symantec, a spin-off of Machine Intelligence Corp., also plans to apply natural-language processing to

PATTERN RECOGNITION INTERPRETS TEXT

Savvy, a microcomputer software product from Excalibur Technologies, Albuquerque, N.M., seems to perform natural-language processing. For example, the system might recognize the two requests, "List employees" and "List all of our employees" as equivalent and process each correctly. To analyze these sentences, however, Savvy uses pattern recognition of the sentences' bit streams, not grammatical rules and lexicons. "Savvy doesn't attempt to understand language; it just allows you to predefine commonly used sentences," explains Larry Harris, president of Artificial Intelligence Corp. (AIC) "As such, Savvy doesn't qualify as a natural-language system."

Excalibur founder Nelson Winkless, now a consultant to the company, admits, "What we are doing is offensive to good taste and morals if you're a traditionalist." Nevertheless, he says, Savvy is a very useful product at its price. Three versions—all running on Apple Computer Inc. microcomputers—are available at \$349, \$495 and \$950. The \$950 version includes various business applications. An IBM PC version of

Savvy is planned for release this fall.

Winkless explains that Savvy leaves the factory with some fundamental skills, and users teach the system additional information pertinent to each application. To teach Savvy, a user inputs English (or other language) requests that the user might expect to employ in querying the database. Savvy stores the sentences, and, when the user types in a request, Savvy compares the bit-stream pattern of the request with the bit patterns of sentences in its memory. "We've set Savvy up so that it can make measurements, whatever they are, in hundreds of dimensions," Winkless says.

Savvy also has an "Associate" function that lets users specify that some phrases with different patterns are synonymous. "We can tell it to associate the phrase 'Who works here?' with the phrase 'List employees,'" Winkless says. Furthermore, if a user writes a request containing elements from both phrases, such as 'Who are the employees?' Savvy recognizes the pattern relationship and responds correctly.

"We provide Savvy with the means

to tell one thing from another," Winkless remarks, "but we really don't understand how it does what it does." Because Savvy can classify and compare patterns in so many dimensions, it's almost impossible to trace the route that the system follows in processing requests, he explains. Because Savvy employs pattern recognition rather than specific language rules, it can work equally well with foreign languages and speech and image patterns, Winkless asserts.

However, Savvy's approach has one drawback, contends AIC's Harris. Unless a user trains it in great detail, Savvy might not distinguish between phrases such as "List employees" and "List female employees." Teaching the system each phrase avoids obvious areas of potential confusion, but Harris maintains that it's very difficult to foresee, or program, all the requests a system might encounter. "Pattern recognition is an important part of natural-language processing," Harris observes, "but it's only the first level, used to smooth over rough data coming in. Beyond that, you have to look at how words interact."

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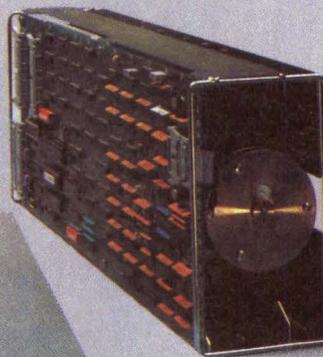
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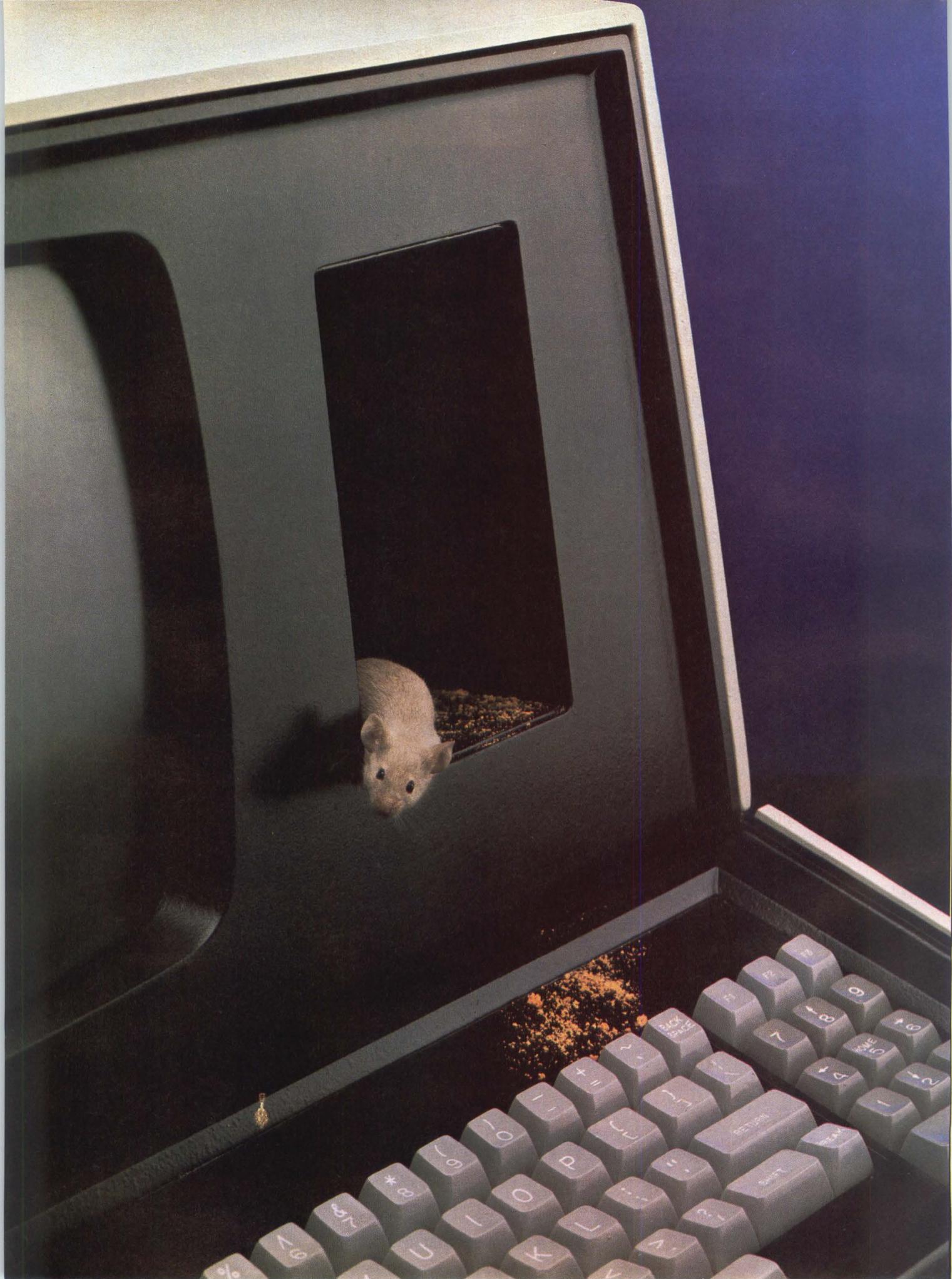
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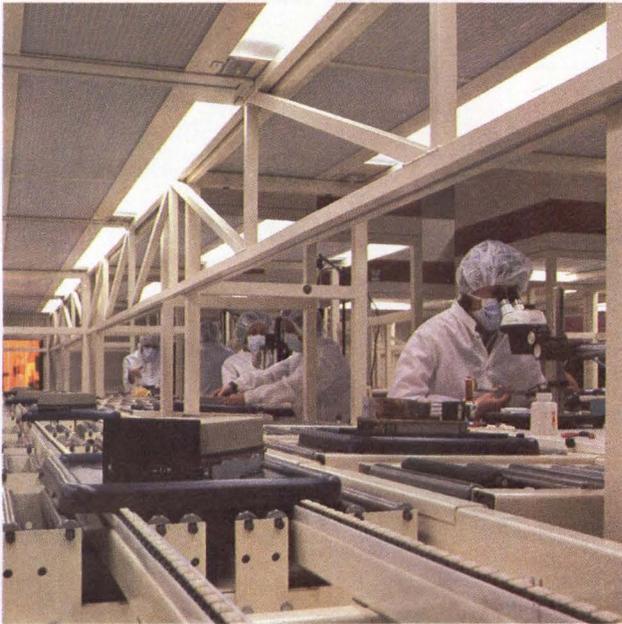
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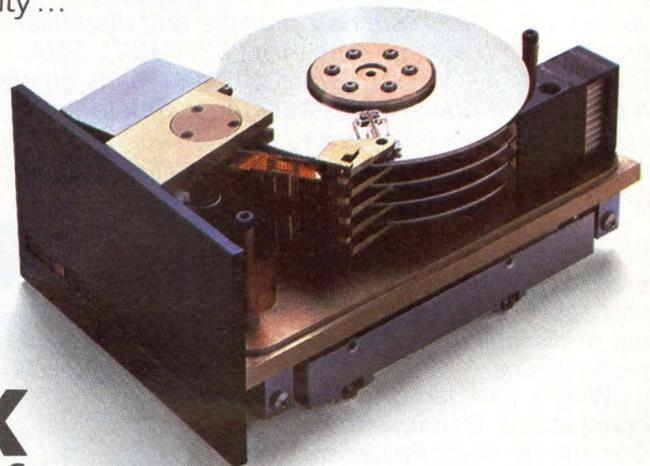
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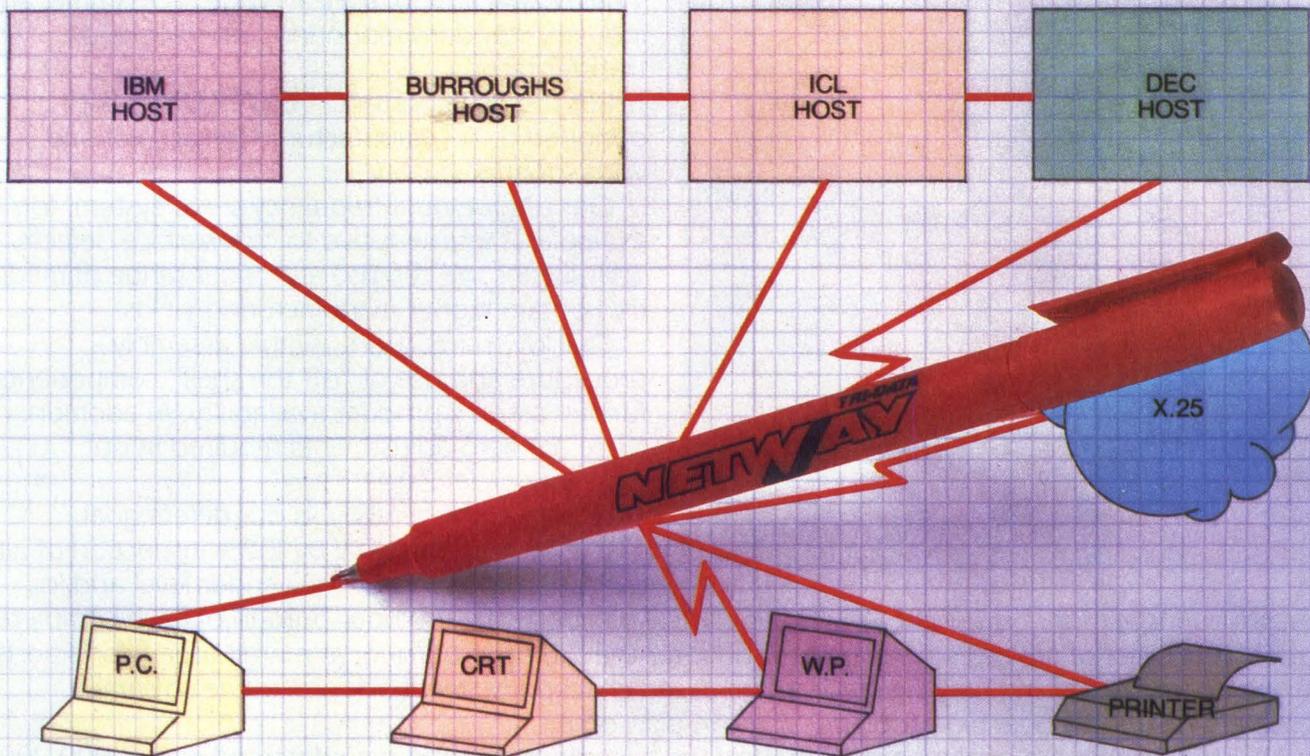
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The Interpreter

microcomputers. Like many software vendors, Symantec is targeting the IBM Personal Computer for its products. Symantec president Steve Shank expects a software product incorporating various elements of artificial intelligence to be available this year.

Gary Hendrix, vice president of research and development and chairman of Symantec, says the company can produce natural-language systems for microcomputers because much of the "black magic" of such processing has been reduced to well-understood theories and algorithms. "For years, the question has been 'Is there any solution at all?'" Hendrix says. He notes that the search for solutions required large computers, but, now that some partial solutions are known, it's feasible to optimize those solutions to run on smaller machines.

Hendrix believes database query is the largest short-term market for natural-language products. He says natural-language shells could also be written around operating systems such as UNIX, which users view as unfriendly. He believes that the ultimate use of natural languages on computers will be with systems similar to KLAUS (Knowledge Learning and Using System), under development at SRI. KLAUS has elements of expert systems and can serve as a broker between a variety of systems and resources, including users of natural languages. "This broker will have to have knowledge about what each of the other systems knows about," he explains, "so it will have to have knowledge of knowledge."

Modeling the domain

The third vendor planning near-term activity in the natural-language market, Cognitive Systems, claims to be building systems that have extensive knowledge about the domains in which they operate as well as knowledge about language. Cognitive Systems' products will include both natural-language front ends for database query and "advisory" systems that advise users on specific topics. The company's systems are based on the work of Cognitive Systems president Roger Schank, who also works at Yale University. Schank's work emphasizes the meanings of words rather than their syntax. Because the systems focus on the domain representation, they avoid complex syntax rules, explains Abraham Gutman, assistant vice president of Cognitive Systems.

Modifying systems employing a number of syntax rules can be difficult. AIC's Harris admits that changes to Intellect's grammar rules can cause unanticipated problems. "It's like the classic problems with COBOL bugs," he says. "You fix one bug and introduce 10

more." Still, Harris notes, now that Intellect's grammar is stable, one version meets every need with an appropriate user-written lexicon. Harris observes that Cognitive Systems' approach requires that high-level customization be done by experts employed by Cognitive Systems. Customized systems, he adds, run a greater risk of introducing errors each time they are built.

Gutman says Cognitive Systems is interested in forming joint ventures with companies such as banks and insurance companies, which have expertise in their own domains. "We would produce products jointly with these companies and share royalties gained from marketing the products." Advisory systems already in development include TIBS (The Ideal Business System) and a financial portfolio manager. Gutman estimates that prototype systems from Cognitive Systems could cost \$250,000 to \$400,000. The systems run on computers such as Digital Equipment Corp.'s VAX-11/780 and -11/750 and products from Apollo Computer Inc.

Academic research vs. market realities

The companies developing natural-language products have close ties to academia, from which many employees come. And much of the corporate research in this field is done in close conjunction with university personnel. But some differences exist between the companies and the scientists. Company staffs want to build useful devices from the available technology, while research scientists occasionally scoff at available products' limitations, given the power that natural-language systems may someday provide.

Grosz at SRI explains that research scientists' lack of interest in commercial products is in part understandable because products appearing on the market are based on technology at least 5 years old. "The commercial people, of necessity, have to stop at some point, take a particular technology and say, 'OK, what can we do with this?'" she says.

However, Grosz cautions, "It would be an enormous mistake for the two communities to be isolated." The vendors must keep up with research advances, she contends, and it's also important for the academic community to be aware of vendors' problems.

Symantec's Hendrix dismisses any academic queasiness about the shortcomings of the current generation of natural-language products. "If we wait for perfect systems that can communicate in natural language as well as people can, we'll be waiting forever," he remarks. "Cars can't fly, so I suppose they're not the perfect transportation vehicle. But we still seem to be able to find enough uses for them." □

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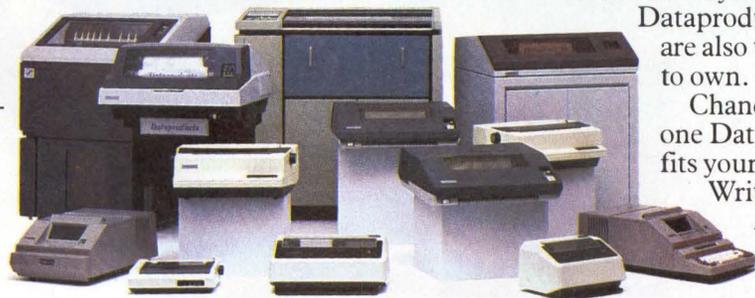
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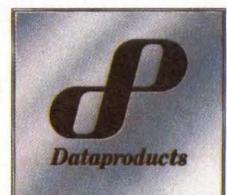
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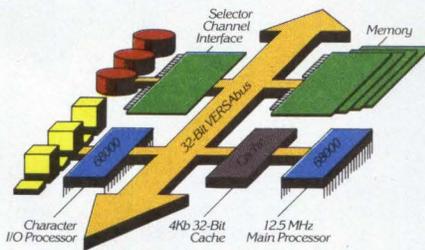


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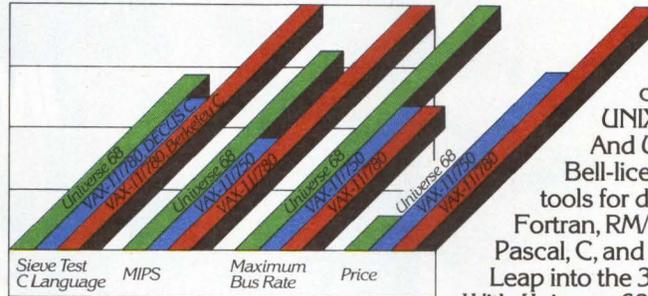
The Universe 68/05 is a true 32-bit system because it handles 32-bit data transfers in parallel on its 20Mb/sec VERSAbus, while most 68000-based machines are still limping along with 16-bit buses. With the next generation of processors (like the MC68020), a full 32-bit bus will be a requirement on *all* systems. VERSAbus is there now, and it's non-proprietary.



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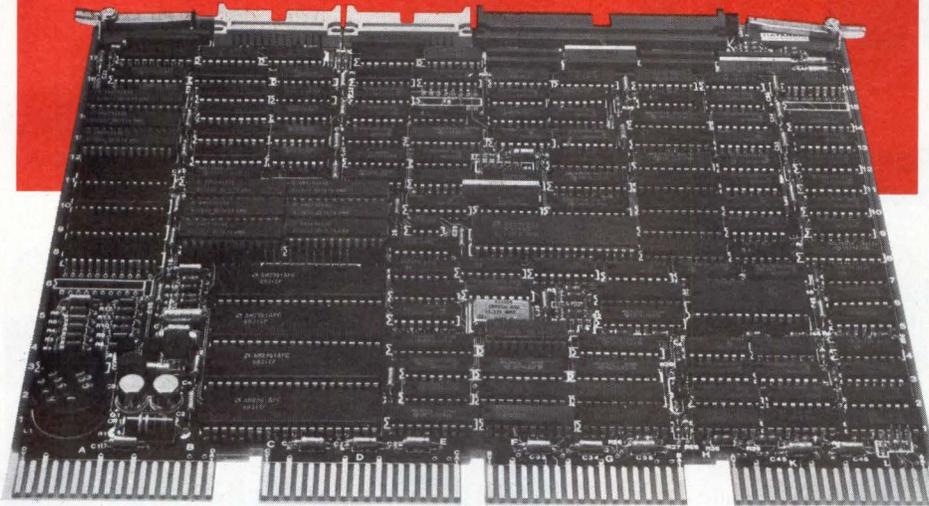
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T04/C	Mag tape streamer coupler	TM11/TU10
T04/N	NRZI mag tape controller	TM11/TU10
T04/D	Dual density mag tape controller	TM11/TU10
T34/C	Mag tape streamer coupler	TM11/TU10
T34/N	NRZI mag tape controller	TM11/TU10
T34/D	Dual density mag tape controller	TM11/TU10
T36	Dual density mag tape controller	TM11/TU10
T34/T	GCR mag tape controller	TM11/TU10
S03/A, S04/A	80 MB/300 MB SMD controller	RM02/RM05
S03/A1, S04/A1	80 MB/160 MB SMD controller	RM02
S03/B	80 MB/300 MB SMD controller	RK07
S03/C	200 MB/300 MB SMD controller	RP06
S03/D, S04/D	96 MB CMD controller	RK06
S33/A	80 MB/300 MB SMD controller	RM02/RM05
S33/A1	80 MB/160 MB SMD controller	RM02
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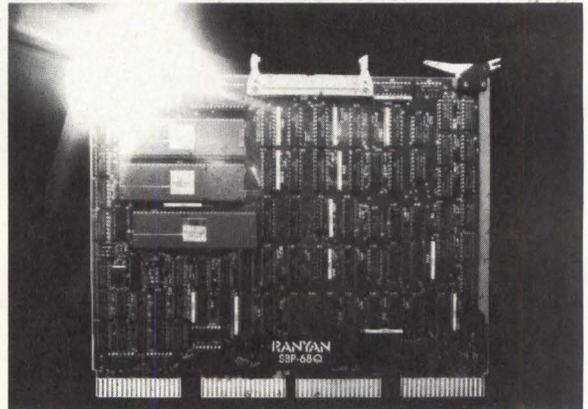
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CIRCLE NO. 83 ON INQUIRY CARD

MINI-MICRO SYSTEMS/October 1983

The Interpreter

GSA modifies acquisition procedures to accommodate growing demand for micros

By Stephen J. Shaw

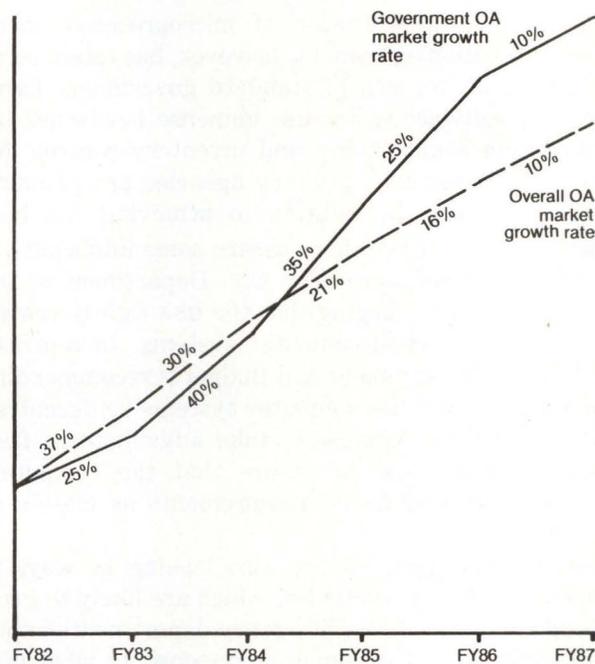
The federal government has lagged behind Fortune 1000 companies in embracing office-automation technologies, but that's about to change thanks to impending volume purchases of minicomputers and microcomputers by several government agencies. According to the General Services Administration (GSA), the number of general-purpose computers installed in federal agencies will grow from about 18,000 systems today to about 1 million by the end of the decade. To better accommodate the expected influx of low-cost computers, the GSA is instituting new procurement procedures, including the use of a procurement schedule specifically for microcomputers and the opening of commercially operated computer stores at various GSA facilities.

Federal government purchases of automated office equipment, including word processors, microcomputers and professional workstations, should swell to approximately \$575 million annually by 1987, more than double the anticipated 1983 level of \$240 million, according to International Data Corp., a market research organization (see graph, right). (Copies of IDC's report, "Federal Acquisition Strategies for Office Automation," can be purchased for \$1,500.) For further information, contact Whit Dodson at IDC, Suite 240, 1500 Planning Research Dr., McLean, Va. 22102, (703) 893-0833.

Signs of increased procurement activity are already apparent. In early July, the U.S. Army was preparing to release a bid solicitation for as many as 12,000 microcomputers for general office applications. The Army will purchase small standalone units, portable systems, workstations and multiuser office systems. The Army may award as many as five contracts for this purchase.

A spokesperson at the U.S. Army Computer Systems Selection and Acquisition Agency says the units purchased must be off-the-shelf models with prices ranging from about \$5,000 to \$16,000 each. The Army expects to make the first award in early 1984. The Army is also evaluating proposals for the acquisition of as many as 1,800 minicomputer systems. These systems will range in price from approximately \$80,000 to \$700,000, and the total value of the contract could reach \$720 million over the two-year delivery period. The Army will buy three classes of minicomputers, defined by the Army procurement agency as small, medium and large, and ranging in capacity from 256K to 2M bytes of

PREDICTED GROWTH IN FEDERAL OFFICE AUTOMATION SPENDING



Federal spending for office-automation equipment will grow from about \$180 million in fiscal year 1982 to approximately \$575 million in fiscal year 1987, according to figures from International Data Corp. The growth rate of government office-automation expenditures will soon surpass that of the total office-automation market, as the graph shows. IDC says there is already much office-automation procurement activity in the government, but because of the lengthy procurement process, much of this activity won't translate into actual expenditures until the 1984-85 timeframe.

CPU memory, with the ability to support one to 56 terminals. "We are selecting only one vendor for this buy to ensure the upgradeability of the units as our needs increase," says Mary Kelly, computer specialist with the Army's acquisition agency.

The U.S. Air Force and the U.S. Navy have combined to issue a bid solicitation on a mandatory contract for 6,000 microcomputers to fulfill, like the Army's machines, administrative applications. In addition, the Defense Logistics Agency has issued a solicitation for 800 microcomputers.

The GSA is responsible for tracking computer orders totaling more than \$10,000 and for authorizing procurements for orders worth more than \$300,000 (see "A

The Interpreter

procurement primer," Page 177). The GSA expects that the minicomputer systems and standalone microcomputers will be used for many of the same applications as their commercial counterparts, including payroll processing, personnel recordkeeping, database management, spreadsheets and word processing.

Standardization concerns

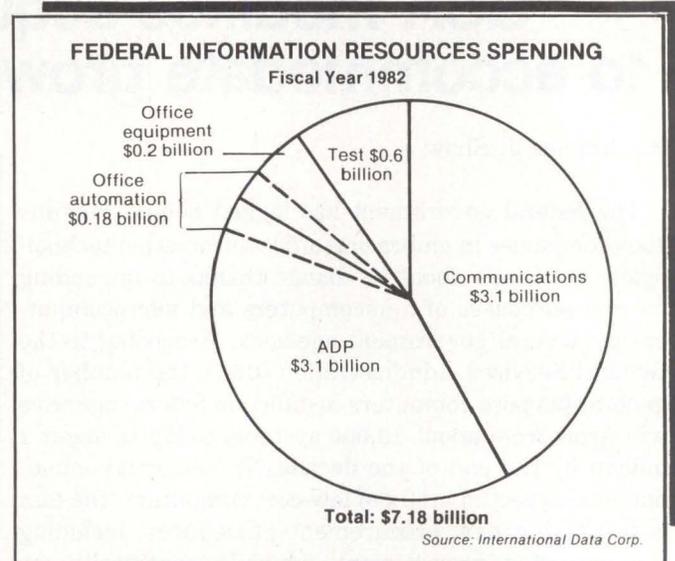
The coming proliferation of microprocessor-based office-automation equipment, however, has raised some concerns that the lack of standard government hardware and software will cause immense headaches for inter-system compatibility and inventory control. An important reason why military agencies are planning such large buys, in addition to achieving the best volume discount price, is to assure some uniformity of hardware and software. The U.S. Department of Defense is reportedly urging that the GSA tightly control procurement of small computer systems. In contrast, the Office of Management and Budget is recommending that selection of office computer systems be decentralized as much as possible to take advantage of fast-dropping prices and to ensure that the computers selected meet end users' requirements as closely as possible.

Government agencies are also looking at ways to manage software inventories, which are likely to grow beyond control as different agency departments implement various office-automation systems. In what may set a precedent for software contracts, the Army is reportedly negotiating with a software vendor for a single licensing fee to allow use of that firm's programs on any of the Army's computer installations. "There's likely to be too much incompatibility within software inventories if everybody had one of everything," observes Ike McKinney, GSA director of office information resource management policy. "The controls on equipment certainly won't be very effective."

New approaches to acquisition

The GSA has implemented a procurement schedule limited to microcomputers and a computer store at GSA headquarters in Washington, the first of a dozen planned for nationwide GSA facilities. Dealers in the Washington area branded the computer-store concept anticompetitive when it was announced this year (MMS, June, Page 32). But GSA officials believe the creation of commercially operated stores at government facilities is essential to its drive to introduce automated office equipment into the federal government.

In late June, the GSA announced the contract award for the first store, which projections estimate will



Federal office-automation equipment includes some products from the office-equipment expenditure segment and some products from the automatic-data-processing segment according to IDC. The office-equipment products typically consist of machines such as word processors that are designed primarily for clerical staffs. Products from the ADP-equipment category usually supply professional staff equipment, which often requires more machine intelligence than office equipment provides. IDC notes that for total accuracy, some of the communications section should also be included in office automation.

generate \$2.5 million in annual sales through walk-in business from federal employees. The successful bidder is The Math Box, a dealer in Rockville, Md. The 3,000-square-foot store at GSA headquarters will carry microcomputer product lines from Apple Computer Inc., IBM Corp., Fortune Systems Corp., Digital Equipment Corp., Compaq Computer Corp. and Osborne Computer Corp. The store will not display equipment from Hewlett-Packard Co., Zilog Inc. and Molecular Computer but will sell it on request, explains Avner Parnes, president of The Math Box.

The Math Box's successful bid includes provisions for a team of subcontractors to support the government's requirements for maintenance, training and software support. M/A-COM Sigma Data will provide the training and technical support, Moore Business Center will provide supplies including diskettes and instruction manuals, MAI Sorbus will perform maintenance support, Software Center International will supply software packages, and Personal Computer Telemart will provide an on-line training and support library.

The store was due to open in mid-August. If it is successful, the GSA will open stores in 11 GSA regions and will consider opening similar commercial stores in other federal agencies.



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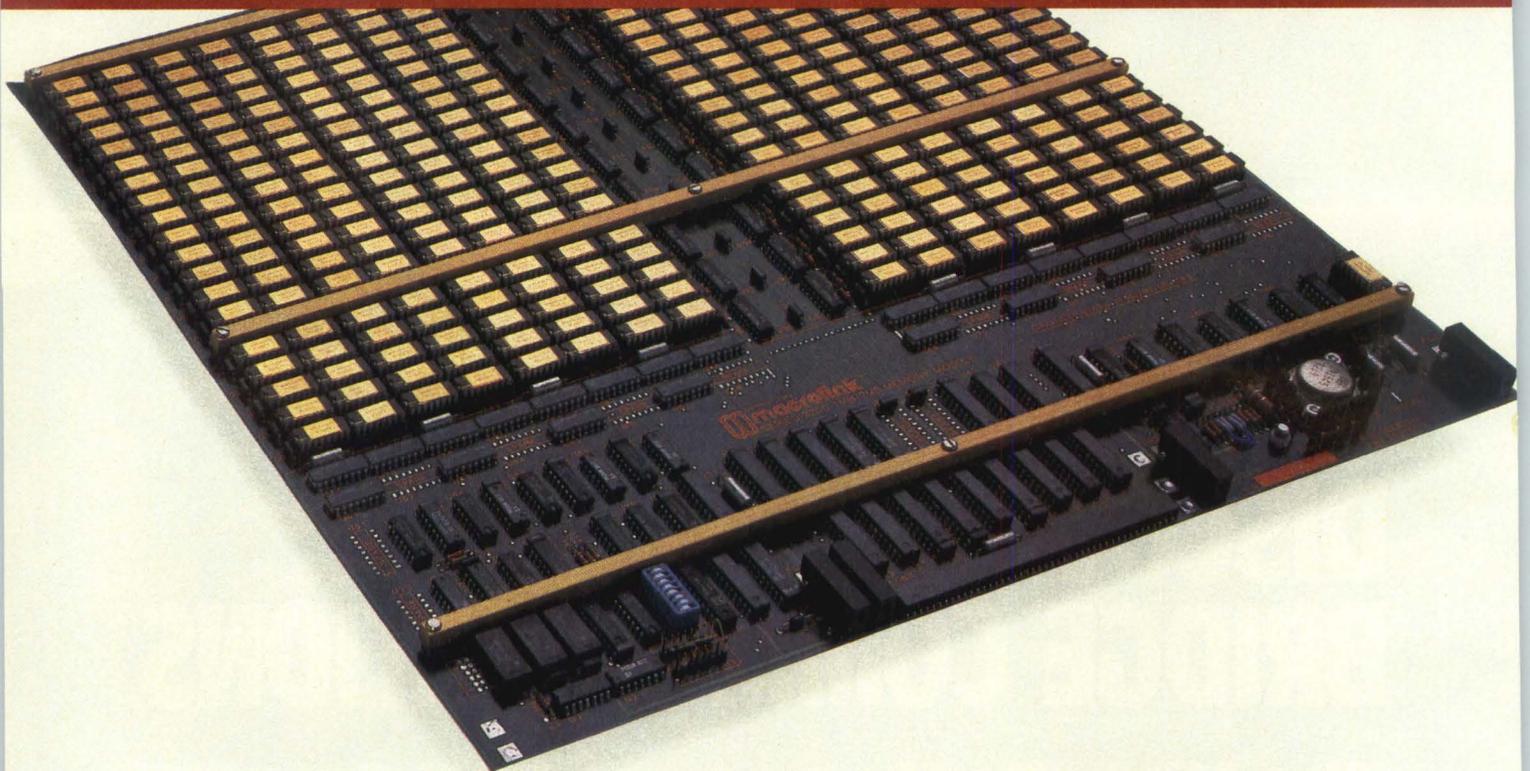
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CIRCLE NO. 85 ON INQUIRY CARD

The Interpreter

A procurement schedule for micros

Procurement schedules are crucial to all government acquisition activities. This is because they contain much of the information required to select equipment and

services for federal agency use, including pre-negotiated terms and conditions, discount prices and details on equipment configurations (MMS, December, 1982, Page 95). One procurement schedule, GSA Schedule A, is familiar to most government computer market-

CONGRESS COMES TO GRIPS WITH COMPUTERS

The U.S. House of Representatives employs an acquisition process for office equipment similar to, but on a much smaller scale than, the General Service Administration's. Like the GSA, the House has centralized the procurement of most office equipment, from chairs and paper clips to microcomputers.

The House maintains its own discount catalog and procurement schedule, including lists of approved vendors. In June, the IBM Personal Computer achieved the minor historical distinction in the annals of Congress of being the first microcomputer added to the procurement schedule. Responsibility for evaluating microcomputers for the schedule rests jointly with the Office Systems Subcommittee and the House Information Systems, which handles all technical testing. The Office Systems Subcommittee is testing Apple Computer Inc.'s Lisa, and plans to examine Radio Shack, Osborne Computer Corp. and Kaypro machines for addition to the schedule.

IBM Corp.'s PC was also the first microcomputer to be installed in the House. The House Armed Services Committee acquired a unit in early spring for test purposes and has since obtained the computer permanently. House committees and subcommittees have acquired several other microcomputers, primarily for database management. The Office Systems Subcommittee exempted the off-schedule acquisitions from the normal House procurement rules, which limit leases and purchases to scheduled items. For several years, some House offices have used minicomputer systems, including systems from Cado Systems Corp., Wang Laboratories Inc., Digital Equipment Corp. and Intelligent Systems Corp., for recordkeeping and tracking of legislation.

As to the application and productivity gains to be realized through the

introduction of microcomputers in House offices, the House's chief evaluator is uncertain. "We don't know what they can do yet," says Jon Carpenter, staff director of the Office Systems Subcommittee. "None of us will be using the equipment to its full capabilities for a long, long time." Measurements of productivity increases, Carpenter adds, will be difficult because the introduction of microcomputers in the House will force a redefinition of many jobs. Use of the microcomputers is likely to supplant certain job functions while adding responsibilities to other jobs. "I don't know how we're going to measure productivity increases," Carpenter says. What's optimum? "I'm doing more sophisticated analyses in my own job—things I could not do before."

The House will add to its procurement schedule according to:

- need, as expressed by House members and staff;
- results of performance testing;
- examination of a vendor's reputation for reliability, service and maintenance;
- price;
- contract terms and conditions, including warranty and delivery provisions;
- place of manufacture.

The funds for the purchase of microcomputers will be drawn from the office expense allotment provided to every House member and committee. Sales by approved vendors are likely to be in small quantities because each House member can choose a system. With more than 600 staff and member offices as likely targets for microcomputers, the potential market could total approximately \$15 million with the sale or lease of one machine per office, says a House spokesman.

A pilot program has been under way in the U.S. Senate since January to evaluate the impact of minicomputer and microcomputer systems on

office productivity. The Senate selected 12 offices to participate in the program, and systems from Xerox Corp., Wang, Honeywell Information Systems Inc., DEC, IBM and Sperry Univac were installed by the end of May. The equipment in each office differs slightly, says John Swearingen, technical services director of the Senate Rules Committee. Equipment includes three to five CRT terminals, one or two printers, a CPU and storage.

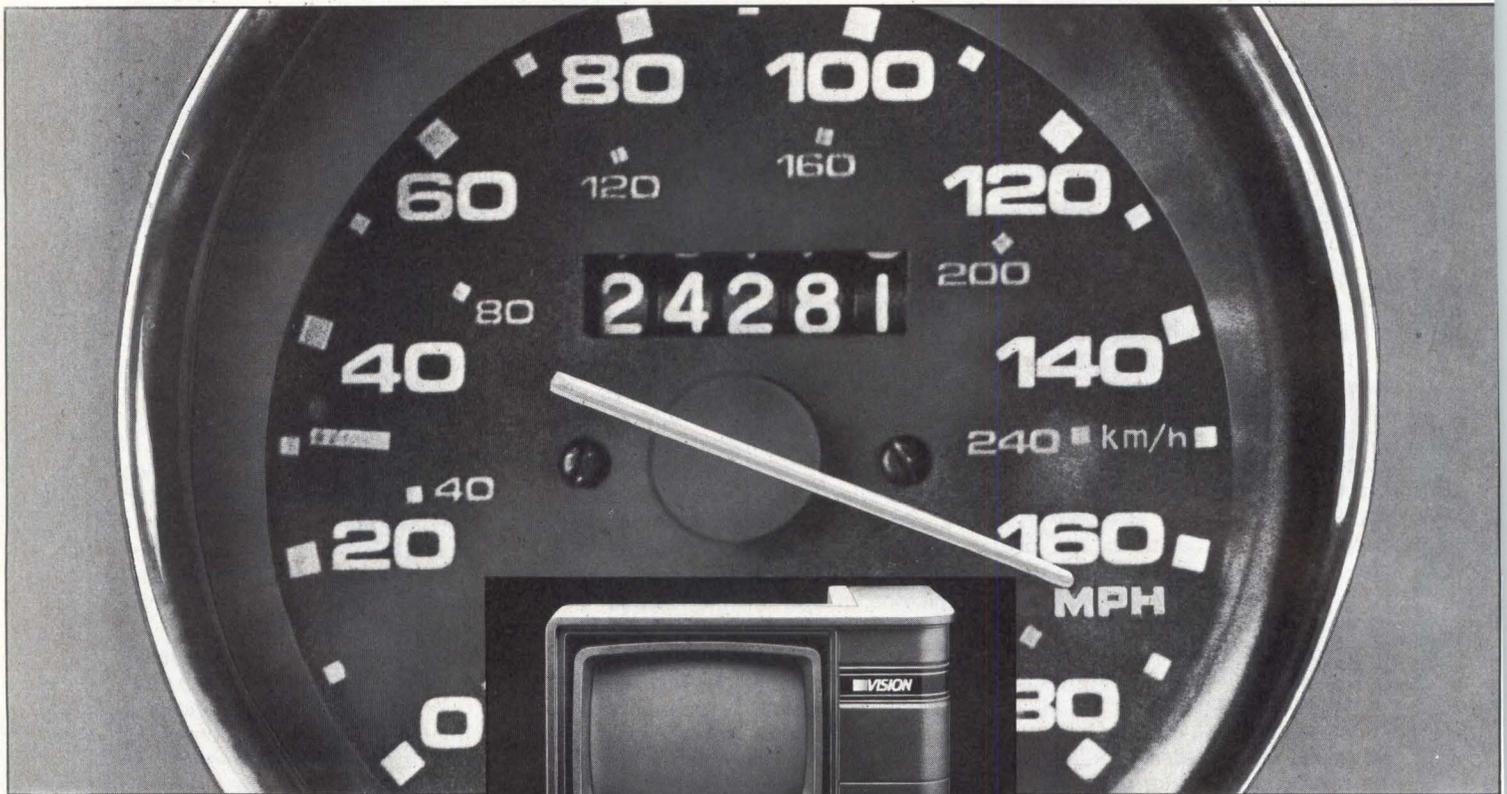
Swearingen says the initial results of the program are positive. A final report on the program is expected to be submitted to the Rules Committee in late summer. "If all goes as anticipated, we expect the report to trigger requests for proposals for systems in all Senate offices," Swearingen predicts.

The pilot program costs \$2,000 per office per month. With 60 to 75 offices likely to be included, the value of computer acquisitions, based on the current per-office funding, could reach \$1.8 million.

A handful of Senate committees is testing minicomputer systems. The Senate Armed Services Committee is using a Dictaphone system, the Rules Committee is using an IBM 8100, and the U.S. Foreign Relations Committee is using a system from Datapoint Corp.

Senators and staff will be able to connect their office systems with the system in place at the Senate Computer Center, which maintains the LEGIS legislative database, the committee budget and funding information, the payroll bookkeeping and constituents' names and addresses for newsletters. The physical medium for the network is twisted-pair copper wire, and network control is achieved with a data switch for an estimated total of 1,000 to 1,200 installed terminals.

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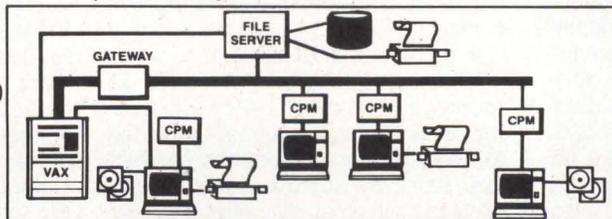
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CIRCLE NO. 86 ON INQUIRY CARD

The Interpreter

ers. Schedule A has long been the standard price and product catalog for procuring automated data-processing systems. But GSA officials were taken by surprise last year when only five vendors—HP, Apple, Xerox Corp., Osborne and Intertec Data Systems—were listed on Schedule A. The GSA had not reacted to the expanding capabilities and falling prices of microcomputers and the proliferation of other office-automation equipment such as word processors.

Recognizing the need for more small computers in administrative applications, the GSA has introduced a new catalog of the microcomputer prices and equipment configurations of more than 35 approved vendors—Schedule C. Introduced on April 1, the schedule originally applied only to the GSA, the Army and the U.S. Department of Agriculture. The schedule was expanded in June to cover purchases by all executive agencies. GSA officials say Schedule C complements Schedule A, which includes 32-bit minicomputer and other data-processing systems, and Schedule B, which contains the listings for peripheral equipment.

Although schedules A and C overlap somewhat, they differ markedly in terms and conditions. Schedule A, for instance, applies to worldwide government purchases, while Schedule C applies only to purchases within the continental United States. In addition, Schedule C discount prices average approximately 15 percent less

than those found on Schedule A, which typically lists prices that average 30 percent less than the vendors' retail price lists. Schedule A also mandates a 30-day delivery time after receipt of a final order, while delivery time for Schedule C items is negotiable. Schedule A specifies a maximum 2-hour maintenance response time, while Schedule C specifies a time to match the response time the vendors provide their private-sector customers. Finally, Schedule C introduces a centralized billing plan under which the GSA pays the contractor, then bills the purchasing agency. GSA is also exploring the introduction of centralized ordering. A few federal agencies now operate under such an arrangement whereby the purchasing agency submits its order to the GSA, and the GSA then batches the orders and sends them weekly to the contractors. "We're trying to develop a contracting vehicle more attuned to the marketplace," comments Barbara Woyak, director of GSA systems and services division.

Hands-on experience

To see how the government could use microcomputers and related office equipment, the GSA used its headquarters personnel as guinea pigs. The GSA asked employees above the rank of GS-10 to complete a questionnaire describing how they could use a microcomputer. The GSA then chose 14 departments from the

A PROCUREMENT PRIMER

Federal government procurement often constitutes a confusing maze of shifting reporting requirements, bid procedures that vary with differing financial thresholds and procurement schedules that can make the most complex commercial price list look like child's play. But commercial vendors who have committed time, energy and resources to sell to the Federal government can take some comfort in the fact that it is often equally as difficult for their bureaucratic government counterparts to buy computer equipment.

The following outline covers current federal acquisition policies and includes a few tips from a computer procurement specialist at the General Services Administration, which is responsible for all major computer purchases by the federal government:

- Orders for less than \$10,000 for civilian agencies and \$25,000 for military agencies fall under GSA's "small purchase" category. Purchase

authorization is required only from the particular agency's procurement office

- Orders for more than \$5,000 must be submitted to the *Commerce Business Daily* for publication, unless the equipment is purchased from a GSA procurement schedule

- Purchases of more than \$50,000 must be submitted to the *Commerce Business Daily*, and the government must issue a bid solicitation to give vendors an opportunity to beat the price on the GSA schedule

- Orders exceeding \$300,000 for most civilian and military agencies must be submitted to the GSA for procurement authorization (in addition to the authorization obtained from the procurement office of the agency originating the order). GSA has recommended that the amount for such orders be raised to \$500,000.

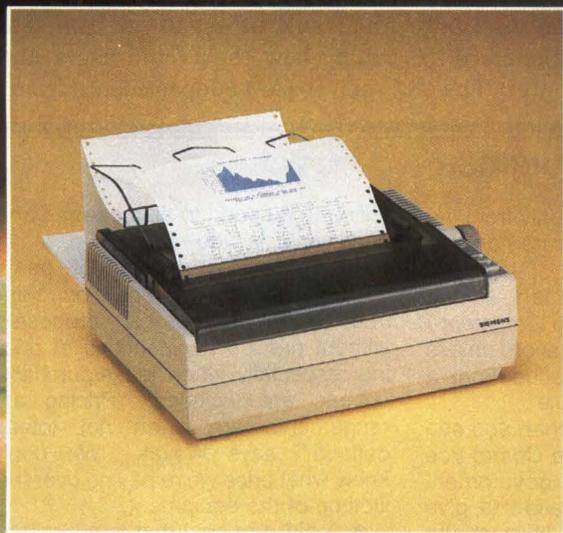
- Computer equipment vendors responding to government bid solicitations often make the mistake of

failing to respond to all the terms and conditions in the solicitation, says Barbara Woyak, director of GSA's systems and services division. Vendors often submit bid proposals without precise explanations of pricing, especially when lease/purchase options are included. "Pricing arrangements are often not totally defined," says Woyak. "We don't know what price we're paying over the lifetime of the equipment."

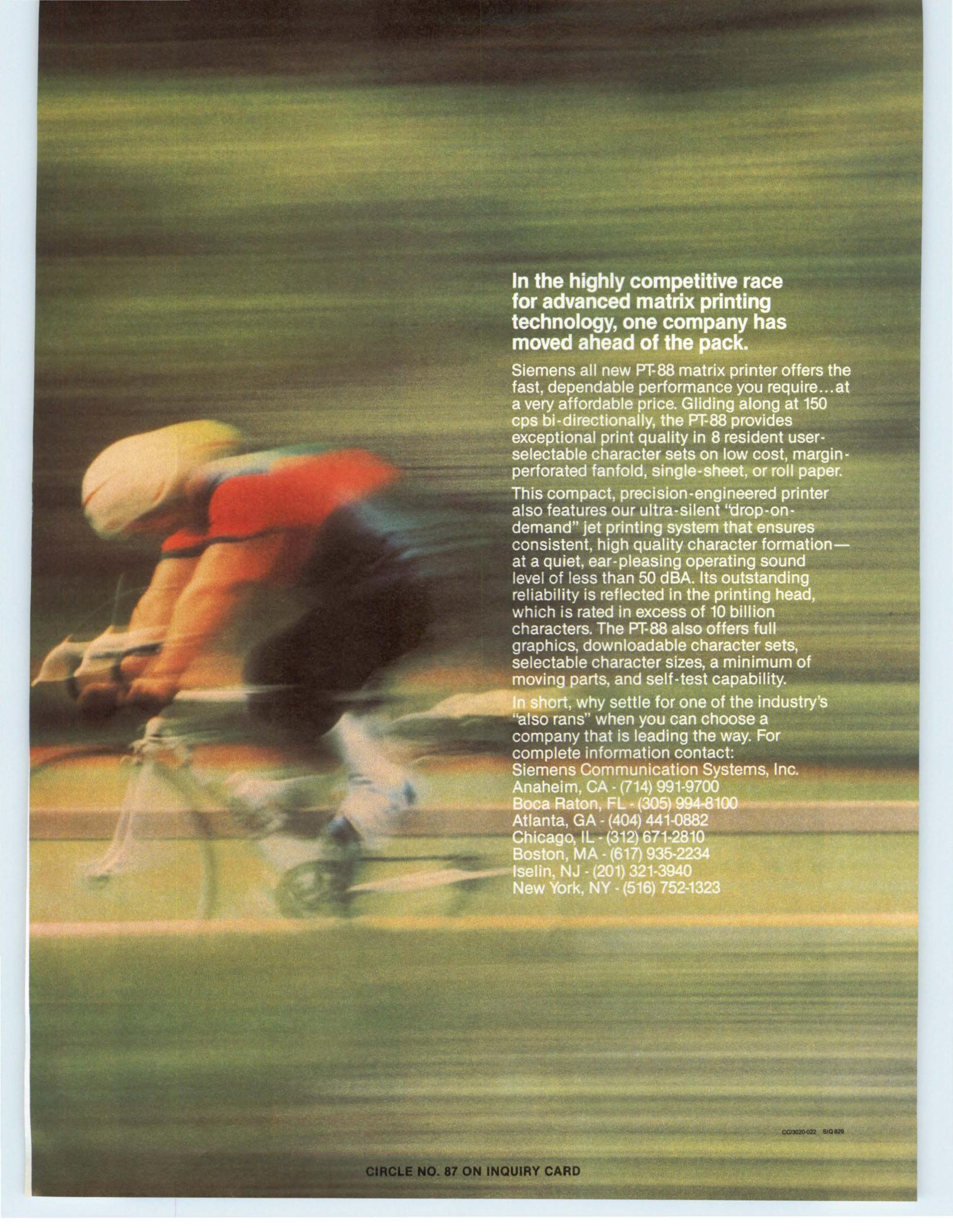
- A bid proposal that is submitted without addressing all points of the solicitation or that requires clarification or price quotations is either rejected outright or requires additional details from the bidder. Woyak offers a simple piece of advice to vendors wishing to capture a portion of the lucrative federal market for computer equipment: "Read the entire solicitation carefully and respond to *all* points listed."

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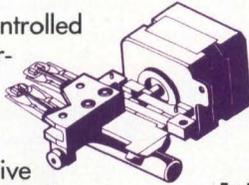
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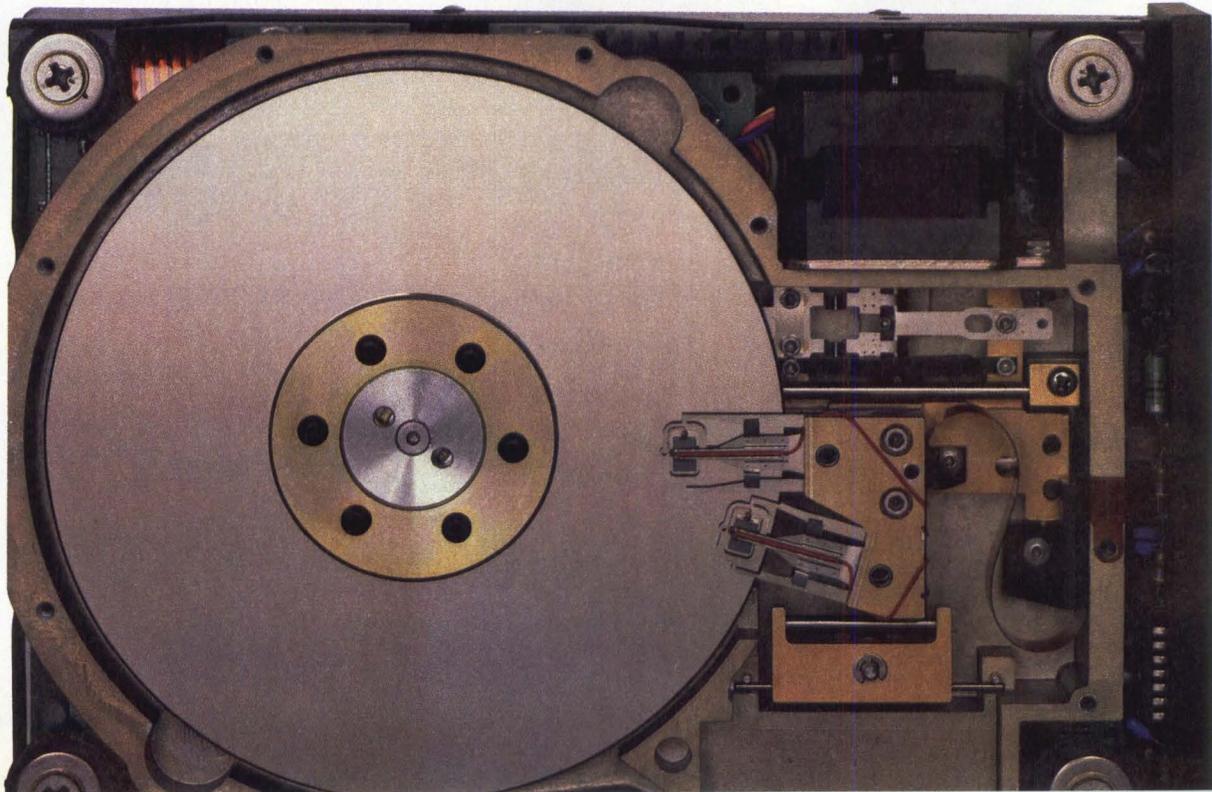
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TO: Western European distributors experienced with high-end disk drives and/or disk backup products
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Company representatives from high-volume computer OEMS.

FROM: Andrew C. Nester, Vice President of Marketing/Sales
Microscience International Corporation

DATES: Tuesday and Wednesday, 25 and 26 October, 1983

TIME: 14:00 to 22:00

PLACE: The Amsterdam Marriott
Stadhouderskade 21
Amsterdam, The Netherlands
(020) 835151

R.S.V.P. To meet with Mr. Nester please contact him prior to the COMDEX/Europe show at Microscience (Telex: 176224). During the show, call Mr. Nester at The Amsterdam Marriott

The Interpreter

respondents as test cases. It supplied those departments with microcomputers from Schedule A. The GSA purchased five units from each of four vendors—Apple, Osborne, HP, and Xerox—and installed them in the 14 departments in March. The GSA did not choose Inter-tec, the fifth microcomputer vendor on Schedule A, because of the company's reported inability to meet the delivery schedule. The six microcomputers not installed in the 14 departments were used for GSA hardware tests.

Most program participants—clerical and support personnel—had little or no experience with data- or word-processing systems. The GSA says this decision was made to reflect the changing profile of typical users of office computer systems. "It's not the DP professional who's going to the contracting office for micros," says William Frazier, special assistant to the GSA administrator. "If GSA is going to play a policy-making and assistance role in the procurement of these machines, we have to go deeper into departments where the new end user is making the selection decision."

The GSA completed its preliminary evaluation of the program in June. As a result of the experience, GSA officials have some advice for potential users and system vendors alike. Although equipment capabilities "were pretty dramatic," Frazier says, users' expectations of the equipment were often much higher. "Most people didn't know what they have to know," he says.

The level of training provided to first-time users constituted another barrier to increased acceptance of microcomputers in federal offices. The GSA provided one- and two-day group training courses, but officials quickly discovered that one-on-one instruction was also required. Instructors from the GSA's data-processing staff supplied this individualized training. "Most vendors don't provide (personal instruction)," says Frazier.

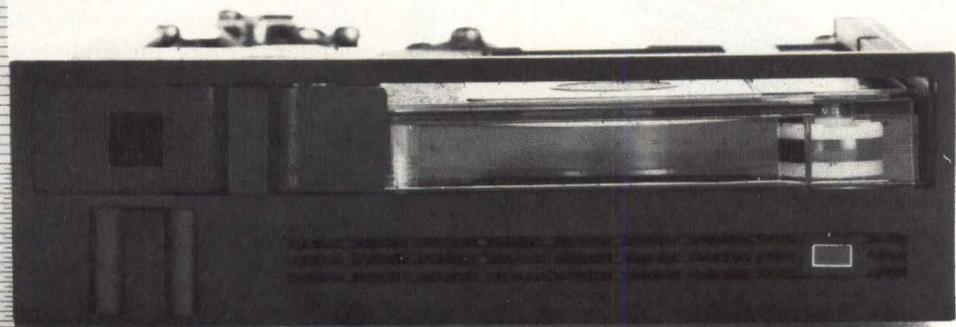
As a result of the program, the GSA intends to launch a "major initiative" to encourage all federal agencies to designate data-processing staff to assist and establish support groups for first-time users of microcomputers and other office-automation equipment. "This goes back to the old IBM Information Center concept," continues Frazier. He adds that the U.S. Department of Agriculture has established an Information Technical Center for in-depth user training.

Frazier also says computer manufacturers and system integrators should provide more effective self-help software programs and better documentation that can be more easily understood by non-data-processing professionals. "Microcomputer capabilities are now masked in smoke and mirrors," he concludes. "Our users are pretty low on the learning curve of these capabilities, so training and support are everything in this business." □

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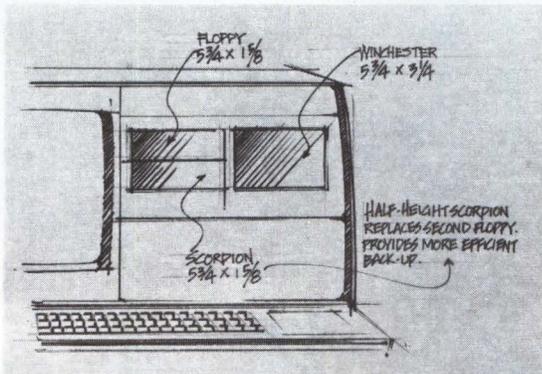
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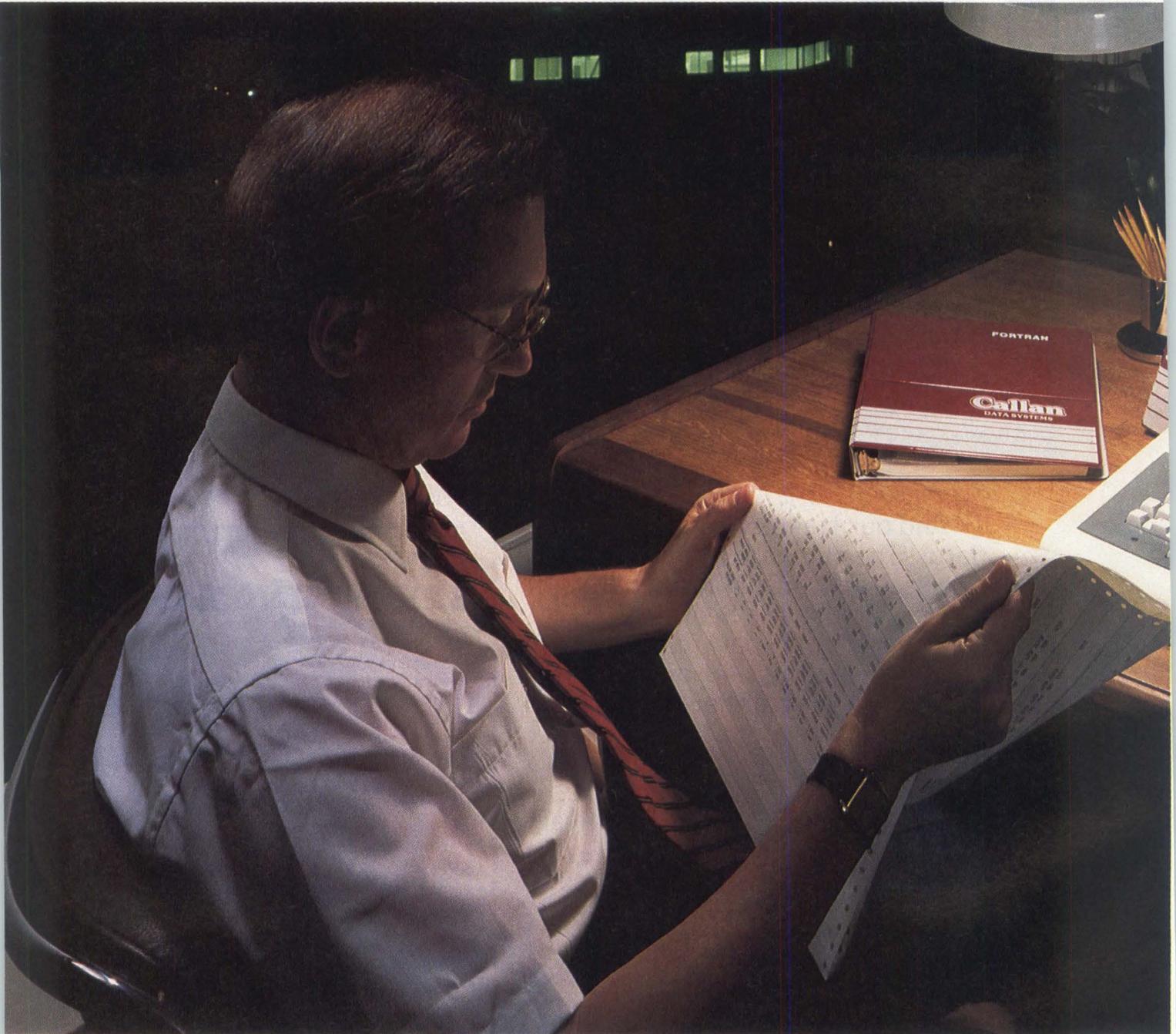
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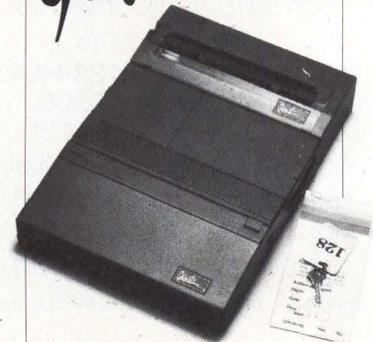
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Systems in Manufacturing

Exploring the use of computers in the factory

Emerging low-end CAD market attracts attention

by Frank Catalano

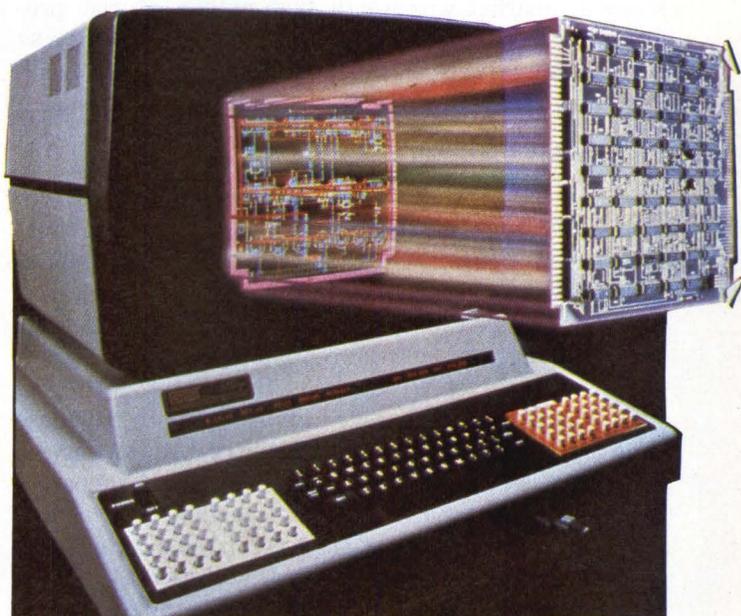
Although the sales of high-end mainframe-and mini-computer-based computer-aided design (CAD) systems are generating most revenues in the CAD market today, vendors and users alike are casting a keen eye toward the embryonic but fast-growing low-end market. That market segment consists of two groups of microcomputer-based workstation systems for design applications in the electronics industry.

One group includes products that provide engineering-support staffs with printed-circuit (PC)-board layout capabilities. Products in the other group—often called computer-aided engineering (CAE) systems—enable engineers to test and verify their integrated-circuit (IC), PC-board, gate-array and standard-cell designs before layout.

Priced at \$50,000 to \$100,000, both product types are being bought by small companies that previously could not afford more than \$200,000 to buy a typical CAD system, as well as by Fortune 500 companies interested in distributing their computer resources. "This is an exciting new market segment in the sense that, even though it's less than two years old, users have a lot of good solid products to choose from," notes Lewis Brentano, associate director of the CAD/CAM Industry Service of Dataquest Inc., San Jose, Calif.

Although it's exciting for users, Brentano notes the low-end market is turbulent for vendors. Unlike the high-end market, which is controlled by large, established vendors whose market shares have remained virtually unchanged for the past four years, the low end is a relatively open market participated in by small start-ups, most of which are less than a year old. Those start-ups battle not only one another for shares of the new market but also service centers, which handle all of a customer's circuitry needs from design to fabrication. The competition will grow even more fierce during the coming year as traditional CAD vendors broaden their product lines with low-end products. Computervision Corp., Bedford, Mass., announced last summer its plans to offer a low-end workstation by the end of 1984, and Laura Conigliaro, an analyst with Prudential-Bache Securities, New York, says Calma Co., Santa Clara, Calif., and Applicon Inc., Burlington, Mass., have plans for similar products.

Timothy Gauhan, vice president of Dataquest's CAD/CAM Industry Service, estimates that 1982 sales for CAD systems totaled \$1.4 billion in 1982 and will be \$2.1



Gerber Systems Technology's CAD workstation for PC-board layout is based on the HP 1000 computer. The company plans to incorporate the HP 9000 32-bit microcomputer when it becomes available. Gerber is one of the leading suppliers of such systems.

billion in 1983. The CAD market grew at a robust 60 percent annual rate in most of the 1970s. The recession slowed the growth rate to 30 percent last year.

The outlook is improving, and Gauhan estimates that, by year-end, growth will be in the 30 percent to 40 percent range. "Even during the recession, the demand for CAD systems was there, but companies were delaying their purchases until the economy picked up again," explains Gauhan. "The market is quite healthy now, however, and almost every CAD vendor we've talked to reports increased sales."

Gauhan lists Computervision as the top CAD supplier, with \$326 million in sales last year and 23 percent of the market. IBM Corp. comes in a close second with approximately \$300 million in sales in 1982 and 22 percent of the market. The other major suppliers are Intergraph Corp., Huntsville, Ala., Calma and Applicon. Intergraph holds an 11 percent market share, Calma holds a 10 percent share, and Applicon holds a 6 percent share. The five leading CAD vendors offer products that address the spectrum of CAD applications—mechanical, electronic and architectural design—as well as cartology applications. In a 1982 study of the CAD/CAM market, Thomas Kurlak, vice president of the Security Research Division of Merrill Lynch Pierce Fenner & Smith Inc., New York, noted that the two major CAD applications were mechanical and electronic design. He

Systems in Manufacturing

estimated that the mechanical-design market was worth \$443 million in sales in 1982 and that the electronic-design market was worth \$300 million. Kurlak projects that the electronic-design market will grow at a 37 percent annual rate this year and that the mechanical-design market will grow at a 23 percent annual rate.

Electronics industry relies on CAD

Dataquest's Brentano attributes the higher growth rate of the electronic-design market in part to the short life cycle of IC products as well as to Japanese competition in the IC market.

"While the life cycle of an IC product was traditionally four or five years, now it's really only about one or, at the most, two years," explains Brentano. "On top of that, U.S. IC suppliers are competing with Japanese companies that come into this country with low-priced products." Brentano says that electronics companies are turning to CAD as a means of speeding their design cycles and cutting costs of products in the design stage.

But Daniel Borda, an analyst with the Computer Integrated Manufacturing Group at Arthur D. Little Inc., Cambridge, Mass., contends that electronics companies, even without the need to cut costs and accommodate shorter product life cycles, would still require CAD systems as essential design tools. "When you think about it, there's no other way for an electronics company to do business than with CAD systems in their design labs," says Borda. "How else are they going to design integrated circuits, for example, that consist of a half a million transistors on a microscopic piece of silicon?"

Before microcomputer-based electronic CAD systems were available, design engineers had two methods of design circuitry. One method was antiquated and tedious, but the other was expensive. The antiquated

method required designers to lay out a PC board and then test the functionality of a prototype model using such tools as logic analyzers and oscilloscopes. The easier but more costly alternative involved designing a PC board using a minicomputer-based CAD system from Calma or Applicon, for example, and then testing the functionality of the design using programs written for mainframe computers.

Brentano notes that design engineers, who are well aware of the technological and financial problems of circuitry design, conceived most of the new low-end electronic CAD systems. "These guys worked at Intel, Motorola and National Semiconductor and recognized the market need for an inexpensive, easy-to-use tool that would make design engineers more productive," he explains. "Rather than develop systems internally, they went off and started their own companies."

And, according to Dataquest estimates, the start-up founders were correct in their assessment of the market. Brentano estimates that the market for microcomputer-based workstations able to handle design and analysis functions in IC, gate-array and standard-cell applications (CAE systems) was worth approximately \$20 million in 1982. That market will grow to as much as \$500 million by 1987, he adds. Brentano says more than \$70 million worth of workstations for PC-board-layout applications were sold last year, and, by 1987, sales will top \$500 million. "I think that the CAD workstation market will grow between '83 and '87 much like the entire CAD market grew between '75 and '80—like wildfire," Brentano comments.

An outline of vendors

The major vendors in the CAE workstation market include Daisy Systems Corp., Sunnyvale, Calif., Men-

CAE vs. CAD

The most obvious distinction between CAE and CAD systems, explains Daniel Borda, an analyst with Arthur D. Little Inc.'s Computer Integrated Manufacturing Group, is that CAE systems access databases that contain electrical information, and CAD systems—at least in the PC-layout world—access databases that contain graphics information. An engineer at a CAE workstation would analyze the functionality of the circuit being designed. The analysis includes timing, logic and sequence analysis as well as simulation. The engineer would then pass the design specifica-

tions to an engineering support person, who would lay out the circuit using a CAD system. "In the past, a lot of engineers weren't even doing logic and timing analysis before a circuit was laid out unless they did it on a batch mode on a mainframe," explains Prudential-Bache Securities analyst Laura Conigliaro. "What's the sense of laying out a PC or even going to the mask stage if you don't know how the circuit is going to behave?"

CAE vendors such as Daisy Systems Corp. and Mentor Graphics Corp. do not offer PC-layout CAD systems, and CAD vendors such as

Telesis Systems Corp. and Gerber Systems Technology Inc. don't offer CAE systems. The result, contends Conigliaro, is that companies must use a CAE system from one vendor and a CAD system from another. She predicts that the situation will eventually change: a customer will be able to buy CAE and CAD systems from one source. "A user will be able to go from the initial stage of figuring out the functionality of a circuit, right through analysis, and finally into the layout and mask-production mode on the same workstation," she projects.

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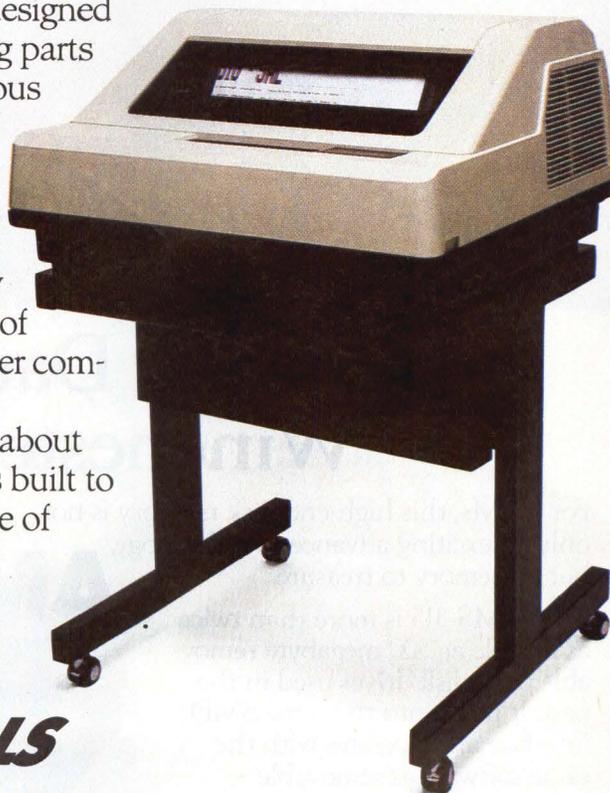
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Systems in Manufacturing



The **Gatmaster CAE workstation system** from Daisy Systems allows design engineers to analyze the functionality of gate-array models as they are designed. Daisy is tied with Mentor Graphics Corp. for the lead in the low-end CAE market.

tor Graphics Corp., Portland, Ore., Computer Aided Engineering Inc., Sunnyvale, Calif., and Methus Corp., Hillsboro, Ore. Daisy and Mentor are tied for the market lead, each reporting sales revenues of about \$25 million last year.

Gauhan divides vendors in the PC-board-layout market into two categories: those whose systems offer automatic routing and placement and those whose products do not provide such capabilities. Among the vendors that do provide those capabilities are Telesis Systems Corp., Chelmsford, Mass., and Racal-Redac Inc., Littleton, Mass. Telesis leads that market segment. Last year, the company reported sales revenues of approximately \$15 million. Vendors that provide systems without automatic routing and placement capabilities include Gerber Systems Technology Inc., South Windsor, Conn., Cadnetics Corp., Boulder, Colo., and EDS Nuclear, Walnut Creek, Calif. Gerber is the leader in that group, reporting 1982 sales revenues of \$20 million to \$25 million.

Whether they provide CAE systems or PC-layout systems, most of the vendors in the low-end market consider themselves system integrators that write their own application software and buy most of their systems' hardware. Jerry Suprenant, director of marketing at Gerber, says Gerber buys 90 percent of its PC-layout system from Hewlett-Packard Co. "The value we add is in software and the ergonomics of the workstation itself," notes Suprenant. "Technology is moving so fast that a company—especially a small company—can't be expert in computers, peripherals and CAD software all at the same time."

Gerber bases its system on the HP 1000 computer and plans to use HP's 32-bit HP 9000 microcomputer when it is available. Telesis builds its workstation around Digital Equipment Corp.'s LSI-11/23 microcomputer, and Mentor Graphics uses Apollo Computer Inc.'s 32-bit microcomputer. "It's still too early to say what technological thread holds all of these systems together," comments Brentano. "As the market really gets moving over the next couple of years, successful vendors will take the standard DEC, HP or Apollo approach. Customers like that because they can then use the networks designed for those computers as well as all the third-party software."

But there's an exception to every rule. In the low-end CAD market, the exception is Daisy. Daisy has taken the vertical-integration approach, building everything from its computer system to the graphics display terminal. The computer backing the Daisy CAD workstation is based on Intel Corp.'s Multibus and uses Intel's 8086 and 8087 coprocessors. Harvey Jones, vice president of marketing at Daisy, says the company's systems can communicate in an Ethernet environment and are compatible with software written for Intel microprocessors.

Competition on two fronts

Brentano contends that the major competitors for low-end CAD vendors today are service centers for very large-scale integration (VLSI). These include LSI Logic Corp., Milpitas, Calif., VLSI Technology Inc., San Jose, Calif., and Zymos Corp., Sunnyvale, Calif. Such service centers not only design gate arrays and standard cells for customers, but also handle fabrication. "There are about 25 of these companies in the Santa Clara, Calif., area alone," notes Brentano. "They allow a customer to walk in the front door with a concept, sit down with a design engineer and, in three weeks' time, walk out with a prototype chip." Brentano says that large companies such as DEC, IBM and Intel would probably opt to buy systems from Daisy and Mentor and design their circuitry in house. However, service centers are attractive to small system houses, which may not be able to afford the time or expense of in-house design. "These service centers will keep the CAD vendors on their toes," says Brentano. "They'll force low-end vendors to keep the prices of their workstations down and to provide software that a user may not be able to get at a service center."

But, although service centers compete with low-end CAD vendors today, they could become customers tomorrow, Brentano observes. Most VLSI service centers, he notes, built their own CAD workstation systems. This is primarily because microcomputer-based systems were not available when the centers were

Systems in Manufacturing

founded. "The goal of these companies is to sell their fabrication service," Brentano asserts. "The design service is just a marketing ploy to get customers in the door. As these electronic CAD systems come on the market, the service centers may find it more practical to buy workstations from the Daisys and Mentors of the world." He adds that LSI Logic is already using a workstation system provided by Mentor Graphics.

But the most intense competition for low-end CAD vendors will come from high-end vendors such as Computervision, Calma and Applicon, when those companies introduce their workstation systems next year. In August, Computervision announced a joint development arrangement with Sun Microsystems Inc., Mountain View, Calif. It will result in a low-cost CAD workstation based on a Sun 32-bit computer.

Computervision's low-end system will initially be equipped with PC-layout software and will eventually handle CAE functions as well. "It's been obvious over the past two years that the workstation approach is the way to go for electronic-design applications," explains James Berrett, president and chief executive officer of Computervision. "Our objective is to remain the market leader, and one way to achieve that is to provide

low-priced systems to users who previously could not afford our products."

But to reach those new users, Computervision must reorient its sales staff, which is accustomed to selling more-than-\$400,000 systems. "Computervision's mainline business is mechanical design," notes Dataquest's Gauhan. "They sell a fair amount of minicomputer-based PC- and IC-design systems, but those sales are primarily to machine-tool companies that need to add control mechanisms to their mechanical equipment. With the Sun product, salesmen will be approaching a whole new group of (electronics) customers in both large and small companies, and that will take some adjustment."

Berrett admits that the sales-force question is legitimate. He believes that Computervision must learn how to reach "small shops," as opposed to the company's traditional Fortune 500 customer base. Computervision sells directly to customers now but may use alternative distribution routes with the low-end product.

Despite distribution questions, Prudential-Bache's Conigliaro says that Computervision's entrance into the low-end market will stimulate the market. "Computervision will give the market momentum," she says. □

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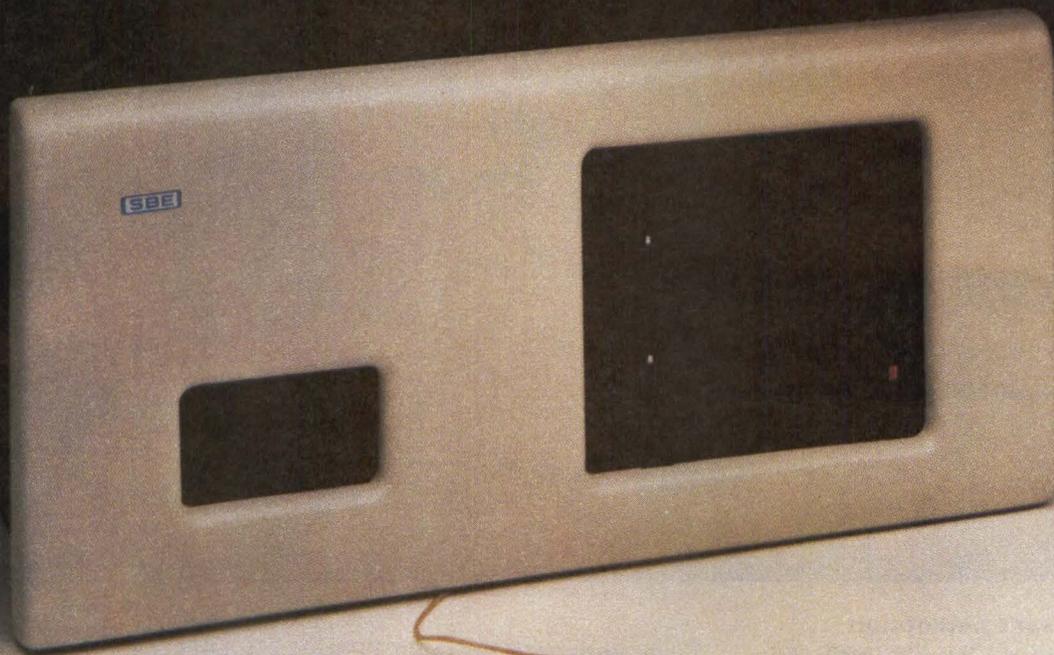
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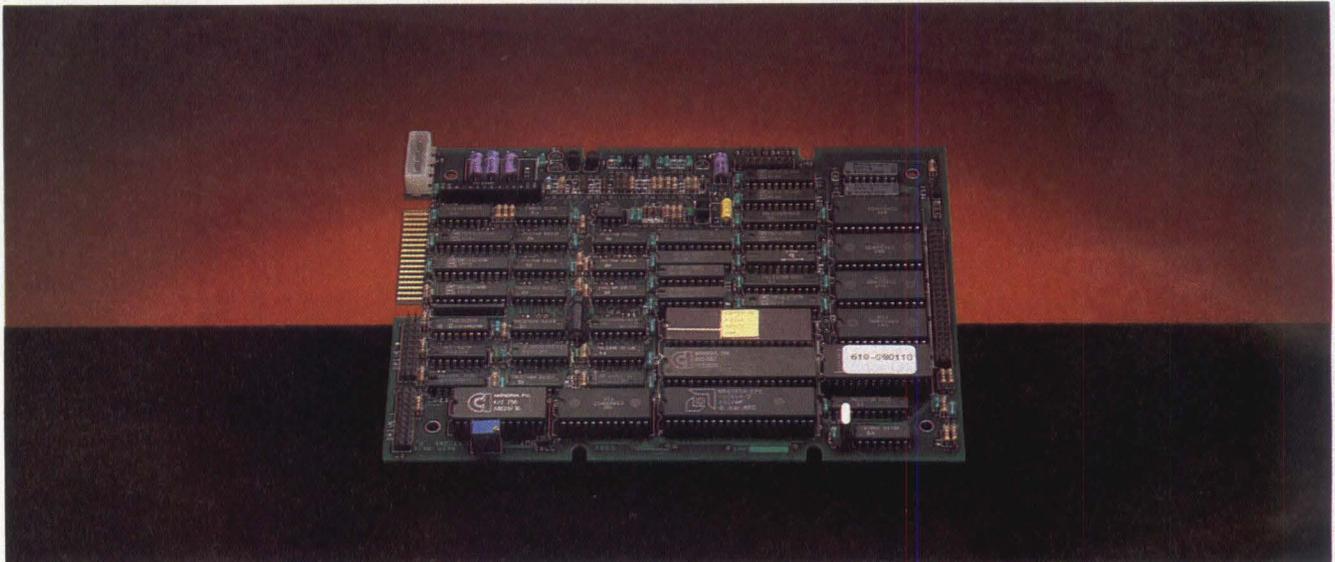
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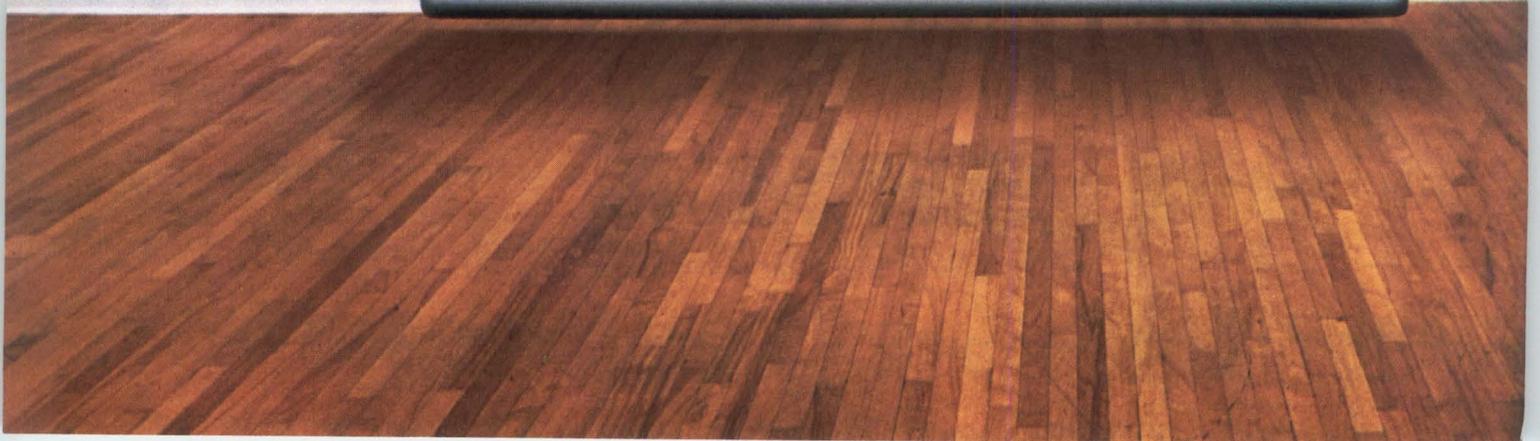
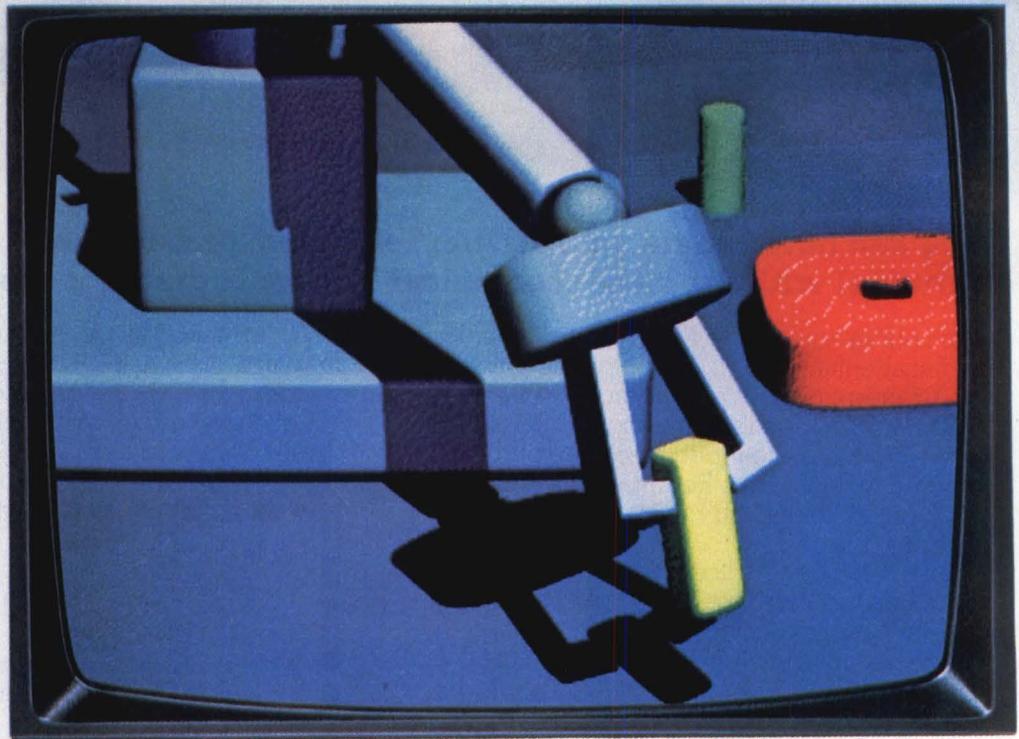
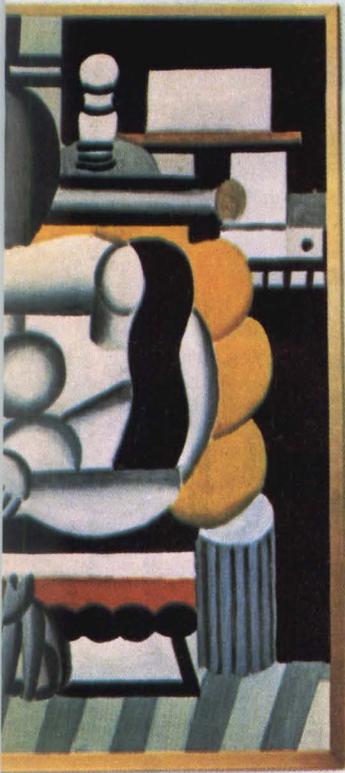
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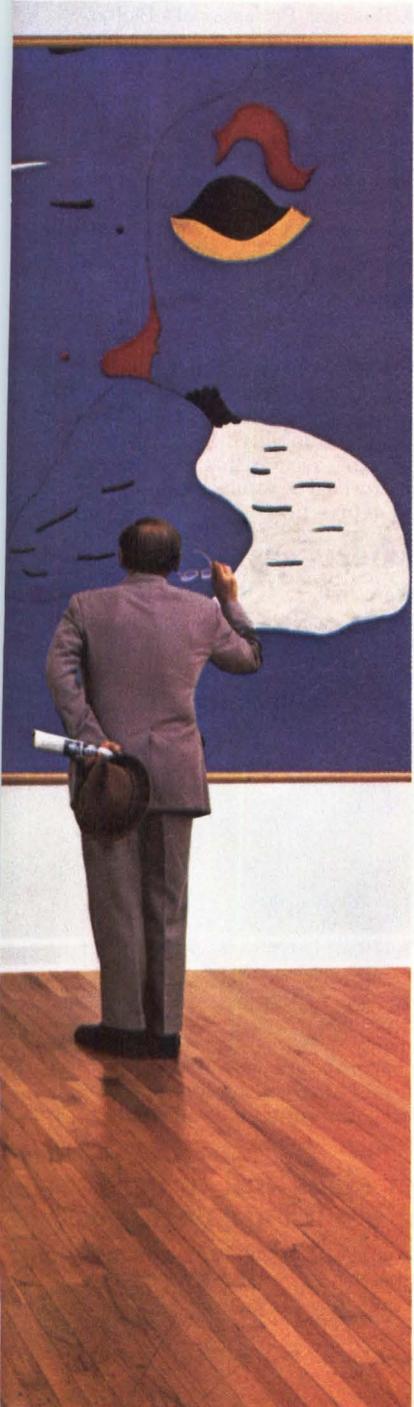
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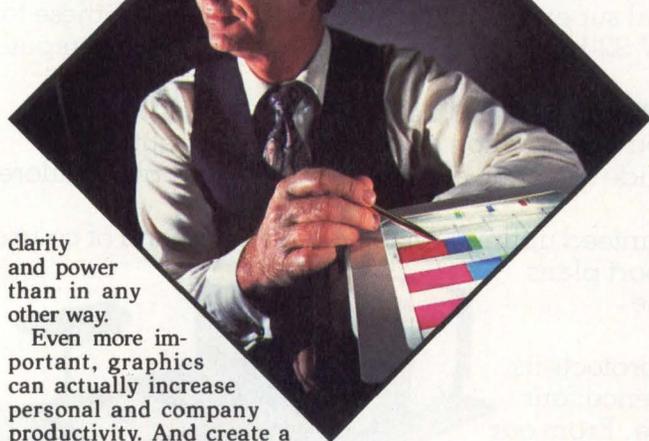
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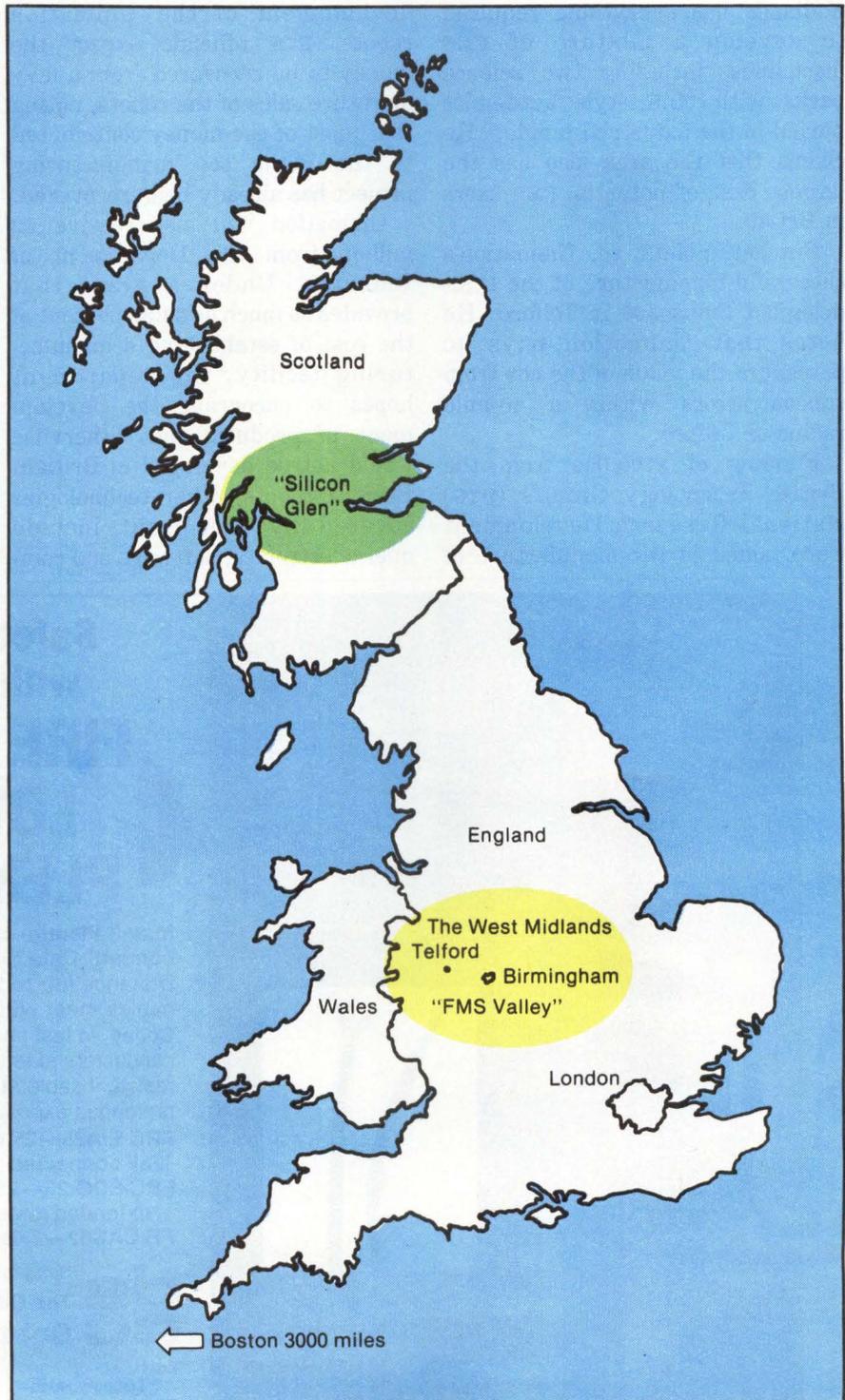
British government woos flexible manufacturing system suppliers

Unemployment in England has increased dramatically over the past few years, and one of the hardest hit areas lies in the once-booming West Midlands region, centered in Birmingham. Foreign competition has had a severe impact on this automotive-manufacturing area, and labor-saving machines such as flexible manufacturing systems (FMS) have caused loss of jobs.

But the British government hopes that FMSs will also prove the region's salvation and is attempting to transform the West Midlands into the FMS/technology capital of Europe. To get the ball rolling, the government is working closely with robotics market leader Unimation Inc. Unimation has chosen the West Midlands town of Telford as its European manufacturing base as well as the worldwide development center for a new family of electrically driven robots.

But while Unimation seems convinced that the West Midlands is ideal for its European Robotics Center, another leading robot supplier, IBM Corp., prefers one of the major industrial cities of West Germany—Munich. Although IBM has no robot-manufacturing or -design operation in Europe, Munich will be the company's European Center for education, technical support and marketing.

John Butcher, undersecretary of state in the British government's Department of Industry, is charged with encouraging other robotics companies to set up shop in West Midlands. "We want to make the West Midlands the "FMS Valley" of Europe," Butcher declares. He hopes the region will emulate the success of another depressed industrial area, Central Scotland. Through government aid, that area



The British government hopes that the West Midlands region will become Britain's "FMS Valley," much like Central Scotland became the "Silicon Glen."

Systems in Manufacturing

has emerged over the last few years as the largest semiconductor manufacturing center in Europe and has earned the title of "Silicon Glen." Butcher asserts that the West Midlands has everything required to develop a mixture of FMS disciplines, including two science parks with "U.S. style academics buried in the industrial jungle." He claims that the area also has the largest base of potential FMS users in Britain.

Butcher points to Unimation's successful manufacture of the U.S.-designed Puma 560 in Telford. He notes that Unimation buys 70 percent of the value of the 560 from subcontractors within a 40-mile radius of Telford.

Funding of \$700,000 from the British Technology Group's (BTG) National Research Development Corp. aided in the manufacture of

the 560 in Telford. The BTG is a government agency that provides partial funding for young high-technology companies. The agency is contributing \$3 million to the development of the Unimation robots. BTG officials expect the money to be recovered from a levy on future sales of the robots, noting that most of the money contributed to the Puma 560 manufacturing project has already been recovered.

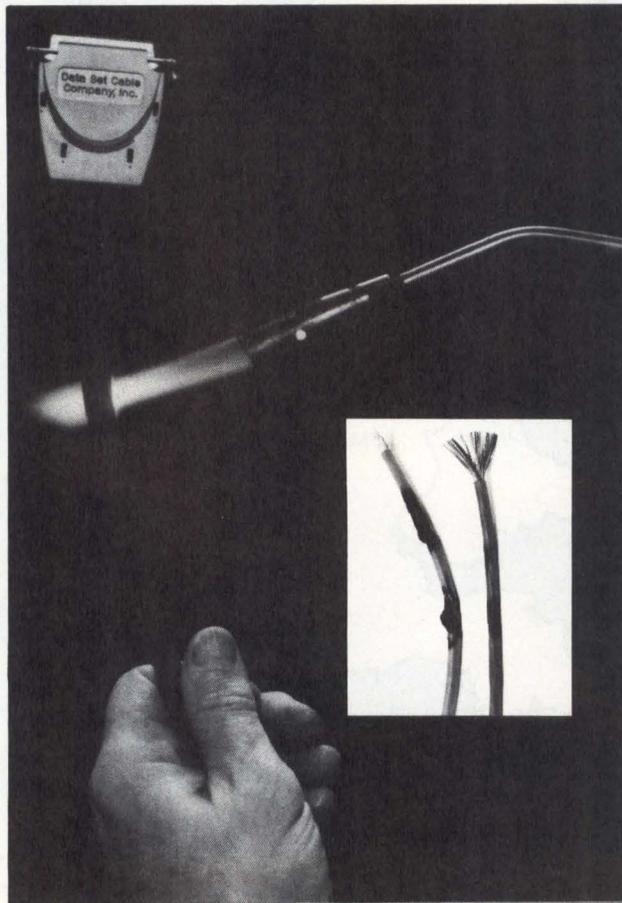
Unimation will also receive \$2 million from the Department of Industry. Under a grant that provides as much as 33.33 percent of the cost of establishing a manufacturing facility, the department hopes to encourage the development of products that otherwise would not be developed in Britain. Besides robots, other technologies covered by the grant include microelectronics, software and com-

puter-aided-design systems. The recipient need not be a British company, but the manufacturing facility must be in Britain.

Undersecretary of state Butcher points to other government cash incentives that could help the FMS Valley project. These include a 100 percent tax allowance for British purchasers of capital equipment such as FMS machines.

Roger Cakebread, managing director of Unimation Europe Ltd., Telford, notes that Unimation will invest more than \$10 million in its expansion program. Besides the robot-development project, the company's plans include establishing a systems engineering division in Telford to customize robots for European purchasers. Unimation also intends to begin manufacturing the Puma 260 and 760 robots in Telford.

—Keith Jones



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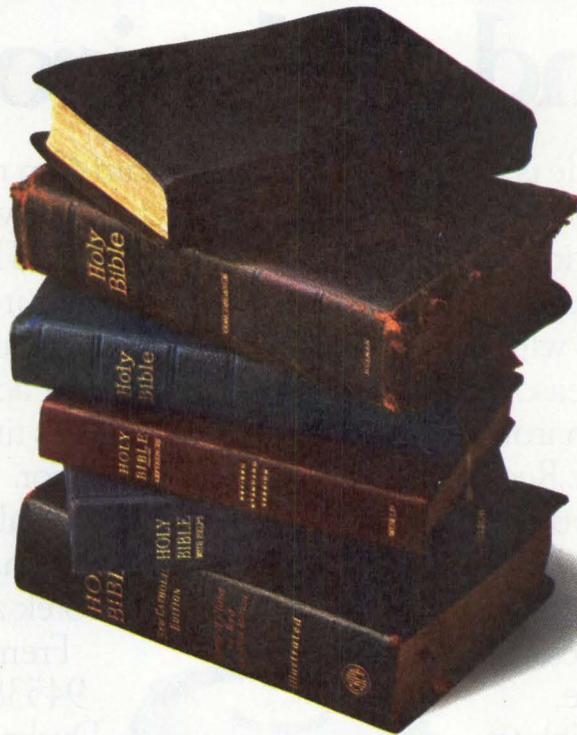
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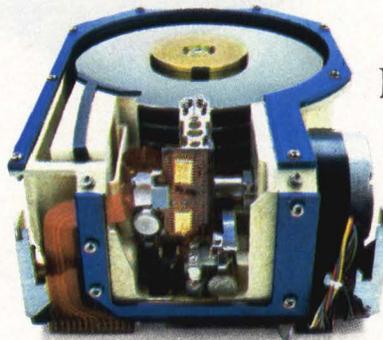
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It's more rugged than iron oxide. Allows greater capacity. Reduces the error rate. And if you buy from Evotek, you can get 5¼" drives with thin-film media for about the same cost as iron oxide drives. Or even less.

With an Evotek drive, you're assured of the highest quality media for the simple reason that we make it ourselves. Which also means you can count on a continual supply of Evotek drives. Today, and tomorrow.



But thin-film media isn't the only reason to buy Evotek drives. With capacities up to 51.68 MB, they have such advanced features as high-torque precision motors. Superior brake force. Six-bearing linear actuator with a 49 ms average access time. Even an on-board microprocessor.

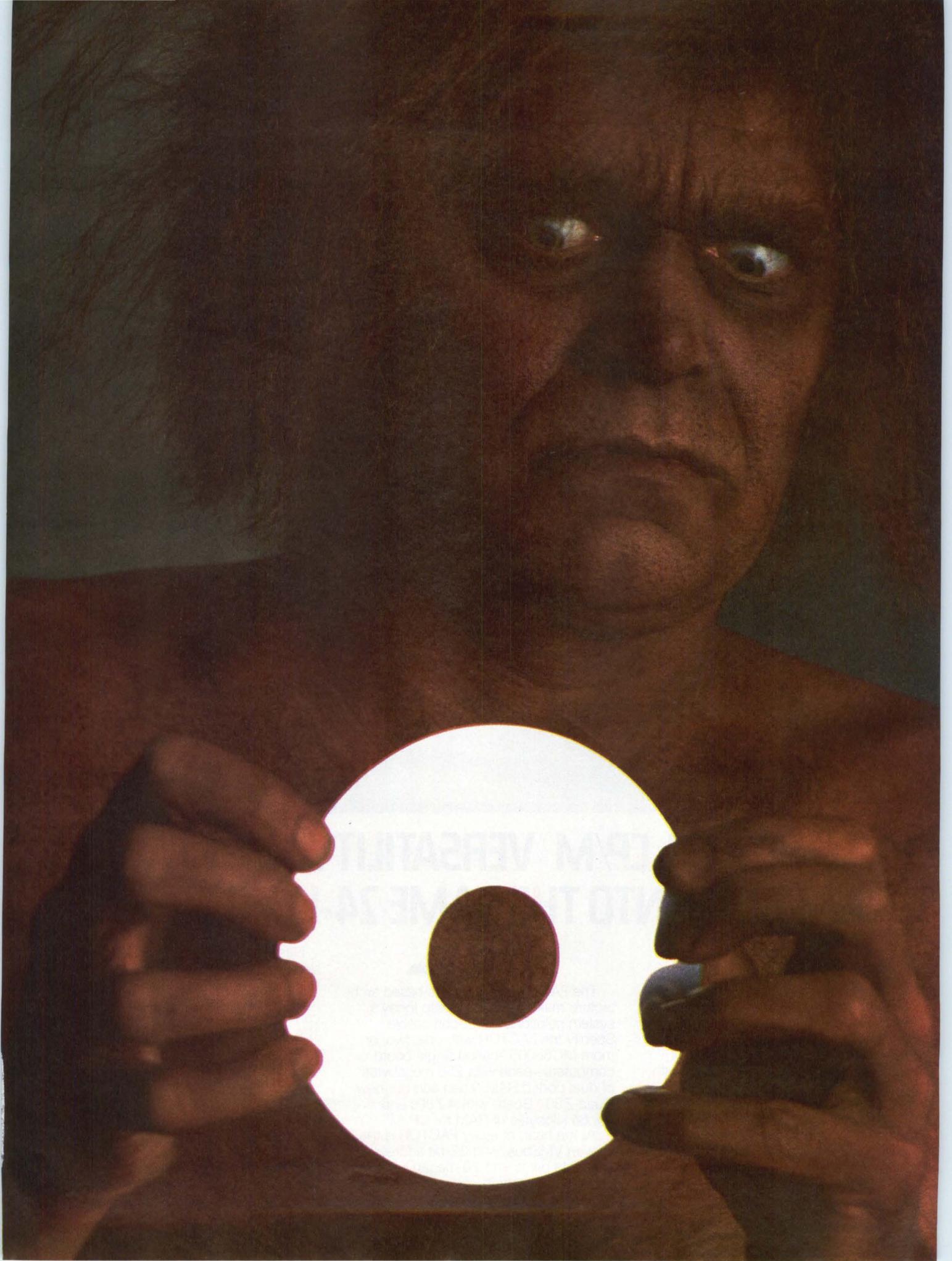
And best of all, we're shipping in volume now. That's right, now.

Write Evotek at 1220 Page Avenue, Fremont, California, 94538. Or call Barry Dyckman at 800/255-2500. (From California, call 415/490-3100.)

He'll tell you more about the evolutionary technology an OEM needs to stay ahead of the times.

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UNIX™ POWER. CP/M™ VERSATILITY. NOW FACTOR THEM BOTH INTO THE SAME 24-USER SYSTEM.

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Now 24 users can explore the power and programming depth of real UNIX without giving up their investment in 8-bit software. You can simultaneously run *both* UNIX System III and CP/M 2.2 on the same Victory FACTOR, with optional multi-CPU support for up to 24 users. So while some people load CP/M for 8-bit applications in word processing, spreadsheets, and DBMS, others can move full-speed into the expanding realm of 16-bit UNIX business software.

The FACTOR: Ultimately OEM'able.

The FACTOR's 32-bit bus-based architecture makes it easy to keep today's system solutions future-compatible. Specify the FACTOR with one, two, or more MC68000™-based single board computers—each with 256 megabytes of dual ported RAM. Then add our new Quad-Z80™ Board with 4 Z80s and 4 x 64 kilobytes of RAM for CP/M.

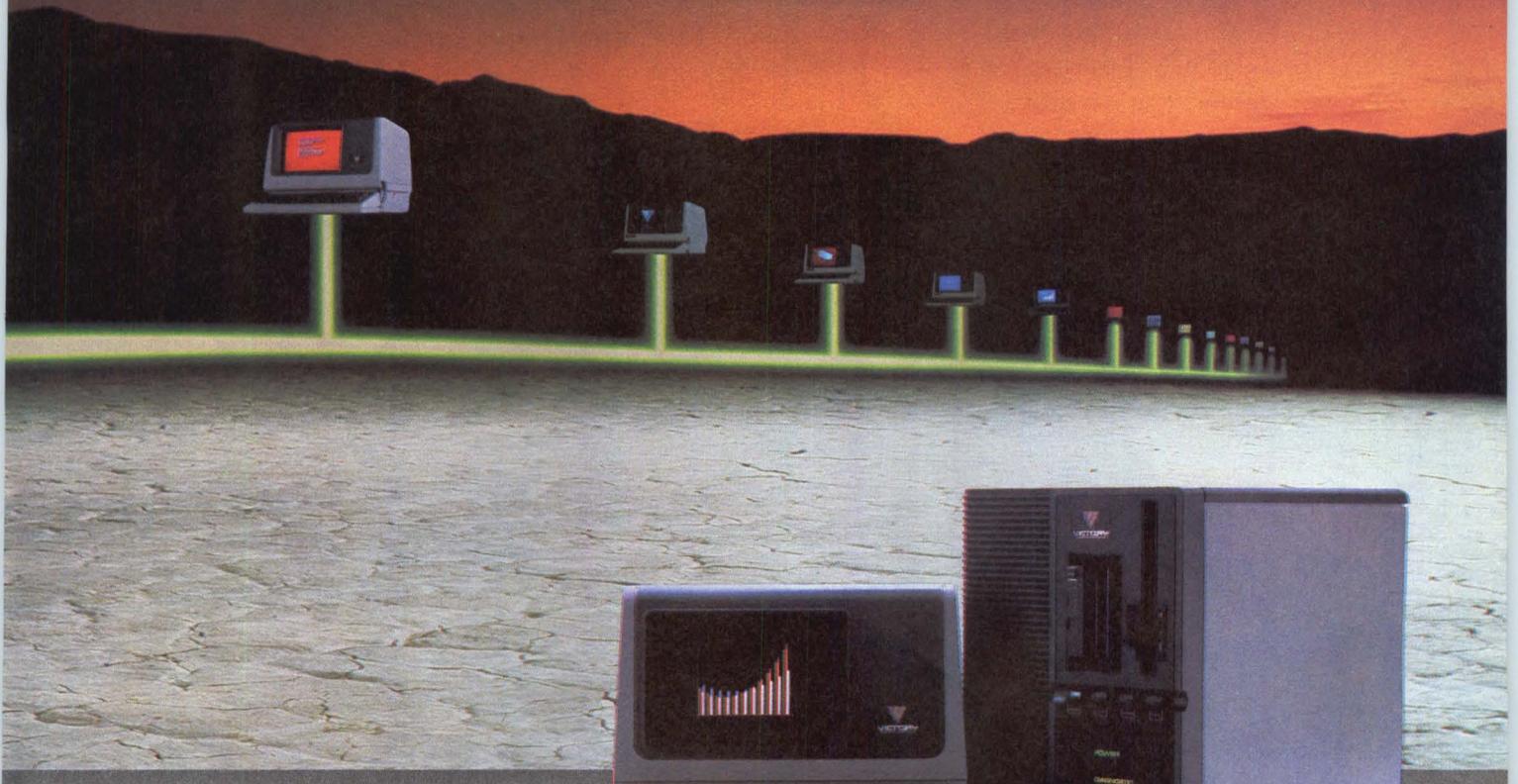
At the heart of every FACTOR is the proven VMEbus, with 32-bit address and data paths and 20 megabyte-per-second throughput.

Nestle all this power into the same sleek system with a combination of Winchester hard disks, floppy disks, and a removable cartridge hard disk. You can have them all standard, for up to 104 megabytes of unformatted capacity.

Here's Another Vital Factor. The Price.

The Base FACTOR supporting 8 users retails for a suggested \$13,950. (And we'll factor-in a substantial OEM quantity discount).

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Victory FACTOR. Now you can add more power. Support more users. Or design custom solutions by factoring your choice of 8, 16, (and soon) 32-bit hardware and software into every multi-user system.

The Victory FACTOR. All in all, it's everything you could want in a microcomputer.

We want to tell you all there is to know about the Victory FACTOR. Call us today for the details.

CIRCLE NO. 103 ON INQUIRY CARD

THE ARCHITECTURE OF INTELLIGENT COMPUTING.

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System Hardware:

- Each single board computer with: 16-bit MC68000 CPU; 256 Kb dual ported RAM; 8 RS-232C Z80; serial ports, and a Centronics-compatible parallel port.
- New international standard 20 Mb/sec VMEbus.*
- Optional 1 MB RAM expansion board.
- Mass storage: Hard disk, floppy disk, and removable cartridge hard disk built-in (29-104 Mb UF)
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- Graphics terminals in monochrome or color.
- Optional Quad Z80 Board for CP/M (4 Z80s, each with its own 64Kb RAM).

System Software:

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- Optional VRTX real-time kernel.
- Available languages: SMC Basic; Fortran '77; Pascal (IEEE Standard); RMCOBOL ANSI '74 Standard (Ryan-McFarland).
- Choose from the growing list of UNIX software for word processing; spreadsheet, DBMS, and advanced communications.
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Computervision unveils products, new approach to CAD/CAM market

Computervision Corp., Bedford, Mass., plans to develop a database-management system based on IBM Corp.'s 4300 series computer, as well as a single-user computer-aided-design (CAD) workstation based on a Sun Microsystems Inc. microcomputer. The move signals not only a broadening of the company's product line but also a departure from the company's traditional vertical integration approach to the CAD/computer-aided-manufacture (CAM) market.

Until now, Computervision, the leading CAD/CAM vendor, has developed and built the components of its systems, including both hardware and software. The company will continue to follow that path with its "core" product offerings but will turn to outside vendors for high- and low-end applications, states James R. Berrett, company president and chief executive officer. Computervision's core products will be based on a new family of systems incorporating the company's proprietary analytic processing unit (APU), a 32-bit minicomputer. Computervision introduced the first member of that family—the CDS 4000—when it announced the IBM and Sun Microsystems arrangements. "In the early '70s, when Computervision started this whole CAD/CAM business, it was easier to manufacture every component of their systems," remarks Timothy Gauhan, vice president of the CAD/CAM Industry Service with Dataquest Inc., Santa Clara, Calif. "Now, I think they realize that the market is changing too fast, and if they want to stay ahead, they can't design and build everything."

Expected to be ready for ship-

ment by year-end, the IBM-based system will be aimed at the high-end factory-automation market and targeted for database-management and -control applications. The Organization for Industrial Research (OIR), which Computervision acquired last July, will write software for the product. "The databases that engineers use to design products and get them to the manufacturing stage are getting larger and larger," explains Berrett. "To extend the capabilities that we offer customers, we needed a computer system capable of handling these databases. We went to IBM because the company has set the standard in database management."

Although Computervision and IBM are rivals in the CAD/CAM market, with IBM holding the number-two position, Berrett contends that the IBM deal will not cause significant overlap in the two companies' products. He concedes, however, that the deal will facilitate selling CAD/CAM systems to customers with IBM machines. Computervision will tailor its software packages to run in the IBM environment, but Berrett does not comment about whether IBM's main CAD/CAM offerings will be made compatible with Computervision systems. IBM's main CAD/CAM offerings are CADAM—a 2D mechanical drafting package written by Lockheed Corp.—and CATIA—a 3D design package written by French aerospace supplier Dassault. IBM sells both packages with its mainframe computers.

"To a limited extent, IBM and Computervision do compete in the CAD/CAM marketplace, and this new

arrangement will give Computervision an edge when selling to an IBM user," comments Laura Conigliaro, an analyst with Prudential-Bache Securities Inc., New York. "But let's face it: IBM doesn't make its money from selling CAD systems, especially considering that their software is supplied by other vendors. They make their money from selling computers, and that's what they're doing here."

Berrett does not reveal the value of the IBM deal but claims that Computervision will be IBM's largest Value-Added Remarketer (VAR). To qualify as a VAR, Computervision must add both hardware and software value to the 4300 series system.

The low-end workstation product that Computervision announced (see "Emerging low-end CAD market attracts attention," Page 189) will be ready for shipment in 1984.

Of all the recent Computervision announcements, the only product ready for shipment is the CDS 4000 system. The first Computervision offering to include the APU, the 4000 has a virtual-memory operating system—Computervision's CVMOS system—and supports program development in FORTRAN and Pascal. More than 2 million lines of application code for the system have been written. The CDS 4000 supports as many as 26 users. Price is about \$500,000. —Frank Catalano

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- New workstation products for business graphics and general office applications
- What's new in terminal design?

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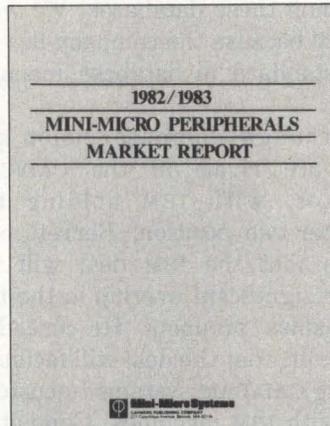
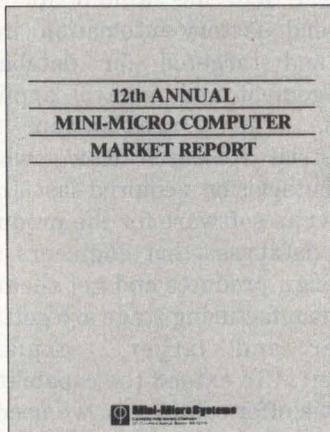
These reports define and detail the buying activity among computer resellers (third party OEMs) and sophisticated end users. If you're competing in this market, you need to know who is buying what equipment and why. Our reports will help you. We document computer buying power. And detailed knowledge is power.

Mini-Micro Systems' 12th Annual Mini-Micro Market Report presents a collection of perspectives allowing the reader to see how computer manufacturers fare by:

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- Computer operating systems

CIRCLE NO. 105 ON INQUIRY CARD

These reports are a must for executives marketing computer products

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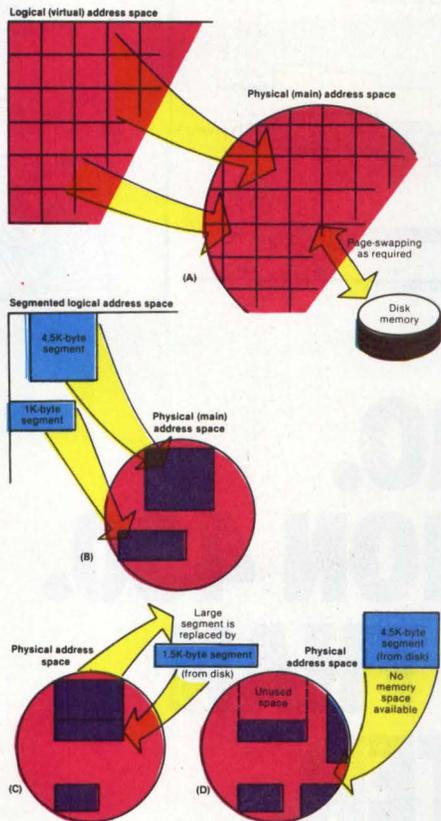
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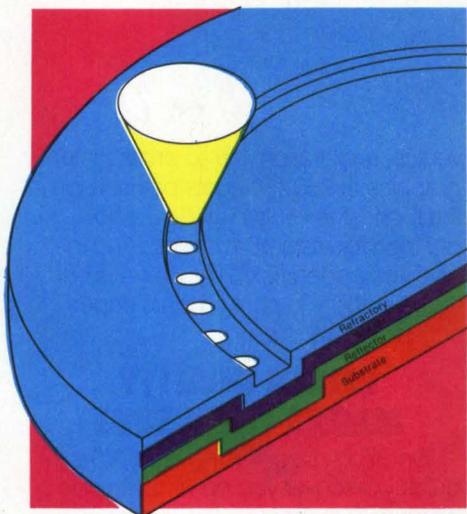
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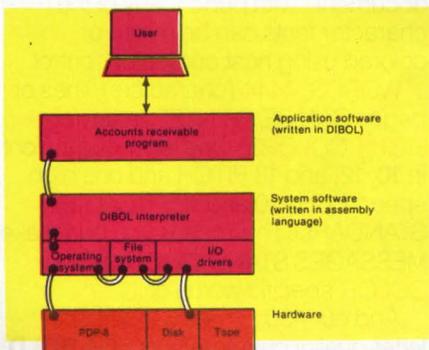
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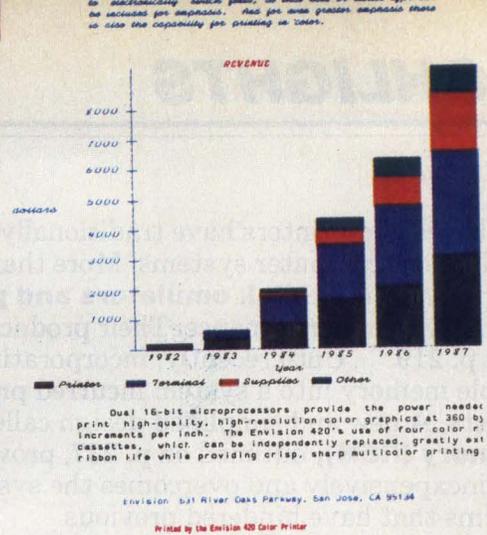
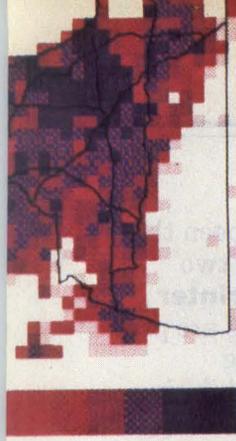
MEMORY: Disk drives and printers have traditionally been the slowest elements in most computer systems. More than two dozen manufacturers now offer **disk emulators and printer buffers** to increase system performance. Their products are profiled beginning on p. 219. . . Until recently, incorporating content-addressable memory into a system incurred prohibitive manufacturing costs. A new and simplified design called **recognition memory (REM)**, outlined on p. 237, provides this feature relatively inexpensively and overcomes the system-integration problems that have hindered previous architectures. . . Upgrading the performance of multiuser computer systems to keep pace with a growing number of users and an increasing application work load can be difficult, if not impossible. The **variable resource architecture (VRA)** of the BTI Computer Systems model 8000, detailed on p. 245, solves this problem by using main memory as a shared resource. . . The next generation of micros, the 32-biters, has arrived with a flourish. Its value lies partly in its ability to use mainframe techniques such as hardware virtual memory. An example of the new micro is Logical Microcomputer Co.'s **LMC-16032 Megamicro**, which is discussed on p. 259. . . A major problem in configuring clustered host/satellite systems is controlling shared access to host memory. Ranyan Computer Enhancement Systems' **peripheral processor link (PPL)** for DEC Q-bus- and Unibus-based computers, described on p. 271, is a board-level solution.



STORAGE: While magnetic-based disk drives are cost-effective choices for most applications, **laser-based optical disk drives** provide a storage solution for systems requiring large amounts of archival storage. One such drive is the Optimem 1000, developed by Shugart Corp.'s Optimem Division, which offers 1G byte on a 12-inch disk using non-erasable laser-recording technology. The cover story starts on p. 277. . . **Recording densities** have been increasing at startling rates. Today, 1 square inch holds as much data as more than 3 square feet of media did nearly 30 years ago. For a look at magnetic-tape advances and recent disk-recording techniques, see p. 287. . . In the 10 years since its introduction as an IBM product, the **floppy disk drive** has become a valued item in computer system sales and, most recently, in small business computer sales. See p. 297 for a closer look at evolving strategies in this burgeoning market.



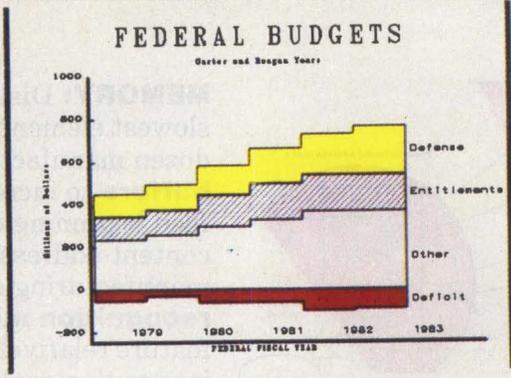
ALSO: Software: Bridge software offers a solution to porting difficulties between proprietary language software and operating systems. See p. 305 for more information. . . **Microcomputers:** Zilog Inc.'s FPP-8/01 floating-point coprocessor option for its System 8000 family combines accuracy and user-transparent operation with bipolar, bit-sliced speed. This 120-KFLOPS number cruncher is profiled on p. 311. . . **Product law:** Knowing how to create a name that is protected by law and how to enforce that protection are essential in today's highly competitive market. Check p. 319 for more information on product and company trademarks.



defined as applications that convert data into a chart or graph for data analysis, presentation, or a report. Currently, the dominant user groups are technical people who use graphs as tools in their everyday work. It is this group that has written most necessary software which enables the non-technical users to begin to use business graphics.

The Computer Graphics Market

Legend: CAD/CAM, PROCESS CONTROL, OTHER



of having the single state ψ_{100} . Similarly, state 3D becomes the pair ($n = 3$), the D signifies $J = 2$, and

Fine structure of the $n = 2$ state of hydrogen

We return now to our original quest: the energies of the states? We see state, obtained from $J = n = J$, the that is the implication of adding moments associated with L and B

RED HOT DEMO. SEE THE NEW ENVISION 430. IF ITS NOT MORE THAN A COLOR PRINTER, IT'S FREE.

You really can't lose. Because if we can't prove our new Envision 430 Color VectorPrinter™ is more than a color printer, we'll give it to you on the spot. Free.

WHAT YOU DON'T KNOW

What you might not know is that our new 430 has the uncanny ability to print high resolution pen plotter graphics. It can do that because we designed vector-to-raster conversion right into the printer.

And to make our 430 that much better than any other color printer you can buy, we also gave it the ability to print 100 characters per second in letter quality mode or 300 characters per second for drafts. This means our 430 gets your work done a lot faster. It also means you can print high speed drafts, letter quality text, high resolution raster graphics and plot vector graphics—on the same page! So when you buy our new 430, you're really getting four very usable talents in one very versatile printer.

A VERITABLE PARADISE OF COLOR

Even if you're not a Van Gogh, our new 430 gives you the ability to create inspired color graphics. It prints any four colors of red, green, blue, cyan, magenta, yellow or black in a single pass. You can also blend any of these colors to create an entire spectrum.

And because a one-eighth inch solid color band is printed on each pass of the 18-wire printing head, our 430 creates your masterpieces with incredible speed.

UNCOMMON VECTOR/RASTER GRAPHICS

We made our 430 compatible with the Hewlett Packard 7220 pen plotter. That means it's supported by a host of business, engineering, and scientific graphics software packages. And it gives you printed quality that's nothing short of superb. As well it should. Because we designed our 430 with exceptionally accurate horizontal and

vertical registration. It also prints raster graphics at 360x144 dots per inch for the highest resolution or 72x72 dots per inch for maximum speed. And to give you added flexibility, we gave our 430 the ability to print on plain paper and transparencies.

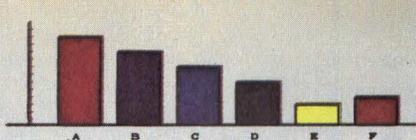
LETTER QUALITY MAGNA CUM LAUDE

When you begin using our 430 you'll quickly discover you don't have to be a wordsmith to create letter quality documents with punch. Any of the character fonts can be mixed or colored using host computer control.

WORDS, 4444 (characters), lines or pages **CAN BE PRINTED** in any of **EIGHT COLORS**. One letter quality font in 10, 12, and 18 PITCH and one high speed font in 10 and 12 PITCH ARE STANDARD. This means you can make **MESSAGES STAND OUT**. You can **COLOR** specific words or **IDEAS**.

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

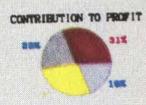
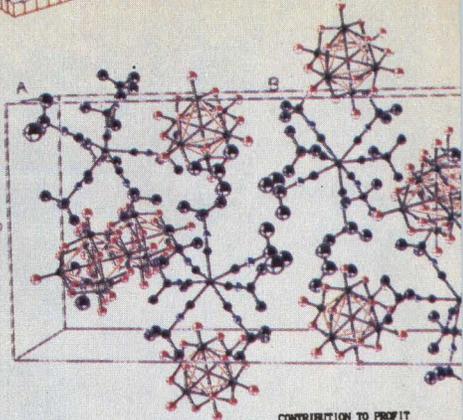
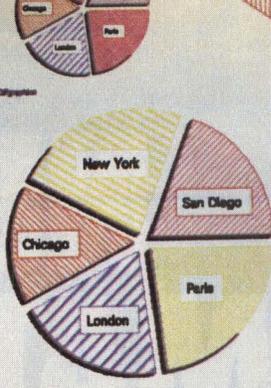
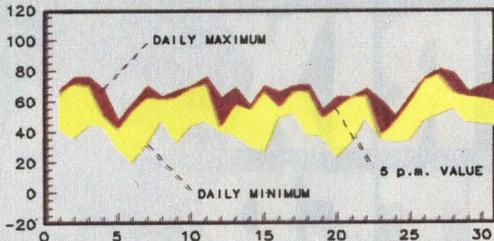
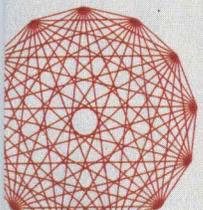
$j = 1$, for example, any z such that $z^2 = -1$, so that $z = i$ or $z = -i$. The pair $2P_3/2$ and $2P_1/2$. The 3 means shell 3 $1/2$ means $j = 1 - z = 2 - 1/2$.



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.

How does the electron spin affect... For example, in the $2P_3/2$ state, the magnetic dipole moment μ_B and μ_M are also parallel.



can define up to 196 characters to print both text and graphics. And to add versatility to your text creations we made our 430 compatible with the **Diablo 630 ECS**. Which means it supports the most popular text and word processing packages.

NO MORE RIBBON WASTE

Another nice little benefit of our 430 you won't find in other color printers is a four-cartridge ribbon system. Our separate color cartridges advance independently as each color is used. By doing things this way you don't end up wasting ribbon or running out of the color you want just when you want it. It also means lower cost per copy for you. Plus you also have a choice of high quality mylar ribbon cartridges and longer life nylon ribbon.

YOU DON'T HAVE TO PASS UP SPEED FOR QUALITY

Our 430 has been designed with an 18-wire printing head. This means that instead of having to pass over a line more than once to achieve high quality, our 430 prints letter quality characters in a single pass. It also does this with a great deal more speed because it never has to retrace the same line.

And while we're talking about speed, you should know we built our 430 with

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.



THE 430's UNFORGETTABLEY EFFICIENT

If you tear down our 430 you'll find two 16-bit microprocessors. One of them controls the printing mechanism; the other takes care of the host interface and command interpretation.

They both share a 128K-byte bit-map memory. So while you're busily telling the 430 what to print next—it's busily printing what you told it to print last.

CIRCLE NO. 106 ON INQUIRY CARD

A RED HOT DEMO

We think you'll be impressed when you see our 430. But that's not enough to get you to pick up your telephone and call. So if we can't prove it's more than a color printer, we'll give you a 430. Free.

Show a little sporting interest and take us up on our offer. You'll get a red hot demo and a chance to buy a printer and a plotter. Send us the coupon or call. Envision, 631 River Oaks Parkway, San Jose, CA 95134, (408) 946-9755 or Telex: 176437.

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

MM 10/83

**OK, ENVISION...
PROVE IT TO ME.
PLEASE CONTACT ME
REGARDING A DEMO.**

NAME _____

TITLE _____

COMPANY _____

ADDRESS _____

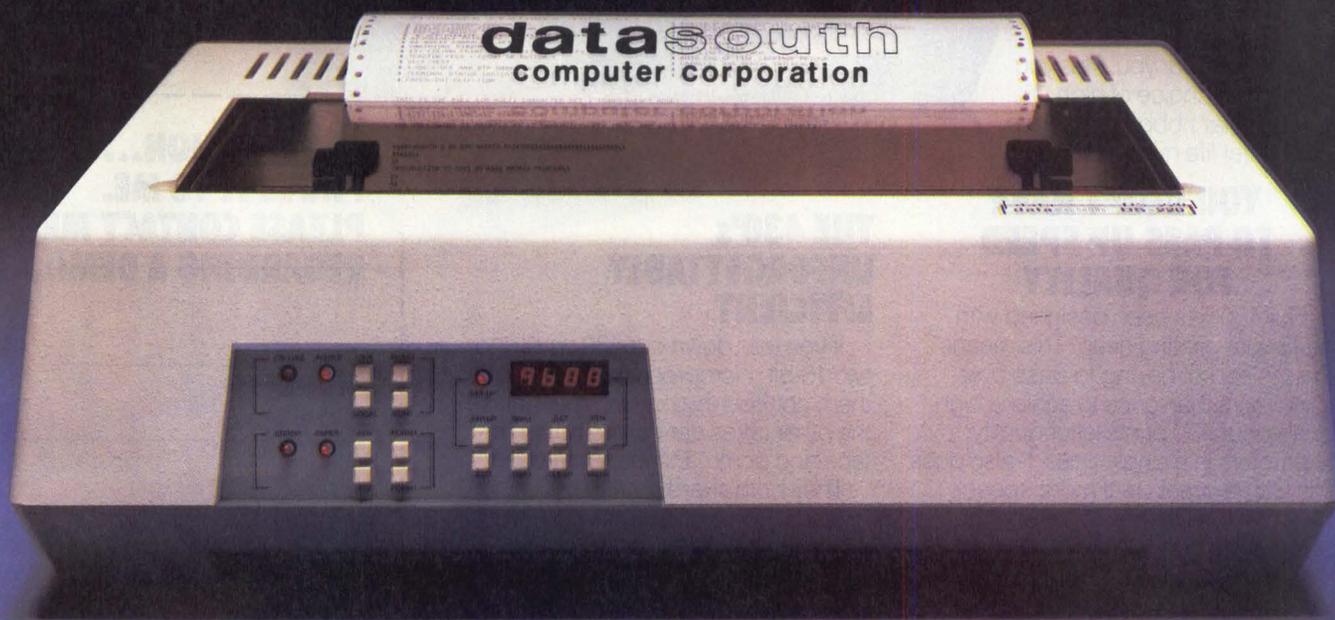
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NEW MATRIX PRINTER OUT PERFORMS ITSELF 3 TO 1.



H I G H P E R F O R M A N C E

INTRODUCING THE NEW DS220 MULTI-MODE MATRIX PRINTER

In the beginning was the Datasouth DS180. A printer that *defined* high performance printing, with a balance of high technology design and mechanical simplicity. A high throughput printer that produced clean hardcopy under the most severe conditions.

Now there's the Datasouth DS220. A printer that raises those high performance standards and applies Datasouth technology to multiple printing tasks—all at one time.

The Datasouth DS220 redefines high performance for multimode printing the way the DS180 did for data quality printing.

For speed, the DS220 combines a 220 CPS print speed with servo-controlled logic seeking and high-speed tabbing over blank spaces. This allows the DS220 to zip instantly from one printable character to the next. In side-by-side tests of real-task performance—not just spec-sheet comparisons—the DS220 outperforms its rivals time after time.

For correspondence, the DS220 uses its 40 CPS bi-directional NLQ mode to form characters with the precision and clarity you would expect from a word processing printer.

And for graphics, the DS220 adds high performance artistry to popular microcomputer applications programs through high-resolution, dot-addressable output. Sharp new details emerge from business charts and graphs, and from engineering drawings.

The sum is even more than three printers in one. The DS220 offers a total of eleven different pitches and fonts along with seven international character sets. Plus non-volatile space for up to 64 do-it-yourself characters for downloading from the host computer.

And those are just the printing capabilities. In other respects, the DS220 outperforms not just itself but virtually every other printer on the market. Its front panel programming sets new standards in user friendly printer ergonomics. Its four digit LED display and push button panel allow programming of over fifty features, with a minimum of fuss and confusion. Those features include a variety of interface and communications selections that allow compatibility with a wide range of mini and microcomputers. And the DS220 handles six part forms with its adjustable tractor feed, as well as cut sheets and letterhead with its friction feed.

Best of all, the DS220 advances all the engineering, design and mechanical virtues established by its forerunner, the DS180. In the Datasouth tradition, the DS220 is made to run virtually nonstop in a wide variety of applications.

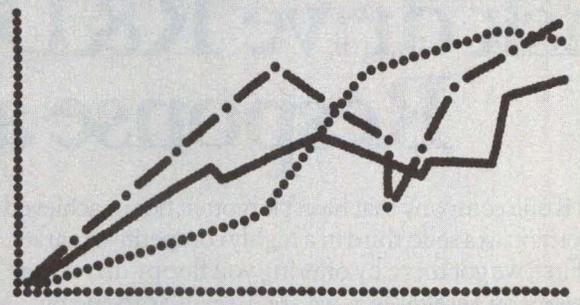
Test drive three high performance printers in one—the multimode DS220.

Call for details and the name of your nearest Datasouth sales/service distributor.

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PERFORMANCE

HIGH
PERFORMANCE

HIGH
PERFORMANCE



Simulated output shown. Call or write to Datasouth for samples of actual output.

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First, we got there by offering you floppy drives that are every bit as reliable as we are. Because producing top-quality, top-performing drives has always been our number one commitment.

Our 5¼" line comes in three different densities (48 TPI, 96 TPI, 100 TPI) to match your application. They're single and double-sided drives with capacities from 250 Kbytes to 1 Mbyte. And our Slimline™ series, at 2" thick and 11.5" deep, are quite simply the smallest 8" disk drives ever made.

Second, we understand that even the

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Assigned memory: disk emulators, printer buffers boost computer-system performance

MALCOLM STIEFEL, Contributing Editor, and JESSE VICTOR, Associate Editor

Add-on electronic memory devices can provide 300-fold increase in system throughput

As computer workstations proliferate on desktops for business, scientific and educational applications, users are beginning to look at these machines with much more critical eyes. Performance is suddenly becoming an issue. Users are no longer content to wait as their floppy disks grind away for every disk I/O or watch impatiently for their printer to eke out its dot-matrix characters while the computer waits for the unit to complete its task. Responding to this need for products

that can speed the slowest elements in most computer systems—the disk drive and the printer—manufacturers now offer disk emulators and printer buffers for personal computers that can increase system throughput and boost user productivity.

RAM disks slash access times

Conventional disk memory systems, using either hard or floppy disks, involve mechanical actions—positioning the head over the disk, reading the disk and moving to another data sector—that are comparatively slow compared to the processing speed of the computer itself. Plug-compatible replacements for conventional rotating memory systems, completely solid-state disk emulators or RAM disks can provide significant improvements in disk I/O times by eliminating these mechanical actions (see “How fast are RAM disks?” Page 225). Available for several years for minicomputers and mainframes, RAM disks offer other performance advantages for personal computer systems in addition to speed (Fig. 1). Furthermore, they are completely transparent to host computer systems, requiring, in most cases, only plugging in an interface card for operation and no changes in host-computer software.

This profile and table are restricted to third-party vendors from an expanding number of independent vendors. The RAM disks surveyed are used mainly to replace conventional peripheral rotating-memory devices and only sometimes used to augment the host computer's main memory, although some units, such as the Quick Disk from CTC Electronics, can be configured as cache memory for the host. Software implementations of disk emulators that use a portion of the host

DISK-EMULATOR SYSTEMS	
Advantages in comparison to conventional rotating-disk drives	Applications
Much faster disk I/O times	Faster disk I/O
Increased throughput in many computer operations	Swapping files
Elimination of component and media wear inherent in conventional disks and drives	Overlay storage
Less data lost due to disk errors	Database management
Elimination of power supply, mechanical and maintenance problems of floppy disk drives	Holding large scratch files
Reduction of standby power needed for data integrity	Matrix transformation
Ability to function in hostile factory environments	Graphics
Special operating-system-plus software for fast loads, diagnostics and copy routines for some systems	Array processing

Fig. 1. Lightning-fast disk I/O time is only one of the many advantages of using disk emulators in a wide range of applications.

computer's main memory are gray-area products not included in the table.

Serving microcomputers to mainframes

Disk emulators can serve microcomputers, minicomputers or mainframes; use MOS RAM or ferrite-core memory elements; and range in price from \$1,000 to more than \$100,000 at the high end. Typical of the units in the microcomputer segment is the Ram disk 320 from Axlon Inc. Plug compatible with Apple Computer Inc. and Apple-compatible computer systems, as well as the Atari 800 and Bell & Howell Co. microcomputers, it includes a slot-independent interface card and delivers 320K bytes of RAM that functions as two 35- or 40-track floppy disk drives or one 80-track unit. System integrators can cascade as many as four devices for more than 1.3M bytes of 200-nsec. memory. The built-in power supply draws no power from the Apple system, and, in the event of power loss, the battery backup furnishes emergency power for at least three hours. Software includes diagnostic, fast-load, copy and business routines. Also noteworthy is CTC's Quick Disc for the IBM Corp. Personal Computer. It fits on top of the PC and features 128K to 4M bytes of semiconductor memory, a power supply with full battery backup, double-bit error detection, single-bit error correction and scrubbing and the cache-buffer capability. The interface board plugs into one of the PC's device adapter slots.

Most of the profiled disk emulators serve minicomputer systems and fall into the middle performance and price range. Dataram Corp.'s BC-101 Bulk Core (ferrite core) and Bulk Semi (semiconductor) lines, for example, comprise a wide range of units that work with minicomputers from Digital Equipment Corp., Data General Corp., Honeywell Inc., Perkin-Elmer Corp., Intel Corp., Gould Inc. and other manufacturers. Transferring data at rates as high as 64M bytes per second, the devices come in dual-port versions that can function simultaneously with two minicomputers. Various Bulk Semi units incorporate error detection/correction, provide a 48- or 80-bit word (without error-correcting circuitry) and offer optional battery backup.

Ampex Corp. also offers a wide range of disk emulators for minicomputer systems, with some versions using non-volatile core-memory elements. Megastore units, depending on model, have 512K- to 32M-byte capacity; transfer data at 4K to 2M bytes per second and feature internal parity generation and checking, error detection/correction, dual-port options, write protection, extended-instruction mode and DMA controllers. For example, the Megastore 11DS for DEC PDP-11 PDP-11 systems uses 64K-by-1 dynamic RAM chips for as much as 8M bytes of storage in 2M-byte increments. A functional equivalent to RJS04 fixed-head rotating-disk memory, it specs 4- μ sec. access times and 780K-word-per-second (wps) read and 700K-wps write data-transfer rates. Featuring dual-port and error-detection/correction capabilities, the Unibus-compatible unit comes with its own power supply and fits in a standard 19-inch rack.

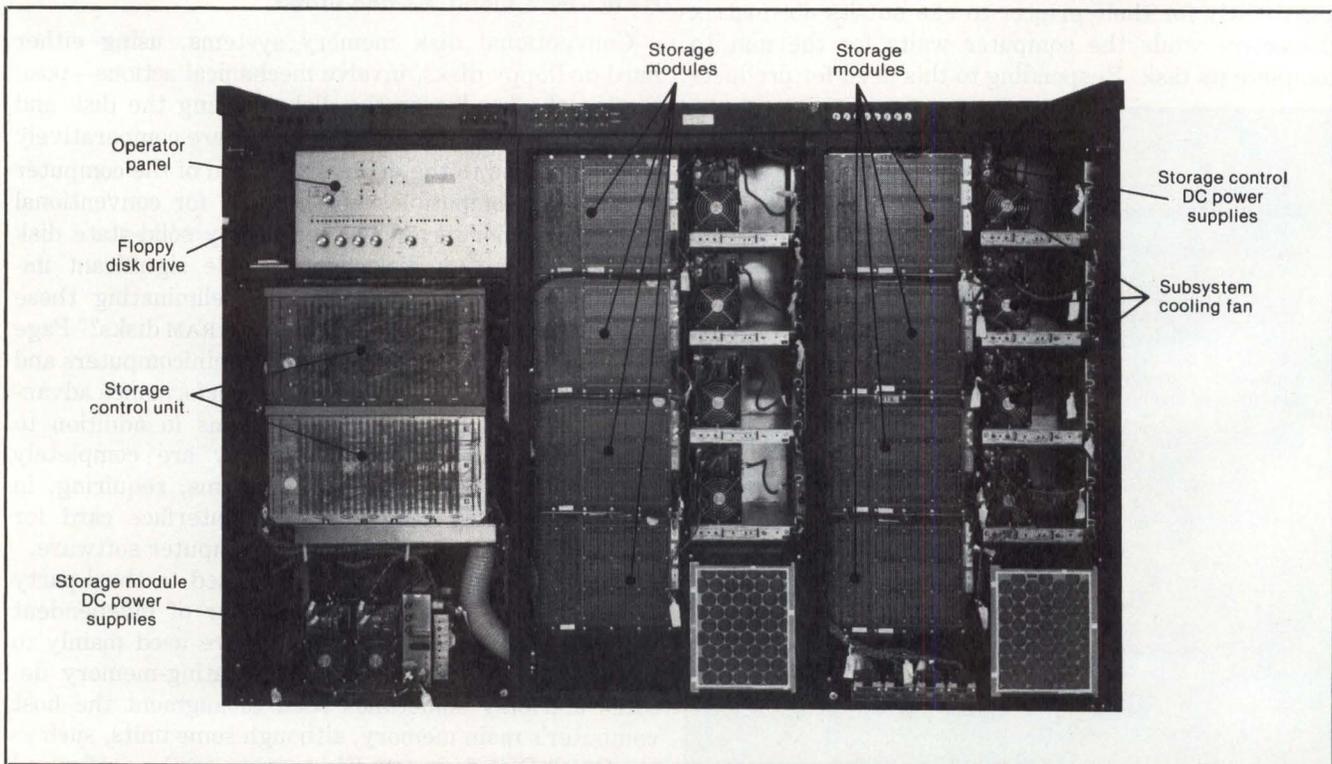
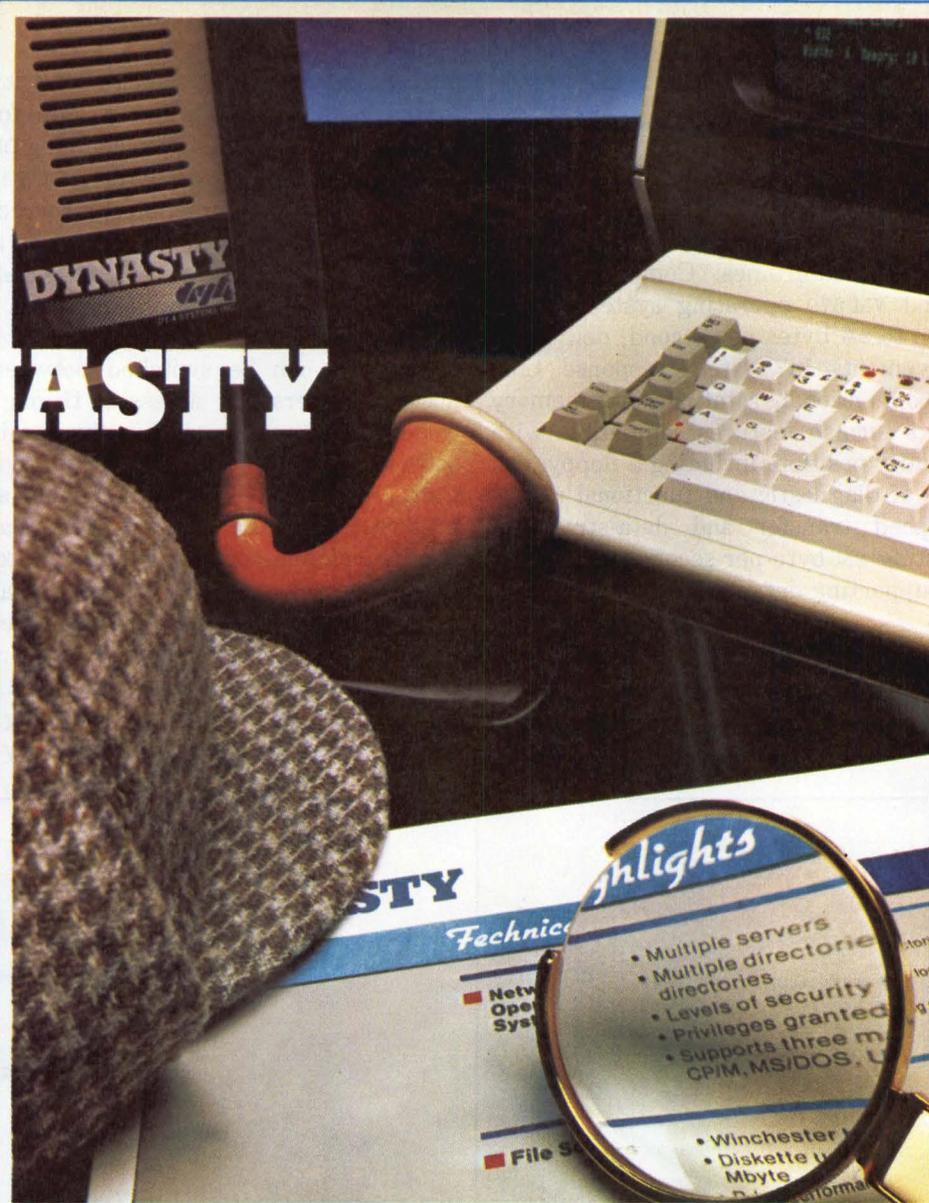


Fig. 2. Modular expandability gives Storage Technology Corp.'s 4305 model 6 Solid State disk 96M bytes of unformatted storage. Each storage module uses 64K MOS RAMs and holds 12M bytes. The two storage-control units provide a separate data path to the storage modules. The flexible disk drive transfers microdiagnostics and functional microcode in IBM mainframe computer systems.

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MA

MEMORY

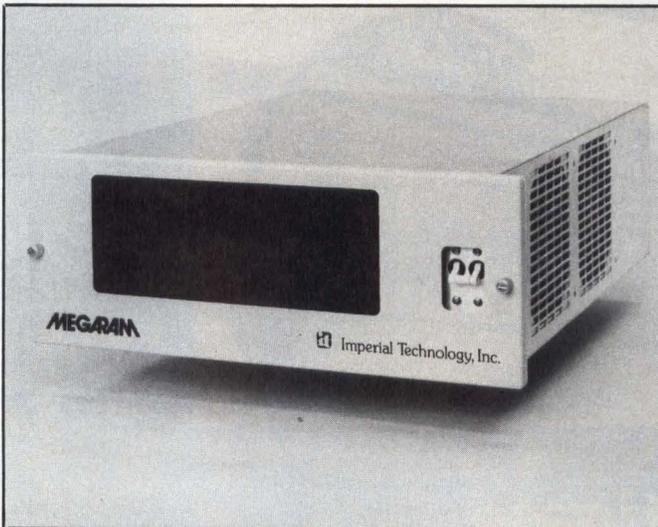
Storage Technology Corp.'s (STC's) 4305 series RAM disks (Fig. 2) are high-end devices that furnish 11.25M to 90M bytes of capacity per subsystem for IBM 370, 303X, 3081 and 4341 mainframes. Compatible with OS/VSL, OS/VS2 and VM/370 operating systems, they transfer data at up to 3M bytes per second, delivering significant improvements in system response time compared with conventional rotating-disk memory systems. The units furnish features compatible with their top-of-the-ladder position, including a floppy disk drive for transfer of diagnostic and functional microcode and high-speed transfer and data-streaming capability, permitting 3M-byte-per-second data transfer on a channel supporting data-streaming protocols.

Software enhances emulator performance

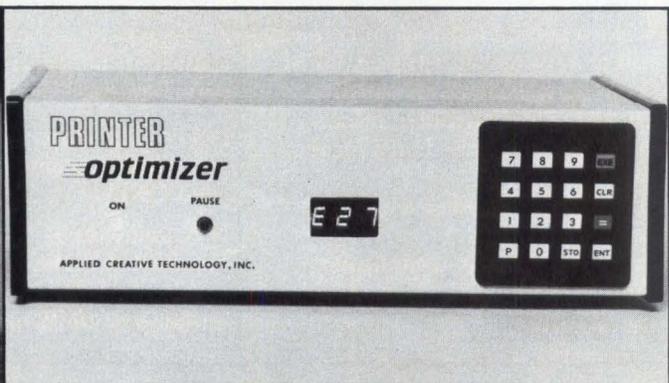
Many profiled units incorporate some of the latest software wrinkles. The MegaRam 20 from Imperial Technology Inc., for example, has an internal micropro-

grammable controller, which allows it to emulate two DG drives (6001 or 6063 series units) for Eclipse, Nova or 1200 series computers by changing DIP switches. The emulator also packs 8M bytes in a 7-inch chassis and provides full error detection and correction. Other disk emulators in the series store as much as 32M bytes (to 80M bytes daisy chained) for DEC, Sperry Univac and Hewlett-Packard Co. minicomputers. The STC 4305, used in place of a paging disk in virtual-memory operations, can be switched between two different hosts, or users can access it through two different channels from one host. Finally, consider a gray-area software-emulation package. Proto Systems, Berkeley Calif., has created the D-M-Driver, a \$550 software product that uses a segment of the main memory on a PDP-11 computer running under RSX-11M as a disk substitute. The vendor claims emulation of 64K- to 3.75M-byte rotating disks using this technique.

Disk emulators are primarily characterized by storage capacity, which must be at least as large as the rotating memory they are replacing. Profiled units provide 512K to 90M bytes of memory per subsystem,

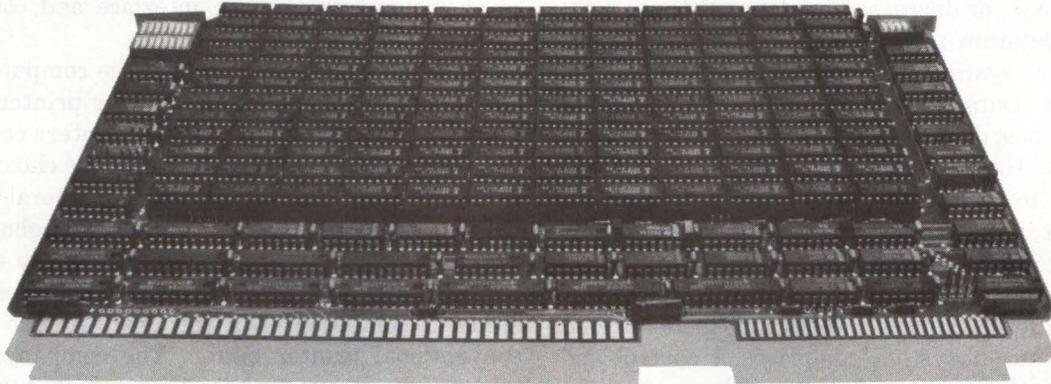


Replacing rotating-disk drives in minicomputer systems and for the IBM Personal Computer, respectively, Imperial Technology Inc.'s MegaRam (left) and CTC Electronics' Quick Disc furnish up to 32M and 4M bytes of semiconductor memory. The MegaRam transfers data to 8.3M bytes per second and, depending on the model, includes single-bit error detection/correction, optional dual-port capability and battery backup. Designed to fit on top of the IBM PC, Quick Disc can be configured as a disk emulator or cache memory and provides error detection/correction and battery backup.



Printer buffers can do much more than buffer data. The Microbuffer (left) from Practical Peripherals Inc. controls the printing of as many as 255 copies, accepts text and graphics and permits single-sheet printing and page formatting. Applied Creative Technology Inc.'s Printer Optimizer accepts printing-control commands via its 16-key keyboard and can handle up to 99 user-programmable strings of ASCII characters and perform character translation and filtering.

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● FEATURES ●

- 64K DRAM Capacity: 512K, 768K, 1M bytes
- 256K DRAM Capacity: 2M, 3M, 4M bytes
- Cycle/Access Time: 350/240 nsec
- Parity generation and checking with the parity output stored in an Error Status Register whose output can be jumpered to any bus interrupt
- Module selection on 4000_H boundaries in the 16M byte address field
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PART NO.	CAPACITY	TYPE
★MM-8500D	256KB	CMOS, Calendar/Clock
MM-8086C	64K-16KB	CMOS, Calendar/Clock
MM-8086	32KB	Core
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which can be increased or decreased for most systems by adding or removing memory cards or modules from a chassis card cage, or decreased by depopulating a RAM board. The Dataram model DR-329 Wide Word Bulk Semi memory system, for example, comprises a semiconductor Data (WSD) board, a semiconductor Control (WSC) board and one to 16 semiconductor Array (WSA) boards. Half- and fully-populated WSA boards provide 1M- to 1.25M-byte and 2M- to 2.5M-byte capacities per board, respectively. The system also provides a data word as wide as 80 bits, a 64M-byte-per-second data-transfer rate and a 325-nsec. access time. STC takes a different approach in its 4305 model 6 Solid State disk. The subsystem comprises a control and storage unit and can be configured with one to eight storage modules, each with a capacity of 12M bytes.

Data-transfer rate is another important indicator of RAM disk capability, although it is only one of the areas in which disk emulators can improve rotating-disk specs (see "How fast are RAM disks?" right). Available data rates range to 64M bytes per second in the Dataram units, the fastest units profiled. Disk emulators are also characterized by the company they keep—the host computers to which they are attached. RAM disks invariably substitute for a specific rotating-disk drive on a specific host, although, as noted, some units can be microprogrammed for two different drives from the same vendor. Many units come with their own controller; others require system integrators to provide control. Invisible to the user, disk-emulator code consists of device drivers and other modifications to the device's operating system, along with initialization routines that permit the emulator to exchange data with the host computer. Most semiconductor-based disk emulators provide battery backup in the event of power failure, although some units require frequent transfer of data to disk for data protection. Ferrite-core-based units are inherently non-volatile and don't need battery backup.

Profiling printer buffers

Like disk emulators, electronic printer buffers or spoolers can increase computer-system throughput by accepting strings of data from one or more host computers at high speed and transmit them at a lower speed to the printer, freeing the host for other tasks. The buffers profiled work only with microcomputers. Spooling of print jobs onto hard disk is quite common in larger computers. Usually, adequate buffering is provided in main memory, so that a separate buffer is not required.

Typical buffers have a capacity of 16K to 64K bytes and sell for less than \$1,000. Many sell for less than \$500, although some units, such as Quadram Corp.'s Interfazer, carry price tags to \$1,395. The Interfazer,

however, has a feature that accounts for its somewhat higher price: it connects a printer to as many as eight computers, accepting data via RS232C or parallel I/O cards. (Computer board rate does not need to match output board rate.) The device operates on a priority port system (first data in, first out) and also functions as an incompatible-device interface and computer-I/O expander.

Consolink Corp. has reversed the computer/printer-linking feature in its SooperSpooler printer buffer by connecting two serial or parallel printers concurrently to one host computer to offer a user the choice of letter- or draft-quality output. Practical Peripherals Inc. takes still another path in its MBIS Microbuffer. This standalone unit permits buffered two-way serial communication between the computer and another device—either a computer or a terminal. It also acts as a conventional printer buffer. The company has other tricks up its sleeve with its Microbuffer II PC board for the Apple II computer. It supports graphics functions that include 90-degree rotation of images, doubling of image size and dumping of reverse images.

Multiple-copy capability is a feature many printer buffers share. A typical unit, such as the PI-II from Warn Electronics Ltd., can control the printing of as many as 255 copies of a document, freeing users for other tasks. Although it is not clear that this method is less expensive than copying or offset printing, it's a useful feature nonetheless.

The Printer Optimizer from Applied Creative Technology Inc. is another versatile printer buffer with multiple-copy capability. It can also control the reprinting of full or partial text and features copy-pause, character-translation and -filtering and character-string capability. Users can select as many as 99 user-programmable alphanumeric or graphics character strings via the keypad and order the device to print a character string upon input of certain characters. The Z80 microprocessor-based unit provides data-compression capability, as much as 256K bytes of memory and an LED display for system-status information.

Housed in a plug-in board or a standalone chassis, printer buffers, like disk emulators, are primarily characterized by their storage capacity. The buffer must be large enough to hold several pages of text. (A 64K buffer can hold up to 32 pages of text at 2K characters per page.) Most of the profiled units spec capacities in the 64K to 256K range. Among the units profiled, Quadram's Microfazer stands out with a generous 512K. Buffers for multiuser systems or those with high printer duty cycles need more storage space than units for low-volume, single-user applications. As with the disk emulator listing, the table is restricted to devices from independent vendors. Unlike RAM disks, however, many printer spoolers can be made to function with several host computers or printers having serial or parallel interfaces. Printer-buffer software in some units permits a user to set margins and print

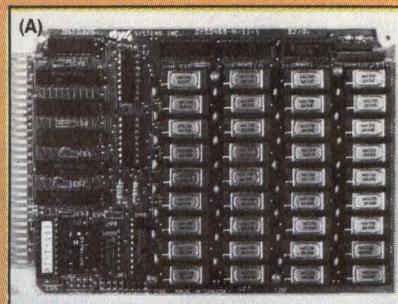
HOW FAST ARE RAM DISKS?

Disk emulators can significantly improve the throughput of computer systems by eliminating the relatively slow mechanical actions of conventional rotating-disk memory devices. But just how much of a performance gain system integrators can achieve using RAM disks depends on the computer system involved, the task to be performed and the claims on manufacturers' spec sheets. Performance improvement claims of 3,200 percent or 100:1 are not uncommon. Undocumented claims, however, are no substitute for controlled testing. Tests conducted by two disk emulator manufacturers can serve as a realistic index to the performance boosts afforded by disk-emulator systems.

Dramatically slashing disk I/O times, dy-4 System's (Ottawa) 256k-byte DSTD-325DP RAM disk card (A) outperformed an 8-inch double-density floppy disk by about 160:1 and an 8-inch Winchester hard disk by more than 23:1 in transferring a 256-byte block of data (B) in tests performed with a 4-MHz system. In general, tasks that are extremely disk-I/O intensive benefit the most from RAM-disk systems. Such performance improvements, however, are not as dramatic for all computer operations, as shown by dy-4 System's tests involving other computer-system activities. The bar graphs compare RAM disk performance to that of various rotating media in editing search functions on a 78k-byte file with MicroPro International Corp.'s Wordmaster (C); assembling a 21k-byte file with Phoenix Software Inc.'s PASM and creating an 86k-byte PRN listing and 8k-byte Hex file (D), loading 24k bytes of Microsoft Corp.'s Interpreter BASIC-80 Version 5.21 (E) and searching/counting 1,000 85-byte non-indexed records using Ashton-Tate's dBASE II (F). (All tests used Digital Research Inc.'s CP/M 2.2 operating system and deblocking algorithms for the disk drives.)

Testing by Storage Technology Corp. using its STC 4305 Solid State disk modules with IBM Corp. main-frame computer systems provides another indication of disk-emulator performance. The STC 4305s furnished better I/O response time than the IBM 3350-compatible STC 8350 hard disk or the STC 8380 disk drive (G) under the same fixed load but with varying degrees of channel-path utilization. Significantly, disk-emulator response holds up as path utilization approaches 80 percent. The 1.5M- and 3M-byte STC 4305 bested both the STC 8350 disk drive (H) and the

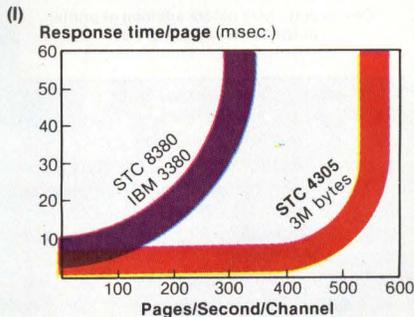
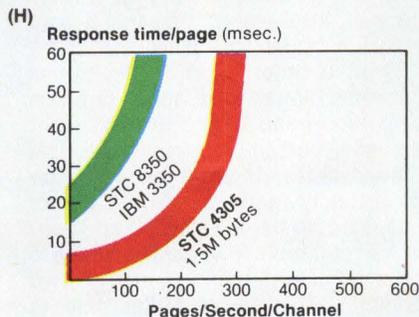
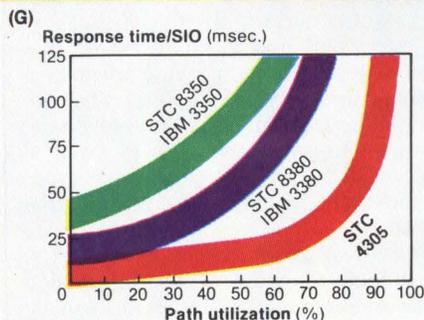
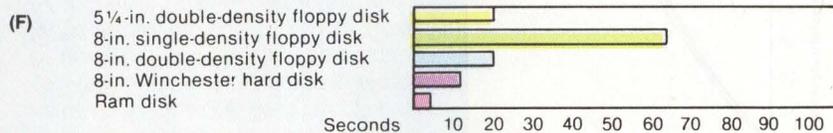
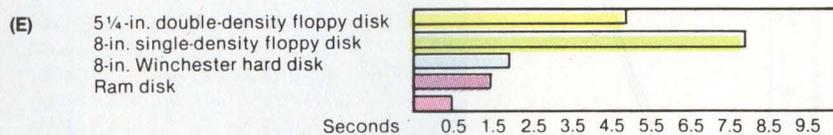
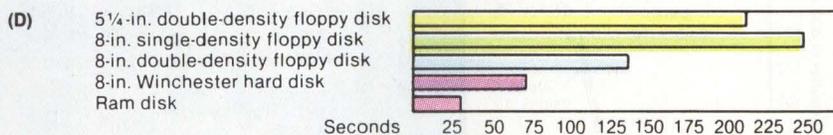
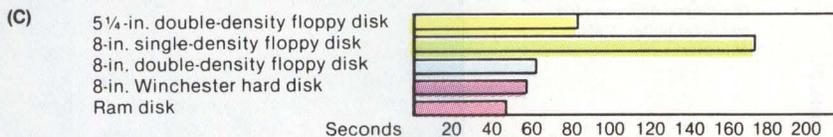
STC 8380 disk drive in page-response-time tests (I). —J.V.



(B) Transfer rate at system interface for 256-byte block of data

(μ sec.)

	Data handling		Latency time		Total speed
5 1/4-in. double-density floppy disk drive	4,100	+	10,000	=	104,100
8-in. single-density floppy disk drive	8,200	+	56,000	=	64,200
8-in. double-density floppy disk drive	4,100	+	56,000	=	60,100
5 1/4-in. Winchester hard disk drive	450	+	8,330	=	8,780
8-in. Winchester hard disk drive	450	+	1,010	=	1,460
Ram disk	380	+	none	=	380



densities, make multiple copies of files and carry out other printing functions that would otherwise be implemented in host software.

Looking ahead

Disk emulators will play an important role in large-machine environments, particularly in

relational-database applications, where they should quickly pay for themselves by increasing system throughput and reducing response time. Although RAM disks may be too expensive to make inroads into the microcomputer market for some time to come, precipitous declines in memory-chip prices could suddenly make RAM disks a hot item in every market. In fact, if disk emulators take on spooling functions for microcomputers (as hard disks have in larger machines), RAM disks might make printer buffers obsolete. □

ARE PRINTER BUFFERS AND DISK EMULATORS COST-EFFECTIVE?

The cost-effectiveness of a device aimed at hiking productivity is measured by the extent to which it speeds up a task or increases the amount of work that can be completed in a given time, relative to the value of the time saved and the cost of the device. Duty cycle—the percentage of time that the device is in use—must also be considered. For example, if a

printer runs for an average of 1 hour in an 8-hour working day, its duty cycle is 12.5 percent. If it runs 2 hours, its duty cycle is 25 percent. Most peripherals intended for personal computer applications are light-duty (low-duty-cycle) units; more rugged devices for professional and business applications are designed for duty cycles of 50 percent or higher.

The higher a device's duty cycle, the more effective a printer buffer or disk emulator will be in boosting its productivity (see figure). If a 100-character-per-second (cps) printer has a 25 percent duty cycle and a printer buffer is installed providing a host-to-buffer transfer rate of 2,500 cps, a speed gain of 25, the effective duty cycle of the printing task relative to the host computer is reduced to 1 percent. The time available to the host computer (and to the user in a dedicated system) for handling other tasks rises from 75 percent to 99 percent—a potential performance gain of 24/75, or 32 percent. If, on the other hand, the printer duty cycle increases to 50 percent, the time gained by the host computer grows from 50 percent to 98 percent, a performance increase of 96 percent.

In typical personal computer applications, the printer duty cycle equals 5 percent or less. It might take 5 to 10 hours to create and edit a 10-page, double-spaced manuscript using a personal computer text editor but less than 5 minutes to print the entire manuscript at the end of the period. In this environment, where the duty cycle is less than 2 percent, a print buffer is hardly worthwhile.

On the other hand, a direct-mail business may need to send hundreds of personalized letters to existing or potential customers every day. The duty cycle of the printer would be consistently high, and the printer buffer would be an effective addition.

A printer buffer can also be useful to several users sharing one or two printers. A multiport buffer can be connected so that each user can

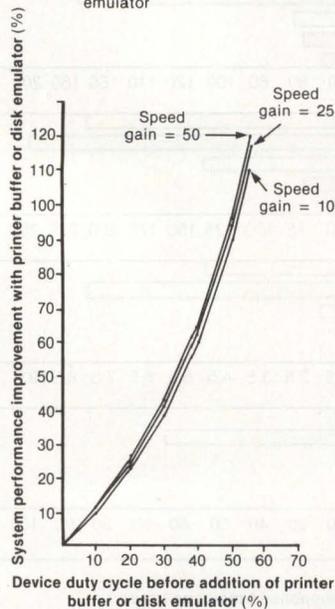
address the printer from his own computer. The buffer queues print files as they are sent, freeing users to continue their work. This is an effective arrangement even for low-duty-cycle users because it increases printer use and reduces contention for printer services among users.

The use of a disk emulator is likely to result in more consistent productivity for a user than the printer buffer because the emulator allows better user interaction with the computer. Like the printer buffer, the disk emulator is most efficient in high-duty-cycle situations, such as database-inquiry applications, where a user must search an entire file in response to a question. An emulator can cut processing time from several minutes to a few seconds or, with batch work, from hours to minutes. However, the emulator is less effective in standard word-processing and spreadsheet applications because disk access is relatively infrequent.

A printer buffer or disk emulator's cost-effectiveness to a user depends on the value he places on the time the device saves. Consider an employee who earns \$60,000 per year and spends 10 percent of his time (200 hours a year) working with a computer connected to a printer with a duty cycle of 5 percent and a floppy disk drive with a duty cycle of 10 percent. If his company installs a printer buffer and a disk emulator to replace the floppy disk drive, each providing a speed gain of 25, then the printer duty cycle drops to 0.2 percent, and the disk duty cycle drops to 0.4 percent. The work that formerly took the employee 200 hours a year now takes approximately 171 hours. The 29 hours saved at his \$30 hourly rate translates into a savings of \$870 a year. If the printer buffer costs \$300 and the emulator costs \$1,300, the two devices will pay for themselves in less than 2 years. Therefore, if the company expects to use the system for 2 years or more, it will find the units cost-effective.

$$\text{System performance improvement (\%)} = \left(\frac{1 - \frac{D}{G}}{1 - D} \right) - 1$$

Where: D = Device duty cycle (printer or rotating-disk drive)
G = Speed gain provided by printer buffer or disk emulator



Improved system performance is attained by adding a printer buffer or replacing a rotating-disk drive with a disk emulator. It is a function both of printer or disk-drive duty cycle and of the speed gain the added device affords. However, a device 50 times faster than the unit it augments or replaces does not provide much more of a performance boost than a device only 10 times faster, particularly at lower duty cycles.

MANUFACTURERS OF DISK EMULATORS

Manufacturer	Circle no.	Model	Storage capacity	Data transfer rate	Host computers	Host operating systems	Controller	Price	Comments
Ampex Corp. 200 N. Nash St. El Segundo, Calif. 90245	Circle 837	Megastore	512K to 32M bytes	4K to 2M bytes/sec.	Honeywell H-316; Raytheon RDS-500; DG Nova and Eclipse; DEC PDP-11 and VAX-11				Some models use core memory, depending on model: internal parity generate and check, error detection and correction, dual port option, extended-instruction mode, DMA controller, write protection
Axlon 70 Daggett Dr. San Jose, Calif. 95134	Circle 838	Ramdisk 128, Ramdisk 320, Rampower	128K to 320K bytes; can be cascaded to as much as 1.3M bytes	1 MHz	Apple II, Ile, III; Atari 800; Bell & Howell microcomputer	Apple DOS, Apple Pascal, CP/M		\$1,395	320 contains battery-backup system
BGL Technology Corp. 19151 Parthemia Northridge, Calif. 91324	Circle 839	BTC301, BTC302	128K bytes	As much as 3.3M bytes/sec.	Perkin-Elmer 16- and 32-bit computers			\$3,000	Incorporates single-bit error correction, includes battery backup
Centennial 6100 Executive Blvd. Rockville, Md. 20852	Circle 840	Solid State Disk	4M to 128M bytes		Sperry Univac 1100 series				Built in controller plug compatible with Sperry 5046 or 5056 storage control unit
CompuPro Division Godbout Electronics Oakland Airport, Calif. 94614	Circle 841	M-Drive/H	512K bytes per board; can be cascaded to as much as 4M bytes per system		IEEE 696/S-100 bus computers	CP/M, CP/M-86, MP/M-816		\$1,895	Autoformat at power-up
CTC Electronics 2237 Colby Ave. Los Angeles, Calif. 90064	Circle 842	Quick Disc	128K to 4M bytes		IBM Personal Computer				Incorporates double-bit error detection, single-bit error correction, includes battery backup, can be configured as disk emulator or cache memory
Dataram Corp. Princeton Rd. Cranbury, N.J. 08512	Circle 843	BC-101 Bulk Core, BC-101 Bulk Semi	1M to 32M bytes per chassis	As much as 64M bytes/sec.	DEC, Data General, CSPI, Honeywell, Intel, Modcomp, Perkin-Elmer, Rolm, SEL computers	Dataram controllers available			Bulk Semi incorporates error correction/detection, battery-backup option, provides 43-bit or 80-bit word, dual-ported units available for both systems
dy-4 Systems 888 Lady Ellen Pl. Ottawa, Ontario Canada, K1Z 5M1	Circle 844	DSTD-325DP board	256K bytes plus parity	666K bytes/sec. for DMA transfer	Runs under Z80 processor-based systems on STD bus	CP/M, IOS and others that the Z80 supports	External control required	\$1,000 (approx.)	Includes parity generation and checking logic, new 1M-byte version works with 8088, 68000-based computers, Z80 systems
Imperial Technology Inc. 831 S. Douglas St. El Segundo, Calif. 90245	Circle 845	MegaRam	1M to 32M bytes per chassis; as much as 80M bytes (daisy-chained)	As much as 8.33M bytes/sec.	DEC PDP-11, PDP-11/70; DG Nova, Eclipse; Sperry-Univac V70 series; HP 1000 series (SMD series disks); Westinghouse W2500		Internal controller		Incorporates single-bit error detection/correction, write protection; options: battery backup, dual-port capability, universal controller, DMA interface
Integrated Digital Products 4208 E. La Palma Ave. Anaheim, Calif. 92807	Circle 846	MiniMeg	256K to 2M bytes per board, as much as 32M bytes per system	DMA transfers as much as 2.5M bytes/sec.	DG Nova, Eclipse	AOS, RDOS, BLISS, VMOS	DG Model 4019 disk controller		Write-protect feature, incorporates error correction, battery backup available

MANUFACTURERS OF DISK EMULATORS

Manufacturer Circle no.	Model	Storage capacity	Data transfer rate	Host computers	Host operating systems	Controller	Price	Comments
Semi Disk Systems P.O. Box 66 Beaverton, Ore. 97075 Circle 847	4900 series	512K to 1M bytes	200K bytes/sec.	Radio Shack TRS-80 Model II, S-100 bus			\$1,495 to \$2,650	Includes battery-backup option
Storage Technology Corp. 2270 S. 88th St. Louisville, Col. 80027 Circle 848	4305 series	11.25M to 90M bytes per sub-system	1.0M to 3.0M bytes/sec.	IBM 370, 303X, 3081, 4341	OS/VS1, OS/VS2, VM/370	Built in		Includes floppy disk drive for transfer of microcode, options: dual port capability, two-channel switch

MANUFACTURERS OF PRINTER BUFFERS

Manufacturer Circle no.	Model	Memory capacity	Compatible hardware	Interface characteristics	Print control functions	Physical configuration	Price	Comments
Apparat Inc. 4401 S. Tamarac Pkwy Denver, Col. 80237 Circle 849	Spool/64-SP	64K bytes	Apple II; IBM Personal Computer; Radio Shack TRS-80 Model I, Model III	RS232 serial, as high as 19.2K baud; Centronics parallel	Parallel version: as many as 255 copies, self test, accepts text and graphics	10.4- x 6.8- x 2.5-in. chassis		Incorporates user-programmable Z80 microprocessor
Applied Creative Technology 2723 Ave. East Arlington, Texas 76011 Circle 850	Printer Optimizer	64K to 256K bytes		RS232 serial, 110 to 9600 baud; X-on/X-off, ETX/ACK, DSR, DTR protocols; Centronics parallel	As many as 99 user-programmable strings, individually selectable via keypad; character translation and filtering; select starting and ending page; copy pause; multiple copy with full or partial reprint	10.3- x 3.3- x 7.0-in. chassis		Incorporates Z80 microprocessor, LED display for keyboard entry, errors, space used and available; includes data compression feature
Consolink Corp. 1840 Industrial Circle Longmont, Colo. 80501 Circle 851	Sooper-Spooler, Micro-Spooler	16K to 64K bytes		RS232 serial, 50 to 19.2K baud; X-on/X-off, ETX/ACK protocols; Centronics parallel	Page formatting, header printing, single-sheet printing, self test, forms controls	3.1- x 10.3- x 8.6-in. chassis	\$199 and up	Incorporates Z80 (SooperSpooler) or 8048, 8748 (Micro-Spooler) processor; includes data compression feature
Inmac 2465 Augustine Dr. Santa Clara, Calif. 95051 Circle 852	Micro-buffer	32K to 256K bytes	IBM, Apple, Radio Shack, Osborne, NEC computers; Epson, NEC, Diablo, Okidata, C. Itoh printers	RS232 serial, as high as 19.2K baud; Centronics parallel	Buffer bypass, as many as 255 copies			
Intek Manufacturing Co. 780 Charcot Ave. San Jose, Calif. 95131 Circle 853	Diplomat	16K to 64K bytes	NEC 7710, Diablo 630, IBM PC/Epson, Qume Sprint 5, Atari printers	RS232 serial, 50 to 19.2K baud; X-on/X-off, ETX/ACK, DSR, DTR protocols; Centronics parallel; Qume; Diablo	Vector plotting; proportional spacing, tab set, underscore, superscript, justify; as many as 8,000 copies; page formatting, forms control	8.1- x 2.5- x 6.3-in. chassis		Incorporates Z80 microprocessor, interconnects as many as 4 devices
Interactive Structures Inc. 146 Montgomery Ave. Bala Cynwyd, Pa. 19004 Circle 854	Pipeline	8K to 128K bytes		Centronics parallel	Combines text, spreadsheet, graphics from different files into a document; buffer bypass; multiple copies	1.5- x 8.5- x 6.3-in. chassis		Includes data compression feature



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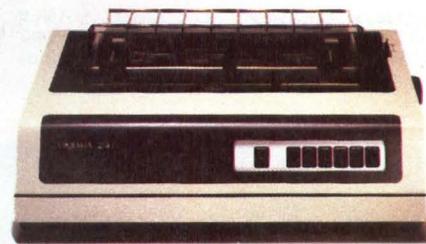
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CIRCLE NO. 111 ON INQUIRY CARD

MANUFACTURERS OF PRINTER BUFFERS

Manufacturer Circle no.	Model	Memory capacity	Compatible hardware	Interface characteristics	Print control functions	Physical configuration	Price	Comments
JVB Electronics 1601 Fulton Ave. Sacramento, Calif. 95825 Circle 855	Spool-Z-Q	32K to 128K bytes		Centronics parallel; transfer rate from computer as much as 2,000 bytes/sec.	Printing pause, multiple copies, self test, single-sheet printing	Chassis	\$165 to \$252 (qty. 1-2), \$151 to \$233 (qty. 11-25)	
Ligo Research Inc. 396 E. 159 St. Harvey, Ill. 60426 Circle 856	Angel Intelligent Buffer	64K to 128K bytes	IBM, Apple, Radio Shack, Vector Graphic, DEC, Xerox, Heath/Zenith, NEC, Northstar, Altos computers	Serial, parallel	Page skip, page reprint, text dump, remote load, multiple copies, printing pause	7.5- x 5- x 1.8-in. chassis	\$295	Includes data compression feature, self memory test
Microtek Inc. 4750 Viewridge Ave. San Diego, Calif. 92123 Circle 857	Buffer Box series	64K to 128K bytes		Serial, parallel	As many as 255 copies, bypass buffer, copy pause, single sheet printing, accepts text and graphics		\$299 and up	Text, graphics compression
Orange Micro Inc. 3150 E. La Palma Anaheim, Calif. 92806 Circle 858	Buffered Grappler +, Buffer-board	16K to 64K bytes	Apple II, II+, IIe, III computers; Anadex, Apple dot matrix, Centronics, C. Itoh ProWriter, Epson, IDS, NEC, Okidata printers	Centronics parallel, transfer rate from computer as much as 3,000 bytes/sec.	Accepts text and graphics; image expansion, rotation; screen dump; page formatting; self test	Board plugs into Apple computer slot		
Personal Micro Computers 475 Ellis St. Mountain View, Calif. 94043 Circle 859	Printer-Maid	64K bytes		RS232 serial; ETX/ACK, X-on/X-off protocols; Centronics parallel	As many as 255 copies, page formatting, self test	6- x 12- x 2-in. chassis	\$399	
Practical Peripherals Inc. 31245 La Baya Dr. Westlake Village, Calif. 91362 Circle 860	Micro-buffer	16K to 256K bytes	Apple II, Osborne, NEC, IBM, Radio Shack computers; Epson, Centronics, NEC, C. Itoh, IDS, Anadex, Okidata printers	RS232 serial, 75 to 19.2K baud; X-on/X-off protocol; Centronics parallel, transfer rate from computer as much as 4,000 bytes/sec.	Printing pause, as many as 255 copies, bypass buffer, single-sheet printing, page formatting, accepts text and graphics	Plug-in boards (Apple and Epson) and 5.4- x 7.4- x 1.6-in. chassis (other computers and printers)	\$259 and up	
Quadram Corp. 4357 Park Dr. Norcross, Ga. 30093 Circle 861	Micro-fazer, Interfazer	8K to 512K bytes		RS232 serial, Centronics parallel	Accepts text, graphics	Plug-in board (Epson printer) and stand-alone chassis	\$169 to \$1.395	Interfazer accepts printer output from as many as 8 computers concurrently
Renaissance Technology Corp. 1070 Shary Circle Concord, Calif. 94518 Circle 862	Parallel Buff-et	16K to 64K bytes	Apple, Atari, Eagle, IBM, NEC, Osborne, Radio Shack computers; Epson, C. Itoh, NEC printers	RS232 serial, Centronics parallel	Multiple copies, self test	4- x 8- x 1.3-in. chassis	\$219 to \$299	
Warn Electronics Ltd. 315 Park Ave. Knightdale, N.C. 27545 Circle 863	PI-II	16K to 60K bytes	Diablo, Qume daisy wheel printers	RS232 serial, 50 to 19.2K baud; X-on/X-off protocol; Centronics parallel	As many as 255 copies, printing pause, forms control, page formatting	8- x 10-in. plug-in board	\$200 to \$650	Includes Z80 micro-processor, data compression feature
Wesper Microsystems 14321 New Myford Rd. Tustin, Calif. 92680 Circle 864	Wizard-Spooler, BPO, SBO, EBI	16K to 64K bytes	Apple II, II+, IIe, IBM Personal Computer; Epson printers	RS232 serial, 50 to 9.600 baud; Centronics parallel	Accepts text and graphics; image expansion, rotation; forms control; page formatting	Plug-in boards	\$179 to \$349	

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CIRCLE NO. 112 ON INQUIRY CARD

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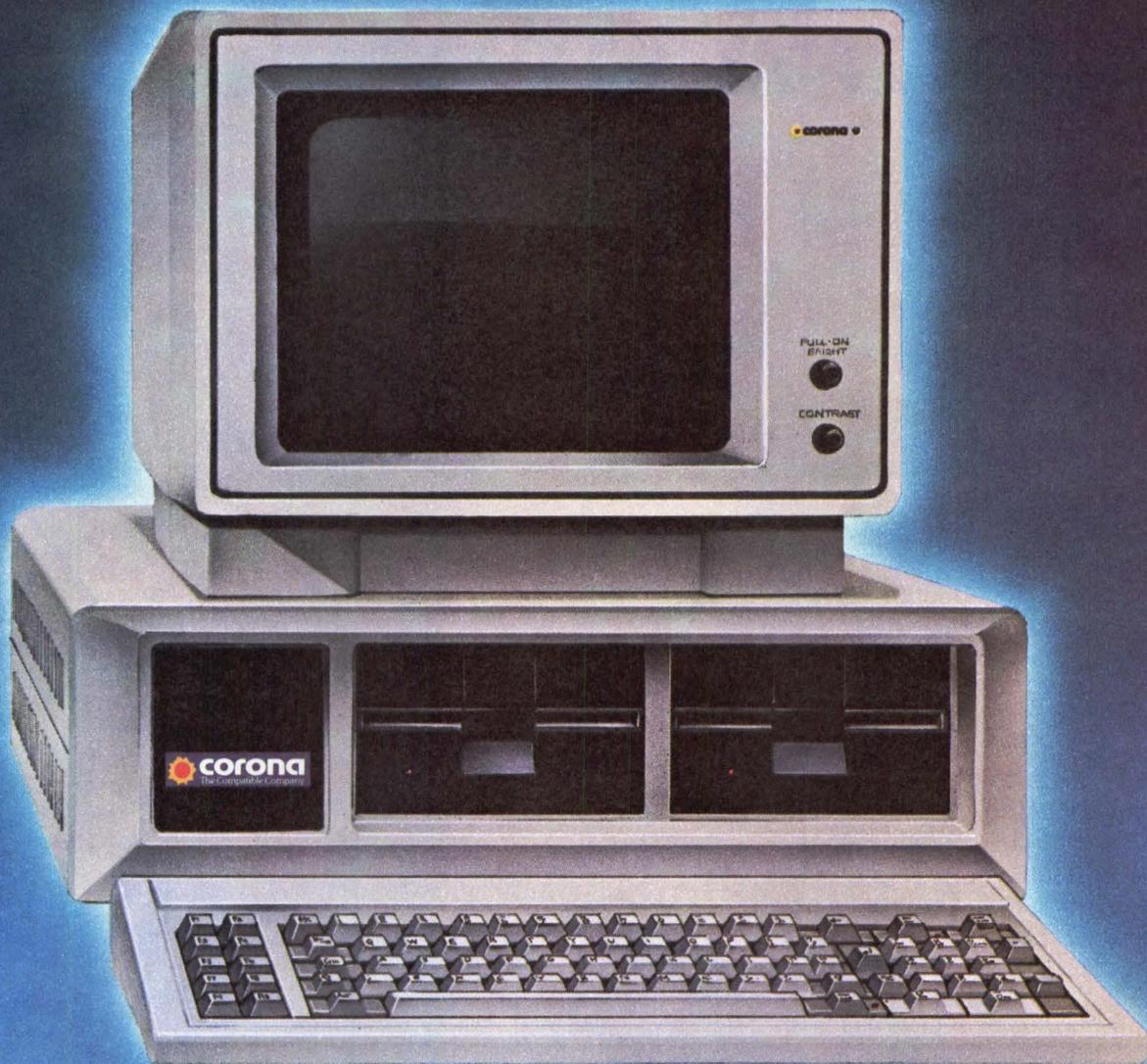
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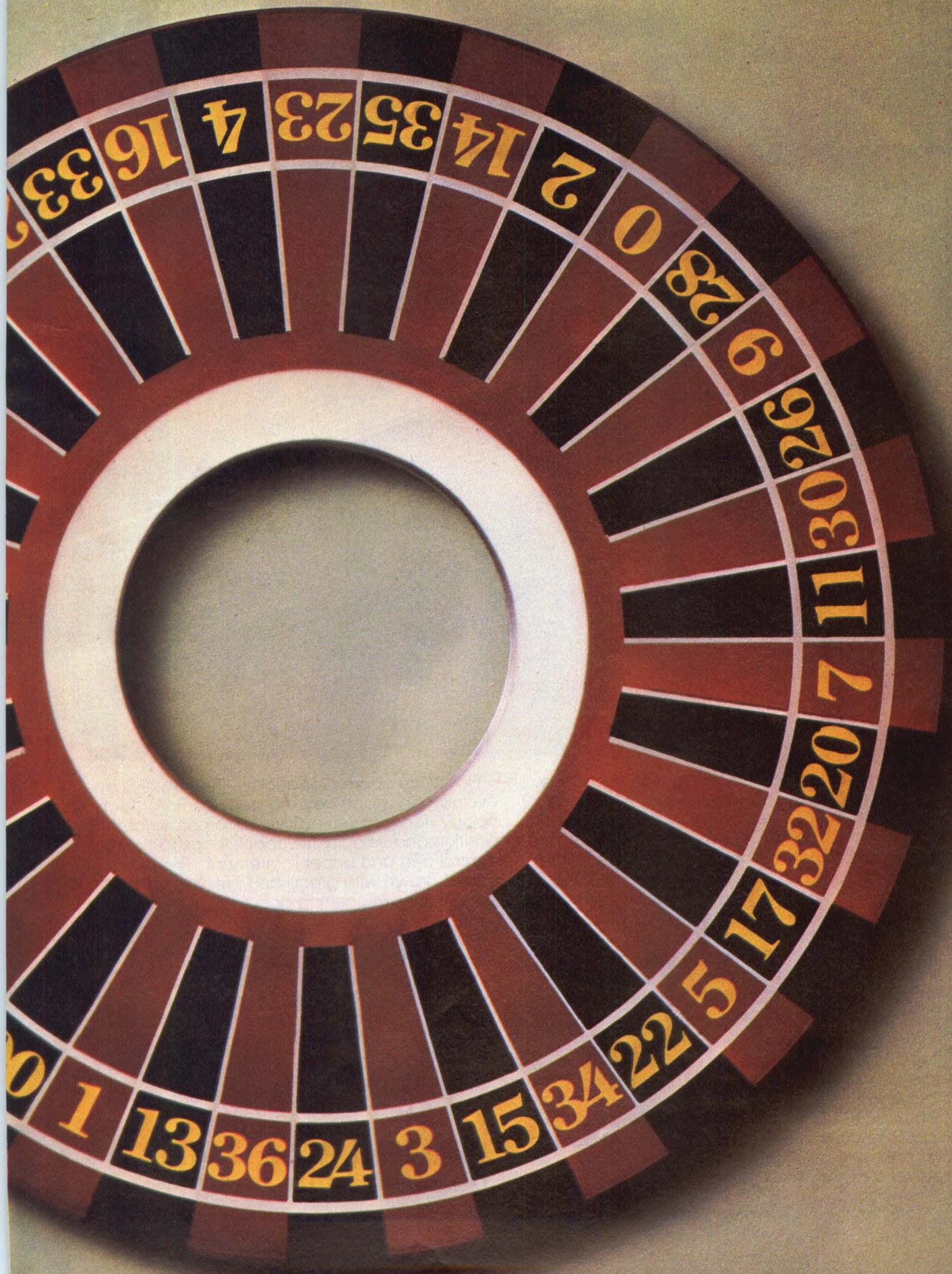


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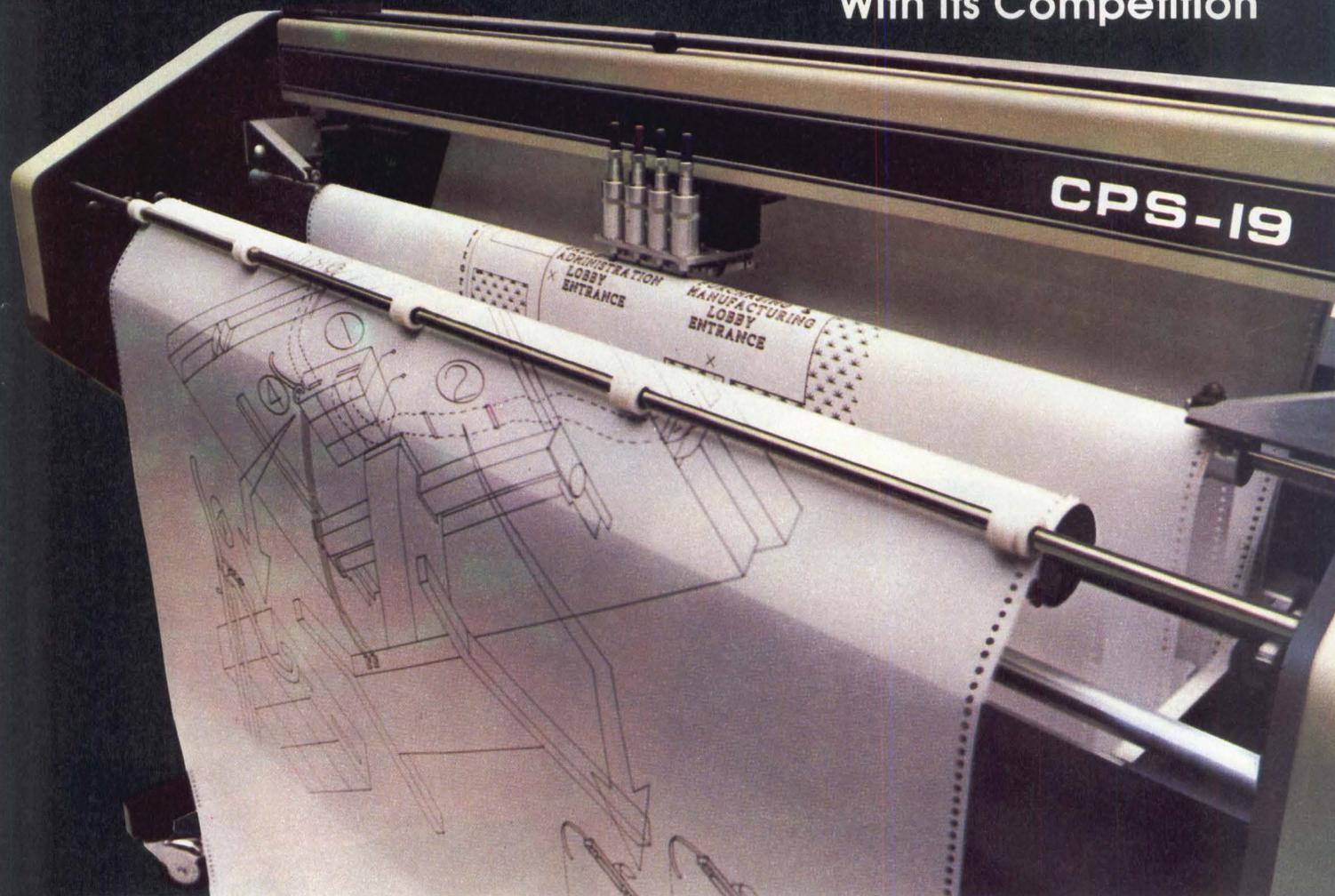
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CIRCLE NO. 115 ON INQUIRY CARD

Content-addressable memory uses 256-byte 'superwords'

SYDNEY M. LAMB, Semionics Laboratories

*New recognition memory design interfaces to
conventional microprocessors and speeds data retrieval*

Using an ordinary computer for database-management and pattern-recognition applications causes a problem: users want to access a datum according to *what* it is, but a computer can access a datum only by

knowing *where* it is in memory. The solution is to incorporate content-addressable memory—memory that allows a datum to be accessed by its content. However, incorporating content-addressable memory into a system incurs prohibitive manufacturing costs that so far have confined it to experimental systems. But now, a new and simplified design called recognition memory (REM) provides content addressability and parallel access relatively inexpensively and overcomes the system-integration problems that have hindered previous architectures. By employing very long data words and special instructions, recognition memory significantly increases processing speed in many applications.

Mnemonic	Description	Operation
SETT	Set T bit	T = 1
CLRS	Clear S bit	S = 0
EQC	Match candidates	T = 0 unless M = D and S = T = 1
IEQ	Initialize and match	T = 1 if M = D; T = 0 if M ≠ D
EQU	Match	T = 0 unless M = D and T = 1
MWR	Multiwrite responders	M = D if T = 1
MWNR	Multiwrite non-responders	M = D if T = 0
MWRC	Multiwrite responder candidates	M = D if T = D and T = S = 1
MWNR	Multiwrite non-responder candidates	M = D if T = 0 and S = 1
EXST	Exchange S and T bits	S = T
ORST	OR S and T bits	S = (S OR T)
ANDST	AND S and T bits	S = (S AND T)
CPLT	Complement T bit	T = NOT T
GEQ	Greater than or equal	T = 0 unless M ≥ D
GRT	Greater than	T = 0 unless M > D
LEQ	Less than or equal	T = 0 unless M ≤ D
LST	Less than	T = 0 unless M < D

D : Datum from microprocessor data bus
M : Datum in each superword at indicated byte offset
T : T bit associated with each superword
S : S bit associated with each superword

The REM instruction set includes seven parallel comparisons, four types of multiwrite and six operations that manipulate the T and S control bits. These instructions supplement the standard operations performed by the system's microprocessor. Some REM instructions operate on all superwords while others operate only on responders, non-responders, responder candidates or non-responder candidates. Responders are superwords whose T bit has been set by a "true" result on the previous comparison. Candidates are superwords whose S bit has been set, saving the responder or non-responder status from an earlier comparison.

Content addressability and parallel access

Technological advances over the last 30 years have greatly increased the power of CPUs and the size and speed of memories. But these developments have resulted in the "Von Neumann bottleneck," which consists of two fundamental obstacles: the CPU can access only one memory location at a time, and data must be brought to the CPU for processing because the memory cannot process data. The use of parallel access—the ability to access several memory locations in one CPU operation—overcomes the first obstacle. Content addressability—the use of memory that can compare stored data with data sent from the CPU—overcomes the second obstacle.

Caxton Foster's *Content Addressable Parallel Processors* (Van Nostrand Reinhold, 1976) illustrates content addressability and parallel access with a classroom analogy. Suppose a teacher wants to know which students have a particular book. If the students behave

like the memory locations in an ordinary computer memory and the teacher plays the part of the CPU, the teacher must ask each student in turn. The teacher could not ask all the students at once (parallel access), nor could the teacher ask that only the student(s) with the book identify themselves (content addressability).

High manufacturing cost has kept content-addressable memory from widespread use despite its appeal. Theoretically, because only a small amount of logic is needed to impart comparison ability to a memory, the cost of manufacturing content-addressable memory might be only twice as much as the cost of manufacturing RAMs. That's a low price for a large increase in performance. In the real world of integrated circuits, however, things are not that simple. Prices of

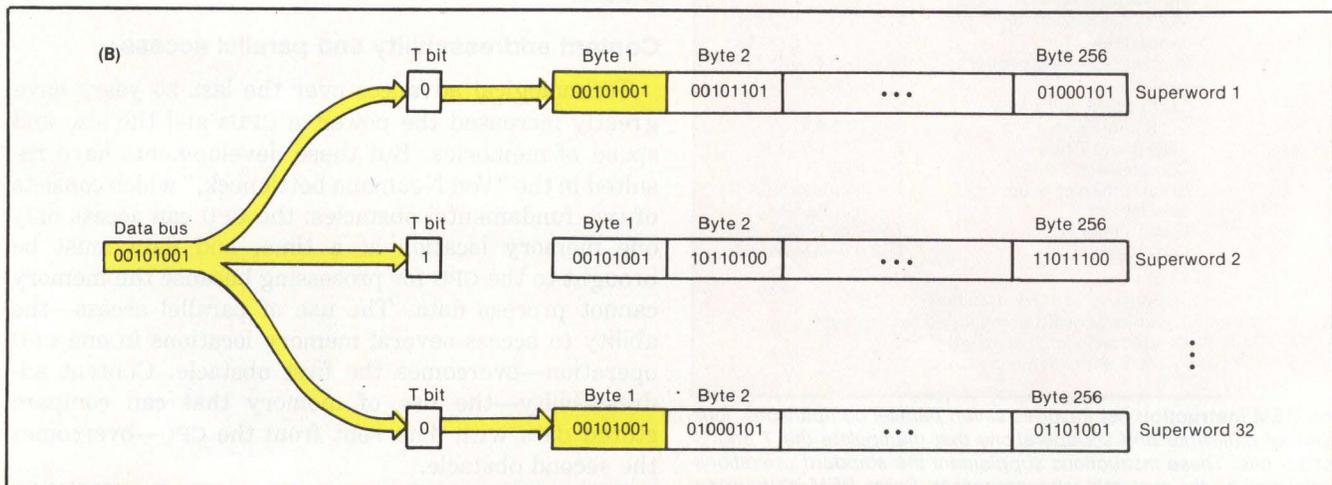
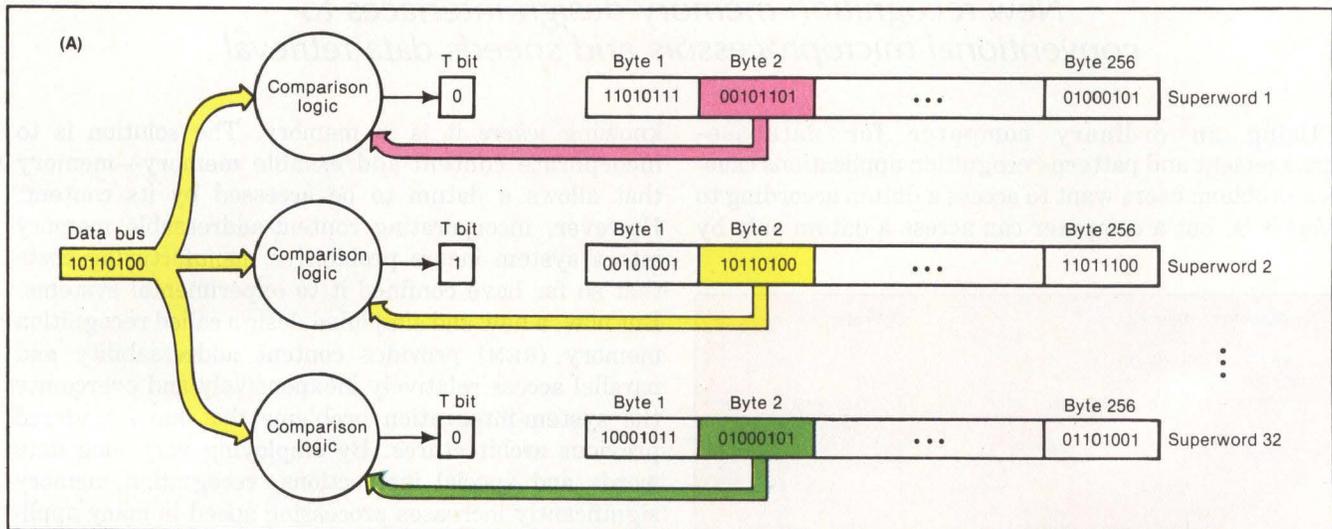
memory chips depend more on production volume than on circuit complexity. Production volume depends largely on demand, which is enormous for RAM but virtually non-existent for content-addressable memory until it can be adopted for wide use.

Another practical problem is system integration. Most content-addressable memory designs have incorporated very large words so that entire data records can be stored in one memory word. The long words necessitate customized CPUs, further adding to manufacturing cost.

Superwords

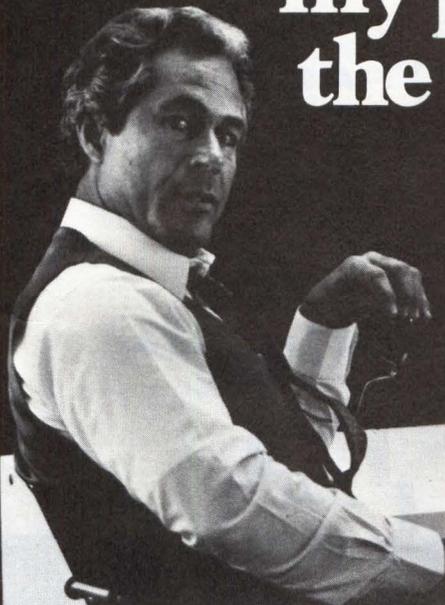
One solution addresses the problems of word size, manufacturing cost and system integration. The solution is a simplified content-addressable design, developed by Semionics Laboratories, called recognition memory (REM).

Using two word sizes—an 8-bit word for the microprocessor and a much longer “superword” for the data comparisons—resolves the conflict between needing a



Recognition memory (REM) consists of 32 or more 256-byte superwords, comparison logic and control bits. REM performs parallel comparison and write operations on 1 byte of each superword. The CPU data bus supplies the 8-bit datum to be compared or written. For comparison operations (A), a logic circuit for each superword determines whether the comparison is true or false and sets the T bit of each superword whose result is “true.” In the figure, the datum “10110100” is compared for equality to byte 2 of each superword, causing the T bit to be set for superword 2. For multiwrite operations (B), the datum from the CPU can be written into selected superwords. In the figure, the Datum “00101001” is written into byte 1 of each superword whose T bit was not set in the previous operation.

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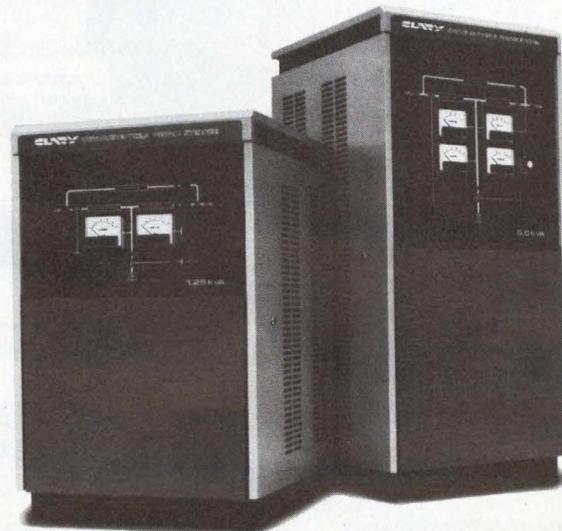
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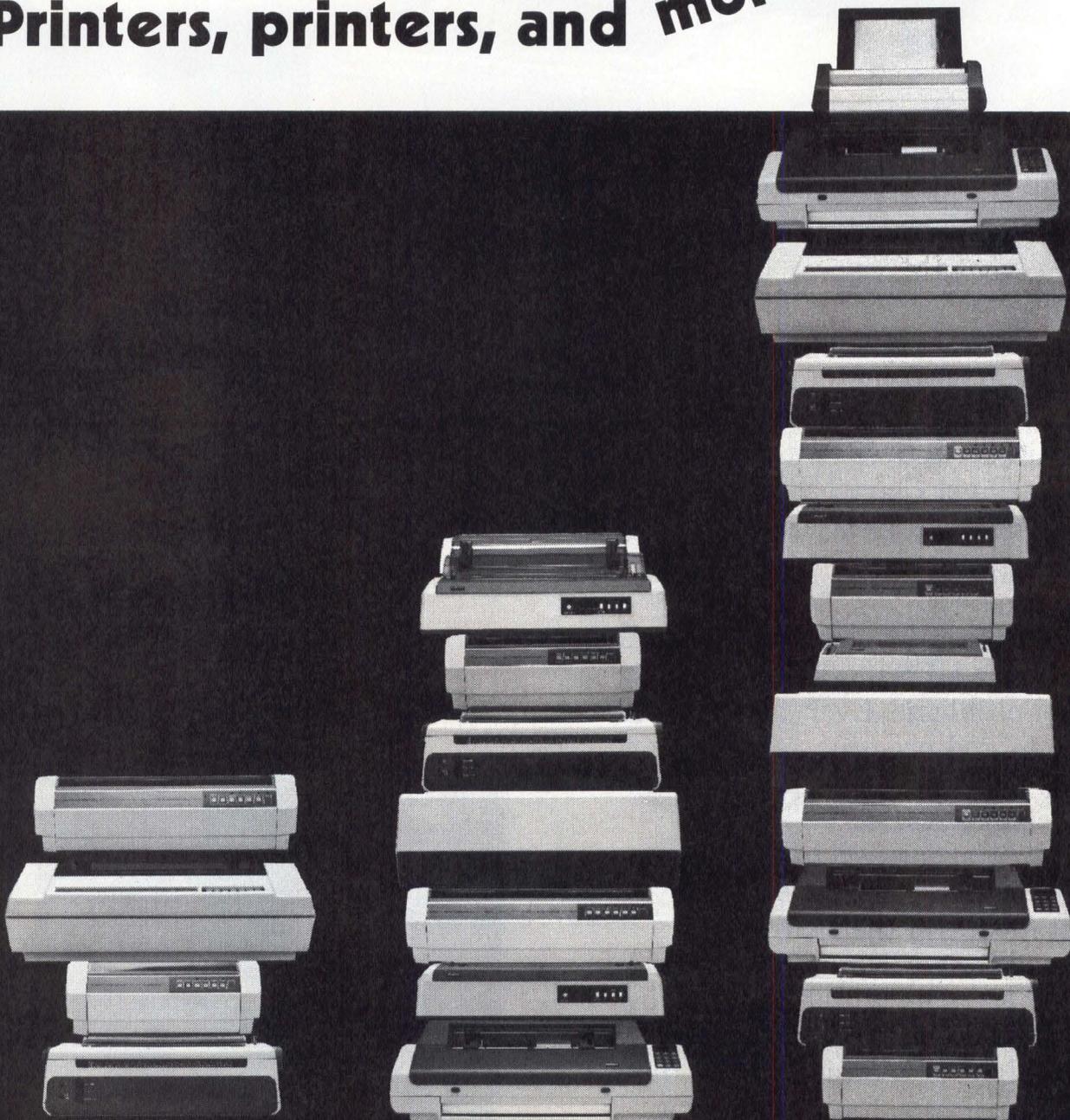
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long word for data-matching performance and needing a short word for integration with existing microprocessors. In REM, superwords are 256 bytes, the same length as sectors on many Winchester disk drives. Superwords are long enough for most records in database applications, and any byte position in a superword can be identified by an 8-bit offset address.

REM works with any standard microprocessor that has an 8-bit or wider data bus (see figure, Page 237). Even though superwords are 256 bytes long, the microprocessor operates on only 1 byte at a time. Therefore, the comparison logic that must be added to an ordinary memory to make it content addressable need not be added throughout the memory but only to 1 byte for each superword—a much less expensive design. To search a superword for a datum, REM operates byte by byte so the bytes comprising each superword use the same comparison-logic circuit.

REM uses two sets of control bits for registering the results of superword comparisons: tag bits (“T” bits) and store bits (“S” bits). The T bit of each superword has a value of “1” if a comparison is “true” and “0” if a comparison is “false.” T bits also specify which superwords are affected by multiwrite operations, which write data into multiple superwords. Superwords that

have their T bit set to “1” are called *responders*. The purpose of the S bits is to save the values of the T bits. Saving these bits preserves the identity of responders while performing further comparison operations. Superwords that have their S bit set are called *candidates*.

REM employs an 8-bit mask register to mask out bits from participating in an operation, making it possible to operate on individual bits. Because it combines parallel comparison, multiwrite and bit masking, REM has parallel-processing powers, including the ability to perform parallel arithmetic. To increment superword records in parallel, REM starts with the least significant bit in each superword and does an equality comparison with “0.” For all responders, REM replaces the “0” by “1” using a multiwrite operation. For all non-responders, it replaces the “1” by “0” and “carries” by repeating the loop for the next bit position.

Specifying REM operations

There are 17 primary REM operations (see table, Page 238). Because REM operations are executed on one of 256 bytes in each superword, only 8 bits are needed to specify the byte offset in a superword. Thus, the high-order bits of the 16-bit address bus are available for specifying the REM operation codes. To perform these operations, REM tricks the microprocessor into thinking it is writing data into one memory location. In a multiwrite operation, the microprocessor is indeed writing data into memory, but the destination is 1 byte in each superword rather than one memory location. In

HOW REM FACILITATES PATTERN RECOGNITION

A common technique in pattern recognition is to compare an input bit pattern with templates stored in memory, determining which template provides the closest match. One way to do this comparison is to perform a bit-by-bit match of the input pattern with each of the templates, counting

the number of matching bits and storing this number in a count field associated with each template. At the end of this process, the template with the largest count field is selected, provided that the number is greater than a predetermined threshold. This is a time-consuming procedure for a serial processor, and the time grows in proportion to the number of stored templates.

In a recognition-memory (REM) system, each bit of the pattern to be

recognized can be compared with the corresponding bit of all the stored templates in a single parallel operation, provided that there is one template and count field per superword. Further, after each comparison, the count fields of all templates having matching bits can be incremented in parallel. All that remains is to find the maximum count field. An example of how REM finds the maximum value of 10 8-bit strings using parallel comparisons is shown. —RRF

Step 1: Flag each string with “1” in most significant bit.

1	0	0	1	0	1	0	1	*
1	1	1	0	0	1	1	1	*
0	1	0	0	1	1	0	0	
1	1	0	1	1	0	1	0	*
0	0	1	0	1	1	0	1	
1	0	0	0	1	0	1	1	*
0	1	1	0	1	0	0	1	
1	1	0	1	0	1	0	1	*
1	1	1	0	1	0	0	0	*
0	1	1	1	0	1	1	0	

Step 2: Retain flag for each string with “1” in second most significant bit; erase other flags.

1	0	0	1	0	1	0	1	
1	1	1	0	0	1	1	1	*
1	1	0	1	1	0	1	0	*
1	0	0	0	1	0	1	1	
1	1	0	1	0	1	0	1	*
1	1	1	0	1	0	0	0	*

Step 3: Repeat for third most significant bit.

1	1	1	0	0	1	1	1	*
1	1	0	1	1	0	1	0	
1	1	0	1	0	1	0	1	*
1	1	1	0	1	0	0	0	*

Step 4: Repeat for fourth most significant bit. No responders. Therefore maximum value has “0” in this position. Retain flags from previous step. After the last bit, the maximum value has been determined. A parallel match can now identify the record(s) with this value.

1	1	1	0	0	1	1	1	
1	1	1	0	1	0	0	0	

a comparison operation, the microprocessor "writes" to memory the 8-bit datum to be compared to the appropriate bytes in superwords.

REM uses two secondary operations—*enter parallel mode* and *leave parallel mode*—to distinguish between primary REM operations and ordinary CPU operations. REM performs the secondary operations by again duping the microprocessor. To the microprocessor, the secondary operations are I/O instructions with dummy port addresses.

Database applications

Although REM was conceived for natural-language processing, it can be effectively applied to any processes that involve pattern recognition or information storage and retrieval. Because of its organization as a set of superwords accessed in parallel, REM suits the relational-database approach. A problem is that superwords are of fixed length and hence are too short for some records while too long for others. Software can solve this problem. Each superword can hold one record of 256 bytes, two records of 128 bytes, three records of 85 bytes, etc. A suitable software interface to REM can provide an enhanced REM module that acts like a content-addressable memory with superwords of variable length.

In the retrieval of data, REM uses the simple process of parallel recognition in place of searching, making it unnecessary to resort to complex techniques such as inverted file structures or hash coding. This makes it possible to add records to a file in minimal processing time. The new data can just be added at the end of the file or in the first empty space; it need not be put in a particular order, and new indexes and pointers are not needed.

REM can search very rapidly for substrings in arbitrary positions within strings. For example, a user may remember only that a company's name contains the sequence "...tronic..." The time required for substring searching in REM is so short that REM typically is ready for more data as soon as the disk is ready to read from the next track. For example, a system with 8K bytes of REM (32 superwords) can locate an arbitrary 8-byte substring within any of 32 50-byte strings in less than the time of one Winchester disk revolution. As a general rule of thumb, a system with 8K bytes of REM can perform searches in less than one-sixth the time required with conventional RAM. Moreover, REM's performance improvement is proportional to the number of superwords, so even greater search-time reductions are possible by using a larger REM. □

Sydney M. Lamb is president of Semionics Laboratories, Houston, Texas.

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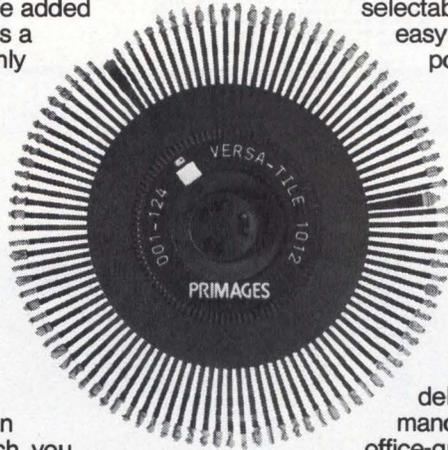
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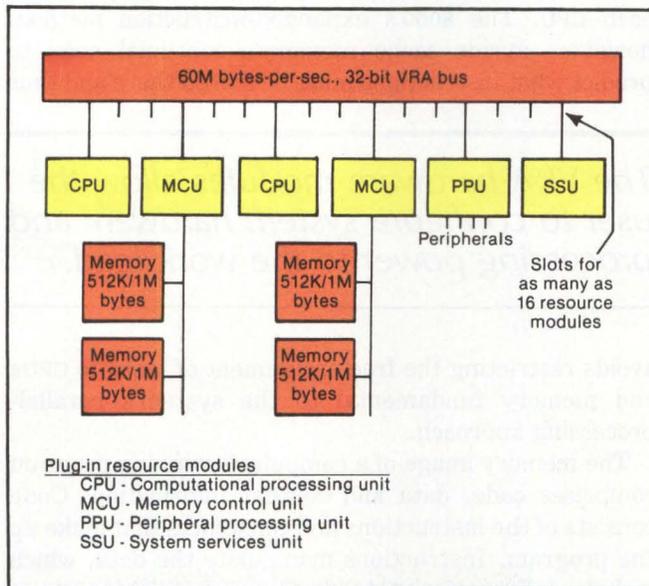


Fig. 1. Plug-in hardware resource modules tailor the model 8000 computer system to the processing and memory demands of heavy application work loads. System memory can be expanded to 16M bytes by adding memory modules that interface through memory control units (MCUs). Each MCU can support as much as 4M bytes of memory.

Upgrading the performance of multiuser computer systems to keep pace with a growing number of users and an increasing application work load can be difficult, if not impossible. Moreover, multiuser systems can exhibit a sudden, massive degradation in performance as both users and work load approach system processing capacity. The variable resource architecture (VRA) of the BTI Computer Systems model 8000, however, allows system integrators to adjust capacity tenfold by adding or deleting hardware modules, expanding main memory to 16M bytes. And because the system manages main memory as a shared resource, with respect to multiple CPU processing demands, the model 8000 can simultaneously support as many as 200 users and multiple user processes even at the top of its range.

Matching resources to the system work load

The BTI 8000's VRA hardware modules allow system integrators to configure system hardware and processing power to the work load and expected number of users. These resource modules add computation capability, main-memory control, I/O control and system support, communicating with one another over the 32-bit, 60M-byte-per-second VRA bus (Fig. 1).

Modular architecture and sophisticated memory management configure system resources to handle large processing demands

The variable resource manager (VRM) operating system automatically configures itself to match the hardware resource modules. Automatic system start-up takes 5 to 20 seconds, depending on the number of modules. The VRM provides each user with a private, secure environment in which to perform any mix of program development and processing tasks in several languages, including BASIC, FORTRAN and Pascal. System main memory can be incrementally expanded 32-fold, from 512K bytes to the maximum 16M bytes, by adding 512K- or 1M-byte memory modules that interface to the system through memory control units (MCUs). A microprogrammed processor, the MCU can support as much as 4M bytes of memory.

Systems configured with more than 1M byte of memory, however, will typically use more than one MCU. Memory is divided about equally between installed MCUs, providing parallel paths to memory for optimal system response. A model 8000 using two CPUs and 1M to 1.5M bytes of memory divided between two MCUs will support 45 simultaneous users with a system response of better than 0.5 seconds. A larger system, with four CPUs and three MCUs, each with 1M byte of memory, provides good response for about 150 users.

Managing memory as a shared resource

Although multiple memory modules can interface to the system through separate MCUs, the VRM operating system manages all system memory as a shared resource. In a multi-CPU system configuration, there are no master-slave relationships between CPUs. The VRM assigns tasks to achieve true concurrent processing. Because there are also no fixed relationships between CPUs and MCUs, a CPU in executing a given process might access memory through one or several MCUs (Fig. 2). Access to memory via the VRA bus takes two 67-nsec. bus cycles (one to read and one to store). Thus, system bus-transfer time is only a fraction of semiconductor memory-access time, which is about 450 nsec. The system, in effect, pipelines information transfers between resource modules, maximizing bus availability by processing protocols for bus service in parallel with bus transfers.

In addition to general-purpose and dedicated registers, each CPU contains a hardware virtual-memory address translator that translates virtual-memory references to physical-memory addresses in parallel with instruction execution. Address-conversion operation time, therefore, has a minimal effect on overall system response.

The CPU instruction set requires a low memory bandwidth—the instructions are designed to make the CPU do more work per instruction—reducing the need for memory accesses. For example, block moves and list

searches can be performed by single instructions. Several CPU instructions are loops in their own right, further decreasing the number of memory accesses required. Instead of using several instructions, each requiring memory access, a character-search instruction can perform the entire operation within the CPU, going to memory only to pick up data.

A reduction in main-memory access could also have been implemented by providing a cache memory for each CPU. The 8000's expanded-instruction method, however, avoids cache memory's continual need to predict what instructions must be stored there and thus

The VRA hardware modules allow the user to configure system hardware and processing power to the work load.

avoids restricting the free assignment of tasks to CPUs and memory fundamental to the system's parallel-processing approach.

The memory image of a computer's running program comprises code, data and context information. Code consists of the instructions and constructs that make up the program. Instructions manipulate the data, which includes information stored in files and variables intrinsic to the program. Context information encompasses the state of the program, as indicated by the contents of its registers and other dynamic elements, such as its working set. If the code is unchanged during program execution life, it is re-entrant and can be shared by many users without endangering any user's processing capability. All BTI-furnished computer programs, including the language compilers and the VRM, use re-entrant code. The 8000 maintains only one copy of any program in memory, regardless of how many users are executing the program, because the compilers can automatically generate the re-entrant application code.

Similarly, when moved into memory, one copy of file data is immediately available to all active programs authorized to use the data. Locking mechanisms to coordinate file updates are available for application programs. Because it employs re-entrant code and shared data, the 8000 uses only a small fraction of the memory that would be required in a non-re-entrant, non-shared implementation.

Large memory pages reduce disk access

The 8000 computer system organizes programs and data files into pages stored on disk (each occupying a disk block) that are copied into physical memory for active processing. The system treats all pages identically; there are no preassigned relationships between pages stored on disk and locations in physical memory.

Each page contains 1,024 32-bit words, equivalent to 4K bytes. Large in comparison with that of other medium-scale multiuser computer systems, this page

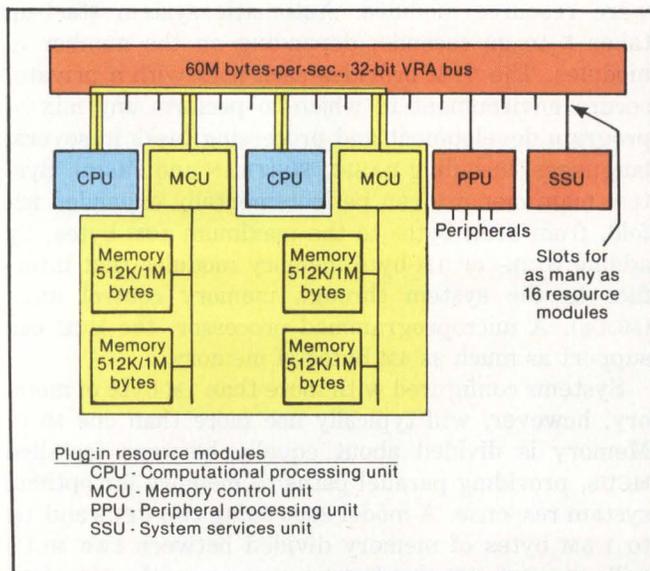
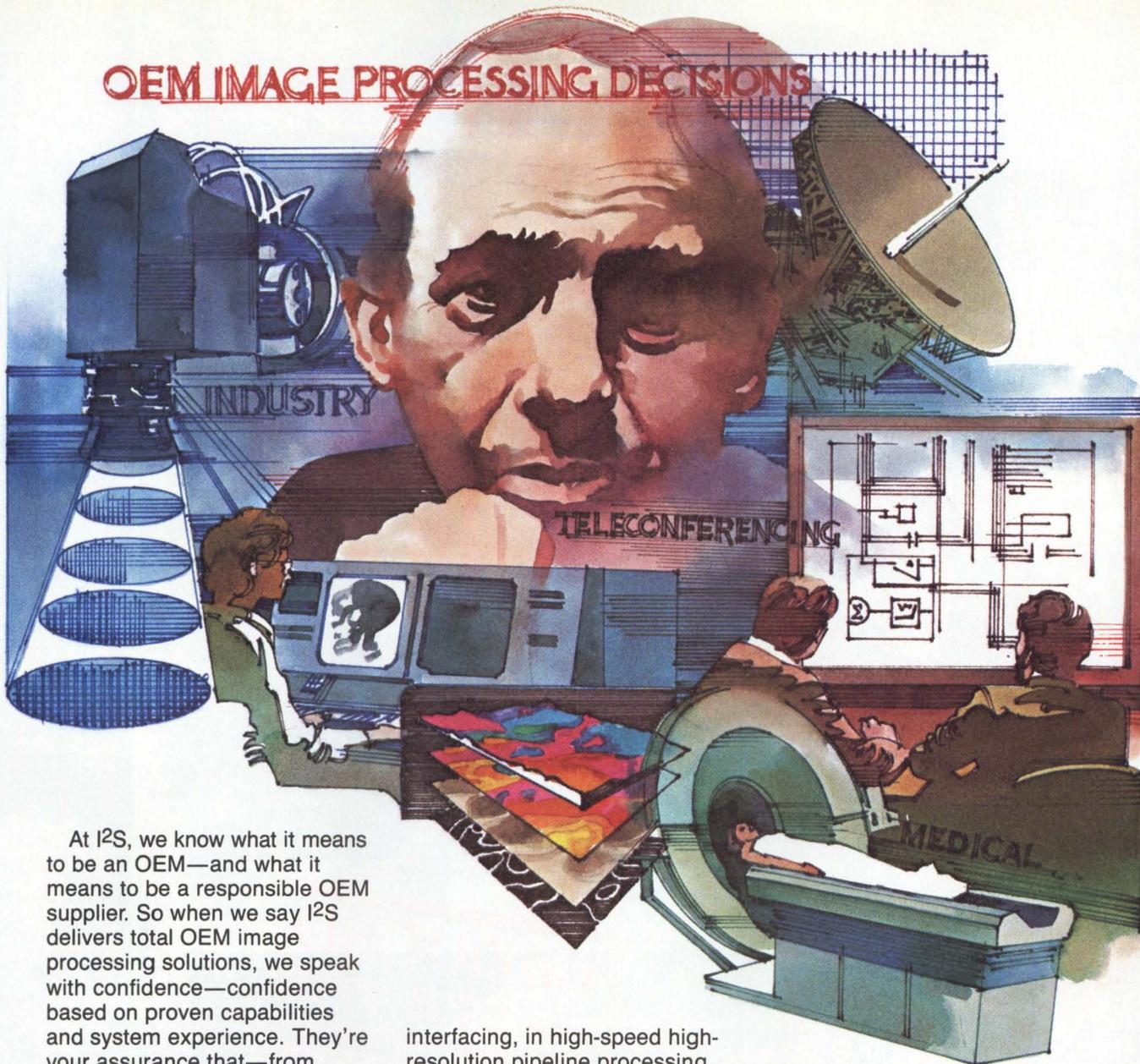


Fig. 2. Main memory is treated as a common resource by the system's virtual resource manager (VRM). Expandable in 512K- or 1M-byte increments, it can serve multiple CPUs and user processes via system memory control units (MCUs).

OEM IMAGE PROCESSING DECISIONS

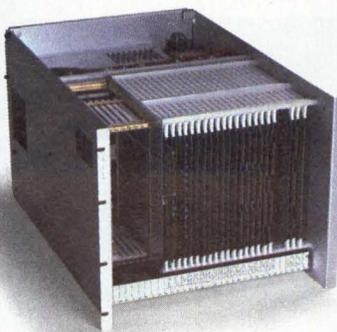


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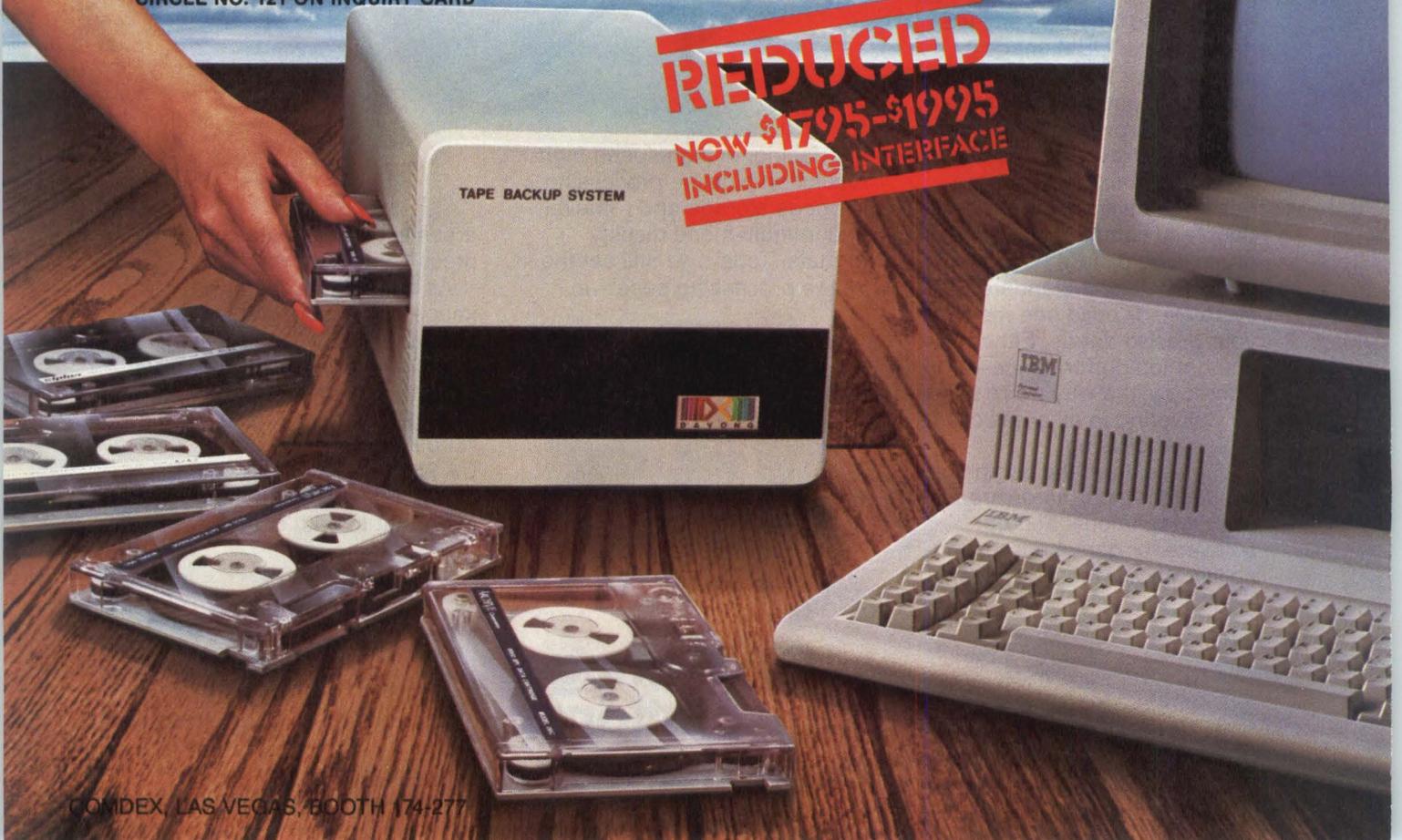


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size maximizes the amount of information that can be transferred to memory at one disk access, reducing the effect of disk-access demand on the system. The 8000 system requires only one-half to one-fourth the number of disk transfers of most multiuser systems. (The 4K-byte page constitutes a practical maximum. Larger pages would entail excessive internal fragmentation of the data in physical memory and disk storage.) System overhead associated with memory management is inversely proportional to page size. A user program with a 4K-byte page typically occupies only six to 10 pages, requiring minimum management.

A large page also reduces the size of the memory address table and consequently the time required to

search the table before executing a disk transfer. It eliminates the transfer times associated with segmented mapping by reducing the size of the virtual-memory address map for each user process to such an extent that the entire map can be stored in the CPU's virtual-memory translator during processing. These reductions in disk-access demand and memory overhead give the 8000 system a throughput advantage of approximately 2:1 over multiuser systems using a smaller page.

The VRM manages the movement of pages between disk storage and physical memory to support the processing needs of active programs. Depending on configuration, the system reserves approximately 10 to 30 pages for memory management and other system operations; the remaining memory is available for user processes and VRM operations (Fig. 3).

A user process can use as much as 128 pages of virtual memory. A complete copy of a process's virtual address space is always available on disk because each page is mapped to a disk block. The VRM can move

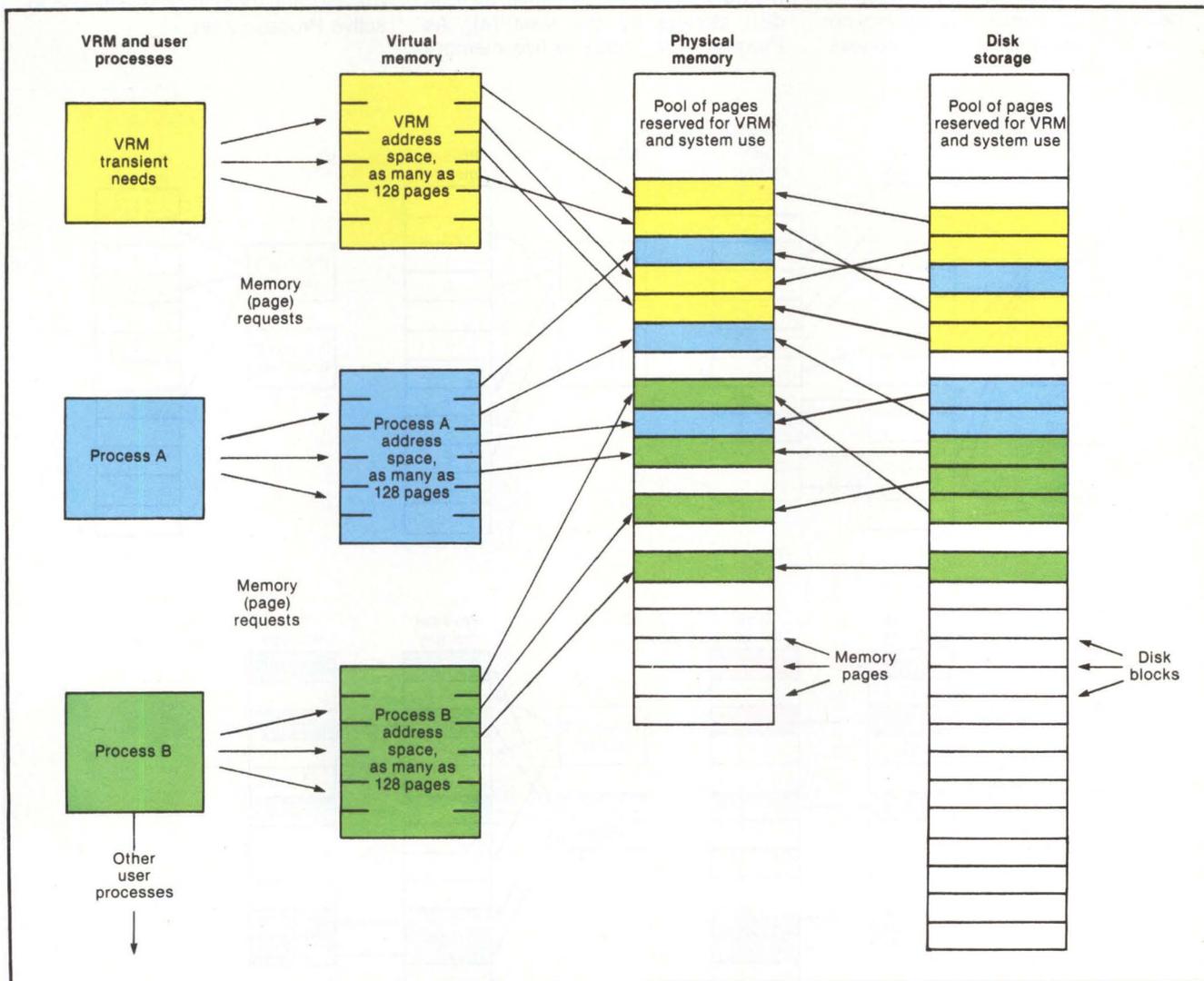


Fig. 3. The VRM manages the transfer of memory pages between disk storage and physical memory in response to page requests by multiple user processes. Non-contiguous disk blocks are mapped to non-contiguous pages in physical memory, but appear as contiguous pages in virtual memory. The system reserves approximately 10 to 30 pages (depending on system configuration) for memory management and other system operations. The remaining pages can be assigned to user processes.

segments of the virtual address space into and out of physical memory, maintaining the copy in main memory

as long as it is frequently referenced. If it is not, the operating system removes it, writing it back to disk if it has been changed.

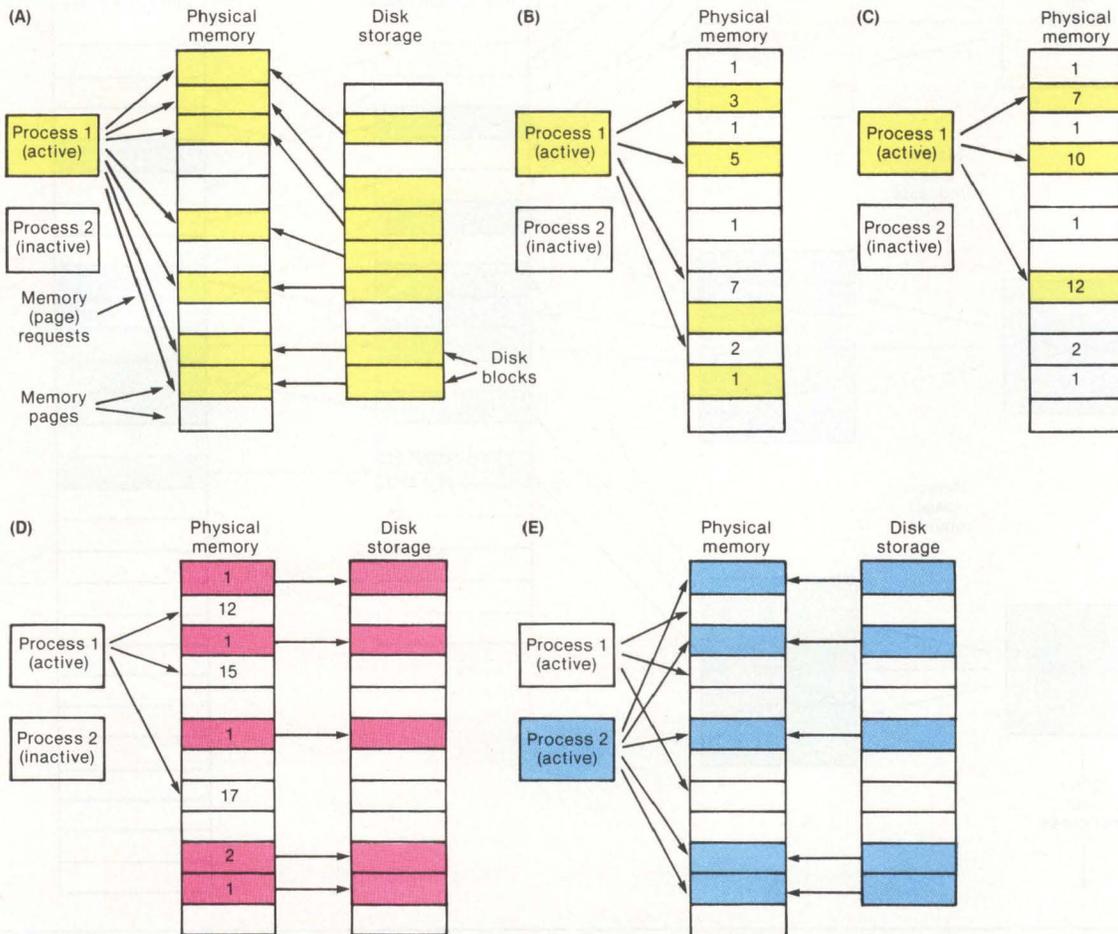
The 8000 computer system employs a demand-paging technique to allocate pages of physical memory to active processes. When a process first references a page, the VRM checks to see whether the page is already in

HOW THE 8000 MANAGES MEMORY-PAGE AGING

The model 8000 computer system uses a memory-page aging process to ensure that all system users and processes will continue to be supported as the system approaches processing capacity. As active processes demand physical-memory space, the system's Virtual Resource Manager (VRM) "ages," or ranks, the 4K-byte memory pages by time since last use. The VRM's memory scheduler uses the page ages to decide what memory pages are not part of the working set of any process.

These idle pages can then be removed from the memory set of the process and reassigned to other active processes. The least active (longest time since last use) memory pages go into the idle-page list first (the least active, most aged pages are the first to be removed from the list). In this simplified functional diagram (virtual memory space not shown), Active Process 1 is assigned physical-memory pages (yellow) called up from disk storage by the VRM (A). As Process 1 continues to use memory

pages, they are aged or ranked by the VRM according to their time since last use (B), with less recently used, less active pages aged more (a lower circled activity number in the diagram) and more recently-used pages aged less (a higher activity number) (C). As process 1 continues to execute, least recently used, idle pages (red) are removed from Process 1's memory and transferred back to disk storage (D), allowing them to be reassigned to active Process 2 (E).



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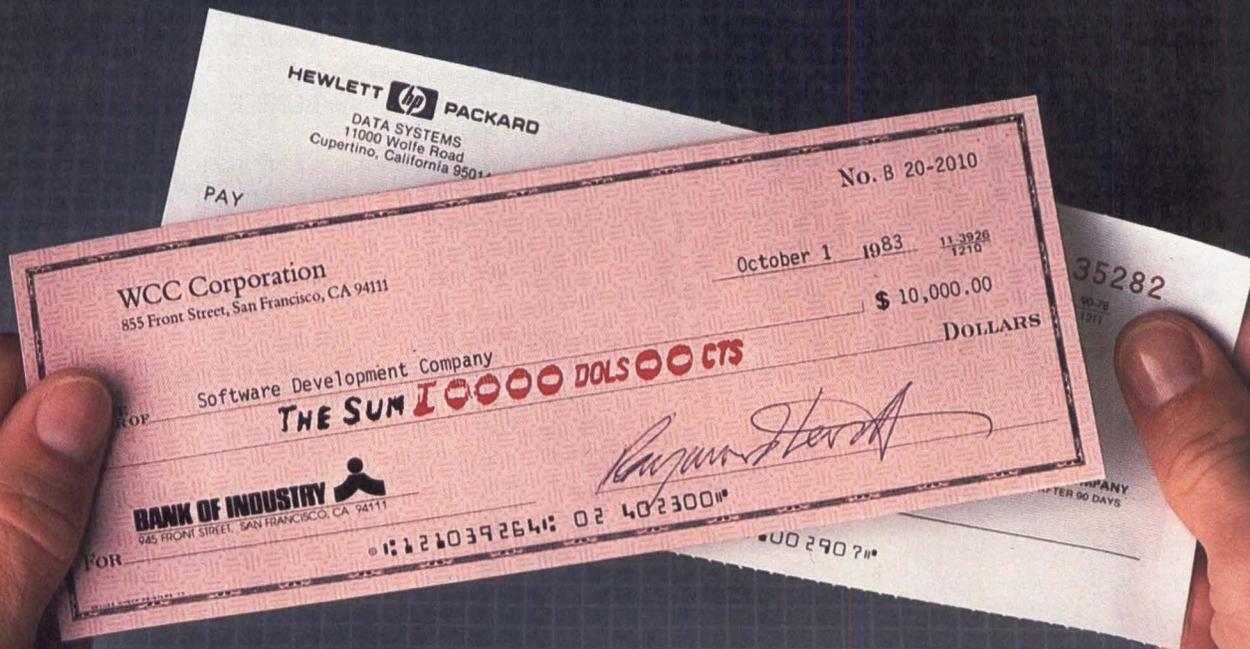
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physical memory; if not, it loads the page from disk into memory. The hardware virtual-memory translator of the CPU executing the process handles subsequent references to that page as long as it continues to reside in memory. Processes accessing the same disk block use the same copy of that disk block in memory. However,

The 8000 computer system organizes programs and data files into pages that are copied into physical memory for active processing.

application programs can lock data structures to preclude simultaneous updating of a common area by more than one process.

If a process issues an instruction that would alter the contents of a shared code page in memory and more than one process is using that page, the VRM automatically creates a private copy of that page for the process issuing the modifying instruction. The modified page then becomes part of the program of the user who instigated the change. When a data page is permanently updated by a program—signified by a file-update request—the new page is immediately available to other users as soon as it is updated in memory. The VRM will ensure that the page is written to disk. This operation, however, does not have to be completed before the updated information can be accessed.

Managing memory under heavy work loads

When overloaded, multiuser computer systems can exhibit a sudden, massive degradation in performance that in most cases results from the large number of disk transfers required when the system's physical memory can no longer support user demands. The 8000 system, however, is designed to slow down gracefully when the overall user work load approaches or exceeds system hardware capacity. Memory management ensures that all users will continue to be supported, although users experience a gradual decrease in the system's response speed. Users with efficiently written programs will experience it the least.

The VRM matches the available physical memory to the combined virtual-memory demands of active processes. It continually monitors the reference activity for each page of physical memory, weighing the cost of retaining that page in physical memory against the cost of later retrieving it from disk storage. Most of the

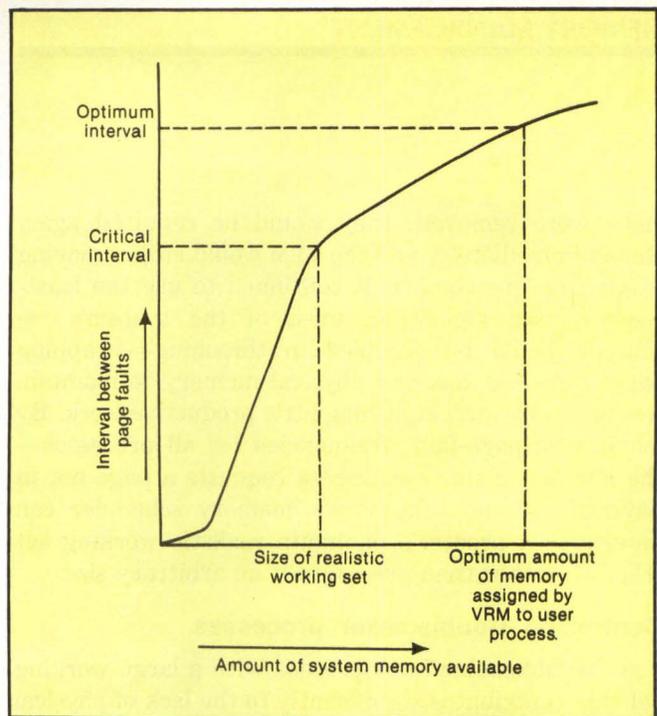


Fig. 4. The interval between page faults is a key parameter in the allocation of system memory. As available memory decreases in response to growing user process demands, the VRM progressively reduces the amount of memory allocated to each process to the minimum, realistic working set. It thus simultaneously reduces the interval between page faults—requests for a page not in physical memory—to the critical level. Beyond this point, the page-fault interval would decrease rapidly, and most of the system's resources would be devoted to swapping memory pages between disk storage and physical memory, resulting in system "thrashing."

time, a process uses only a small portion of its program code and available data, so that only a part of its virtual address space must reside in physical memory.

A program's realistic working set is the smallest set of virtual-memory pages necessary for executing an instruction. The remaining pages are "idle" and, depending on the physical memory available, they can reside in memory or be swapped out to disk storage.

As the number of pages of virtual memory associated with all active processes approaches or exceeds the available amount of physical memory, the memory scheduler within the VRM "ages" pages—ranks them by time since last use (see "How the 8000 manages memory-page aging," Page 250). The VRM tracks how recently a process has used each page in physical memory employing a least-recently-used algorithm to identify and remove from memory those pages that have aged the most. More than one process might be using a page, and the VRM does not remove a page from physical memory until it is no longer a part of any process's working set. Frequently referenced pages tend to remain in physical memory, minimizing disk access.

As system work load increases, the VRM progressively reduces the age limit of pages, removes idle pages from memory and reduces each running process to its working set of memory pages. The process then needs all the pages assigned to it residing in physical memory. If

more were removed, they would be required again almost immediately, and the VRM would stop removing pages from memory. If it continued to use the least-recently-used algorithm, most of the system's resources would be occupied in thrashing—swapping pages between disk and physical memory to maintain working sets—accomplishing little productive work. By monitoring page-fault frequencies for all processes—the number of times a process requests a page not in physical memory—the VRM's memory scheduler can determine a process's minimum realistic working set (Fig. 4), rather than preassign it an arbitrary size.

Controlling 'troublemaker' processes

A "troublemaker" is a process with a large working set that contributes significantly to the lack of physical memory available for other processes. The memory scheduler's troublemaker routine calculates an "offensiveness level" for each process according to the size of its current working set and its page-fault frequency. The process with the highest offensiveness level in comparison with other processes is marked as a troublemaker. Its pages are removed from physical memo-

ry, freeing space for use by other running processes.

The troublemaker is suspended for a certain length of time, based on its offensiveness level. When the troublemaker process is allowed to return to active status, it is given a grace period of execution time proportionate to the length of time it was suspended, ensuring that it is capable of productive work before being declared a troublemaker again.

If more than one process is declared a troublemaker, the processes are placed in a troublemaker queue. A troublemaker with a high offensiveness level would remain in the queue longer than one with a lower level, but it would also have a lower chance of being marked a troublemaker again. A troublemaker's grace period is increased each time it is declared a troublemaker, so that when it is released from the queue, it can re-acquire the large number of pages it needs to execute its task.

In a heavily loaded system, the most efficiently written programs (those with the smallest working sets) are generally executed first because they are unlikely to be marked as troublemakers. Interactive programs are usually compact, and interactive users will normally receive the best system response. □

N. Ronald Crandall is operating systems manager at BTI Computer Systems, Sunnyvale, Calif.



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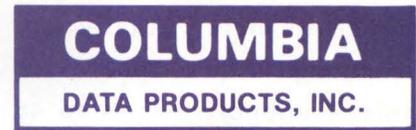
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32-bit 'Megamicro' exploits hardware virtual memory and 'RAM disk'

STANLEY M. METCALF and ROBERT M. FARBER,
Logical Microcomputer Co.

10-MIPS micro vaults 16-biters with 200-nsec., 16M-byte virtual-address space

Sixteen-bit CPUs may be just a stopover on the way from 8-bit CPUs to the next generation of microcomputers: 32-bit machines using powerful processors such as the National Semiconductor Corp. NS16032, the Intel Corp. iAPX 286, the Motorola Inc. 68010, the Bell Laboratories BELLMAC 32 and the Hewlett-Packard Co. HP-32 (MMS, August, Page 187). The value of 32-bit machines is in their multiuser, multitasking power, processing speed, ability to use mainframe techniques such as hardware virtual memory and access to sophisticated software previously available only on minicomputers and mainframes. How a 32-bit microcomputer can accomplish these objectives can be understood by examining overall architecture, virtual memory and "RAM disk" implementation and the hardware/software adaptability of the first production microcomputer to incorporate the 16-/32-bit NS16032.

Architecture stresses parallel operations

Logical Microcomputer Co.'s LMC-16032 Megamicro is based on the Intel Multibus (IEEE-796). Bus arbitration, from highest to lowest priority, is assigned as follows: disk controllers, array processor, intelligent I/O boards, CPU, RAM and non-intelligent I/O boards. The CPU has control of the bus except when the bus is required by a board with a higher priority. The CPU then gives up control of the bus and performs its own tasks, as long as those tasks do not interfere with activity on the bus. When the board using the bus is finished, the CPU regains control.

Instead of using programmable logic for bus arbitration, the LMC-16032 incorporates high-speed, low-density transistor-to-transistor logic (TTL). Although



The 32-bit LMC-16032 "Megamicro" is available in a variety of configurations. "System One" contains 512K bytes of RAM, eight serial RS232 I/O ports, an intelligent disk controller, a 20M-byte Winchester, the UNITY operating system, C and FORTRAN 77 compilers. "System Two" has 1M byte of RAM and a solid-state disk (RAM disk) option. A "System Three" comprises 92M bytes of hard disk storage and an array processor. Prices start at \$15,000.

this increases the chip count, the chips are less expensive and easier to replace. LS series TTL chips are available from most electronics suppliers.

The NS16032 treats the floating-point unit (FPU) and memory-management unit (MMU) as transparent CPU "extensions." The CPU, FPU (NS16081) and MMU (NS16082) are installed on one board (Fig. 1.) Communications between the CPU and coprocessors are via a protocol that is transparent to the programmer. For

slave operations, the CPU fetches the instruction, performs address calculation and routes the instruction with appropriate data to the slave processor. The slave handles actual data manipulation.

The MMU provides virtual-memory management, memory protection, hardware and software debugging and dynamic address translation (see "NS16000 dynamic-address translation," below). It contains page-table registers that determine whether a requested page is in memory, a cache that contains a directory of the most-recently-used pages and a translation block that

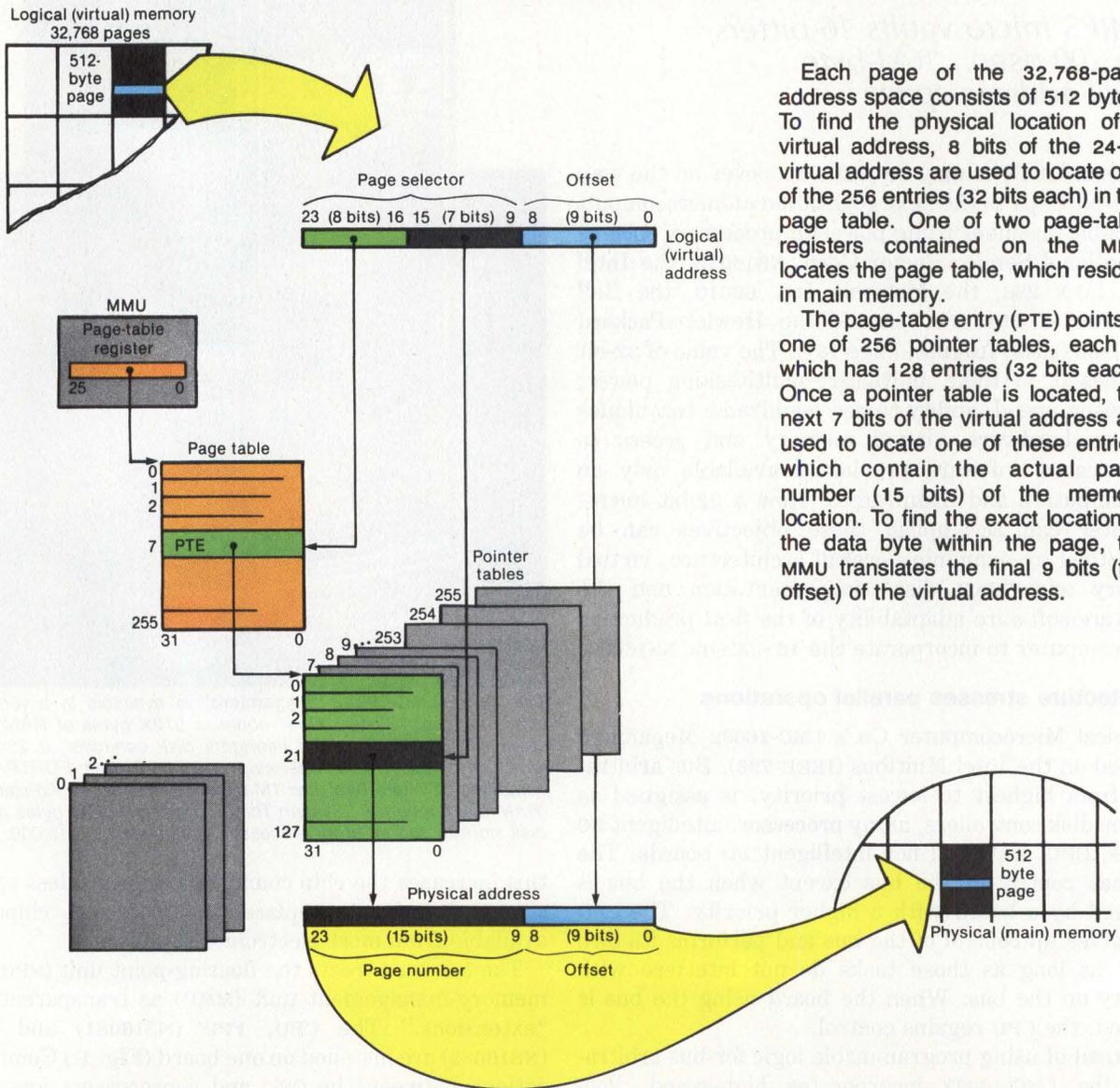
directs the retrieval of requested pages from external disk (Fig. 2).

The FPU's direct communications path to the CPU makes it appear to a programmer as if it were dealing simply with an enlarged instruction set. All NS16032 addressing modes are available to the FPU. A 64-bit floating-point multiplication is accomplished with one assembly language instruction in 6.2 μ sec., and a 64-bit floating-point division is completed in 11.8 μ sec.

The LMC-16032 uses the 6-MHZ CPU clock to generate all timing signals instead of using a separate crystal to control the Multibus B clock and then matching the timing with latches and waits. Thus, the processor runs synchronously with the bus, which eliminates "missed" cycles and allows the system, including parity memory, to run at the same speed as the CPU. (In an asynchronous machine, the CPU often waits a cycle or more to gain access to the bus.)

Although the LMC-16032's architecture, synchronous

NS16000 DYNAMIC ADDRESS TRANSLATION



Each page of the 32,768-page address space consists of 512 bytes. To find the physical location of a virtual address, 8 bits of the 24-bit virtual address are used to locate one of the 256 entries (32 bits each) in the page table. One of two page-table registers contained on the MMU locates the page table, which resides in main memory.

The page-table entry (PTE) points to one of 256 pointer tables, each of which has 128 entries (32 bits each). Once a pointer table is located, the next 7 bits of the virtual address are used to locate one of these entries, which contain the actual page number (15 bits) of the memory location. To find the exact location of the data byte within the page, the MMU translates the final 9 bits (the offset) of the virtual address.



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timing and CPU provide relatively high-speed processing power (0.6 million instructions per second), adding an array processor can boost the system's speed to 10 MIPS. The array processor offered with the system is Sky Computer Inc.'s SKYMNK-M.

The addressing scheme for the array processor is similar to that used in mainframes. Memory addresses are interleaved from board to board. Address 0, for instance, is on board 1, address 1 is on board 2, address 2 is on board 3 and so on until all memory boards have been used. The next sequential address then is on board 1. This is in contrast to the more common method of having the first 512K bytes of addresses on the first board, the next 512K bytes on the next board and so on. Interleaving of memory boards allows the array processor to operate faster than the CPU using standard 100-nsec. memory chips rather than costly 70- or 45-nsec. RAM chips. Interleaving is faster because the RAM access time, rather than the cycle time, determines the speed of reading or writing data. In a non-interleaved system, each memory access and retrieval takes a full memory cycle. In an interleaved system, as an access occurs, the next sequential memory access begins.

'RAM disk' cuts access time

"RAM disk" is a portion of temporarily dedicated memory in which large amounts of data or programs are stored. The data stored in RAM disk can come from external disk or system memory. The RAM disks are part of the system main memory, but the processor handles them as though they were physical disk drives. Because data can be accessed from the external disk in

approximately 30 msec., the same data stored in RAM disk can be brought into main memory in an average of 200 nsec.

RAM disk can be configured in software to identify as many as four solid-state logical drives of sizes ranging from a few kilobytes to a theoretical total of 16M bytes. (In practice, it would be impossible to use all 16M bytes of main memory as RAM disk space.) These RAM "drives" are cordoned off from system RAM, isolating them from the operating system. If input to the RAM disk overflows its allocated size, the CPU automatically creates a file on an external disk to capture the overflow. RAM disk capability is included with an LMC-16032 containing more than 1M byte of main memory.

Hardware virtual memory extends program space

The LMC-16032 provides true hardware virtual memory, with a demand-paged 16M-byte address space and 16M-byte data space for each of as many as 32 users (see "Demand-paged vs. segmented virtual memory," right). As with the array-processor addressing scheme, the virtual-memory implementation is very similar to that of mainframes.

Virtual memory is loosely defined as a scheme that allows a programmer to work with a program that is considerably larger than the system's physical memory. This is accomplished by considering the RAM and external storage as one memory. The rotating storage that contains the part of the program that cannot fit into physical RAM appears to the user to be RAM in terms of speed and efficiency. In the designs of non-virtual-memory microcomputers serving multiple users, RAM must be big enough to meet the worst-case demands that might be put on the system. With a virtual-memory system, the RAM needed is only that for a "typical" mix of requirements. This approach reduces the cost of a system and provides flexibility in adding and subtracting users.

When the program is started, the processor loads the first two pages into memory, and program execution begins. When execution reaches the point at which the next instruction is not in RAM, the processor halts execution, calls a routine that loads the needed pages into memory from disk, backs up and re-executes the last instruction to resume execution.

The operating system allocates space in RAM to the pages it calls in, first filling free memory. When memory is full, the operating system purges the least-frequently-used pages. If a page to be evicted from RAM has been modified, its updated version is written back to disk; if it has not been changed (which is usually the case with programs), it is simply discarded. The MMU also contains a high-speed cache memory that translates virtual addresses to physical addresses and retains a directory of the last 32 pages used, which reduces access time in handling what are probably the most immediately needed pages of instructions and data (see "Caching in on one-cycle addressing," Page 264).

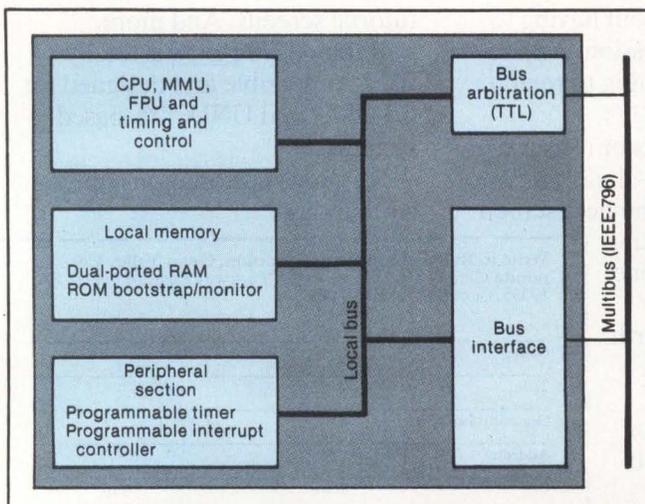


Fig 1. The CPU Board includes the memory-management unit (MMU) and the floating-point unit (FPU). Its major elements are connected via a local bus, which in turn is connected to the (IEEE-796) Multibus.

DEMAND-PAGED VS. SEGMENTED VIRTUAL MEMORY

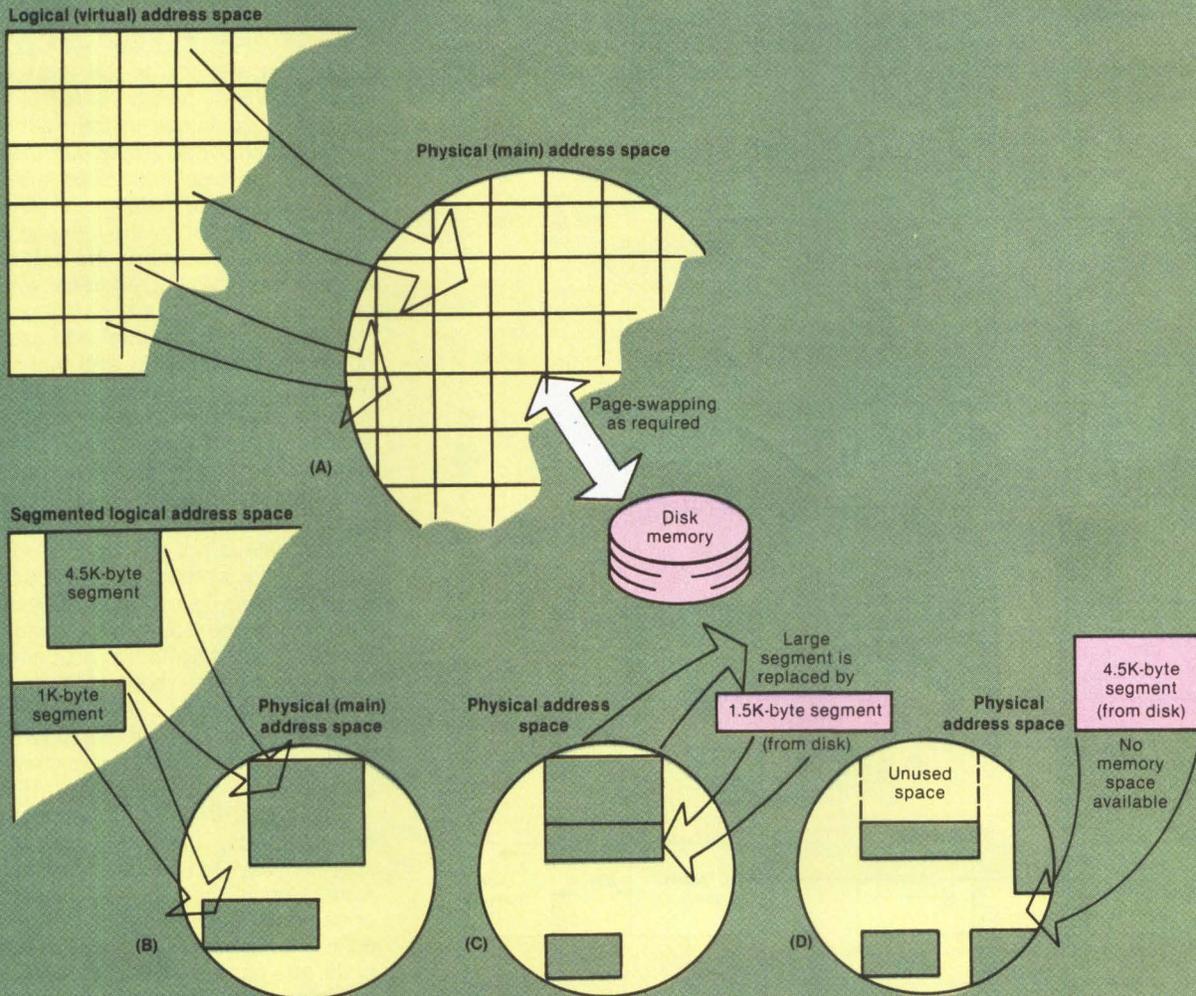
In segmented memories, the address space is divided into segments that vary in size, depending on the programs or data that must be stored. The minimum unit that can be "swapped" into main memory from disk is the segment itself, not just a portion of it. When swapping large segments, main memory must be large enough to contain both the entire segment and other segments that contain the data or routines needed to continue a program. If the data required to run a program is not in main memory or if the program requires a segment for which there is no available space, a fault is generated and the program is halted. The operating system then intervenes and swaps out a segment large

enough to create the required space or condense existing segments. The swap-out alternative is usually used because dynamic relocation of programs and data is not easily accomplished with available architectures. This results in operating system overhead because of the large size of the segment, which sacrifices speed and lowers performance. To avoid these problems, systems with segmented memory often require large amounts of expensive main memory.

In *demand-paged* virtual memories, both the virtual address space and the main memory are divided into equal-sized segments, or "pages." In National Semiconductor Corp.'s NS16000 family, these pages are only 512 bytes. Because pages are of

equal size, they can be swapped without leaving unused fragments. In addition, it is necessary to swap only the pages required for a particular subroutine rather than swapping all the pages required for a routine because the time spent in swapping is greatly reduced. Thus, operating-system overhead is decreased, and performance is improved.

Unlike most segmented systems, the NS16000 family supports abort and retry instructions, so that any reference to external memory can halt a current instruction immediately until the data or routine is brought into main memory. The suspended instruction is then retried, and execution continues. On-demand swapping further reduces operating-system overhead and increases speed.



Demand-paged vs. segmented virtual memory. In demand-paged memory (A), page-swapping with disk storage is performed with pages of uniform size, using a replacement algorithm that maximizes memory use. With segmented memory, segments vary in size (B). Complicated algorithms are required to match incoming segments with available memory space. "Fragmentation" can occur when large segments are replaced by smaller segments, resulting in unused space (C). When there is not enough space to accommodate large segments (D), the operating system must intervene and reallocate memory space.

Adaptability at the machine-instruction level

The LMC-16032 runs Human Computing Resources Corp.'s UNITY operating system, a full implementation of Berkeley's 4.1 enhancement of Bell Labs' UNIX Version 7. UNITY with all utilities requires up to 10 M bytes of disk storage.

The instruction set of the NS16032 is designed to run the high-level languages supported by UNIX. For exam-

ple, NS16032 instructions include a multiway branch similar to the case statement in Pascal. This instruction could replace an entire subroutine, with the economy and speed of a machine instruction rather than the relative slowness and difficulty of a software routine. The NS16032 has more than 100 basic instruction types.

The instruction set is also highly symmetrical, a further aid to high-level language use. Symmetry is the degree to which all addressing modes exist for all operands and all required operators exist for every data type. Instructions can be used with an extremely broad, sophisticated set of addressing modes and operand lengths (byte, word, double-word and quad-word) and can use any general-purpose register. Because of architectural symmetry, high-level languages can run

CACHING IN ON ONE-CYCLE ADDRESSING

The memory-management unit (MMU) on-chip associative cache is transparent to users and significantly speeds information retrieval in main memory. According to National Semiconductor Corp., an address required

by the CPU is contained in one of the 32 entries of the cache memory more than 98 percent of the time. This means that the data can be addressed within one clock cycle. At a 10-MHz clock rate, this amounts to a

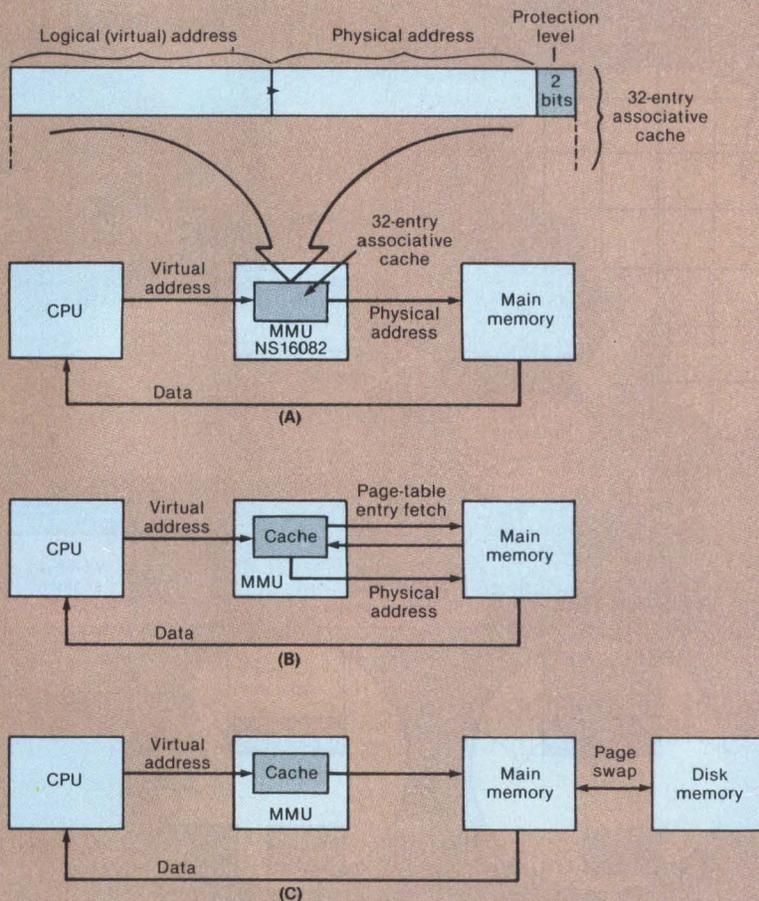
100-nsec. retrieval time. (The LMC "Megamicro" operates at 6 MHz; a 10-MHz version will be available in January.)

As a virtual (logical) address is bused from the CPU to the MMU, the MMU tries to match it with the addresses contained in the 32-entry cache, which contains both virtual and translated physical addresses in each entry. If the cache matches the virtual address requested by the CPU and the data is in main memory, the CPU can access the physical address within one clock cycle.

If, however, the virtual address is not in the MMU cache and the data resides in main memory, the page- and pointer-table entries must be fetched from main memory before allowing the CPU to access the data. This can require as many as 20 clock cycles.

If the data is not contained in main memory, the system must first swap the data from disk to main memory, after which the address procedures follow. This swapping procedure increases the time required to access a memory location. (The actual time lapse depends on system priorities but typically occurs in approximately 30 msec.)

Each time the CPU references a new address, the MMU cache is automatically updated by MMU hardware. Hence, the cache is constantly updated as a user program progresses. Each cache entry, as well as each of the 256 page-table entries, contains two protection-level bits—divided between user and supervisor modes—that allow read-only, full-access or no-access levels of accessibility, thus assuring full information security.



Data addressing with an associative cache can occur in 166 nsec. (one cycle). If the page-table entry, which contains logical and physical addresses, is in cache memory (A), data addressing is accomplished in one cycle. If the page resides in main memory but the page-table entry is not in the cache, a page-table entry must be fetched from main memory (B). This typically requires as many as 20 clock cycles (3.3 μsec.). If a page resides on disk, it must first be swapped into main memory (C), after which the procedure follows (B).



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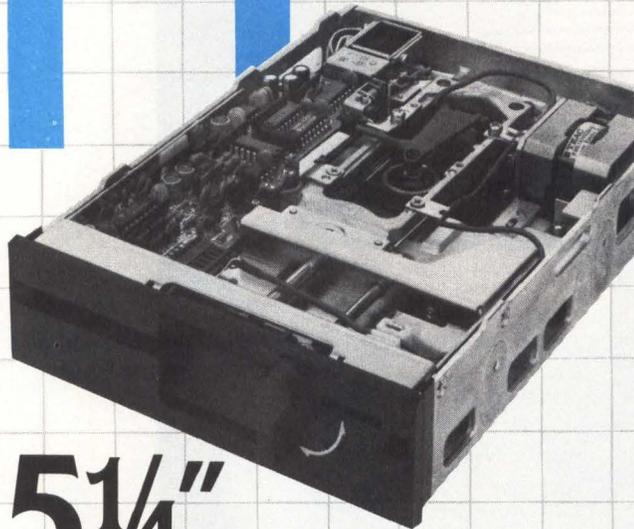
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MINI-MICRO SYSTEMS/ October 1983

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MEMORY

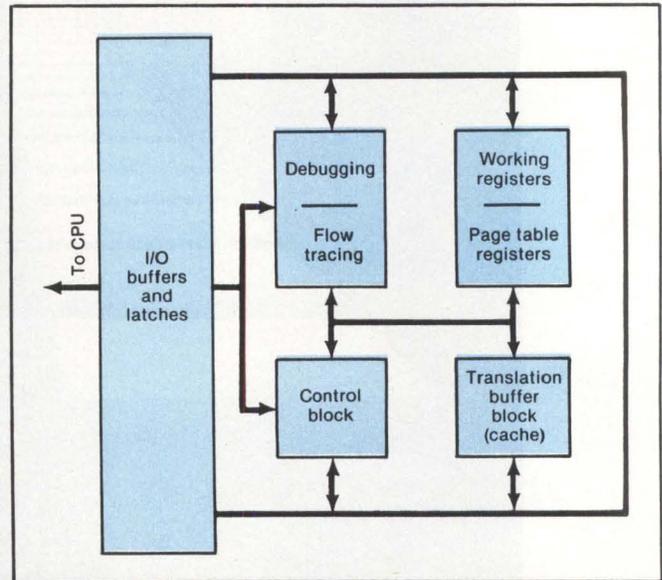


Fig. 2. The MMU includes powerful internal debugging and program flow tracing. The page-table registers, which are part of the working register block, determine whether a desired page is in memory. If it is not, the control block signals the CPU that a page fault has occurred, and execution halts. The translation block, which contains the 128-byte cache for the directory of the 32 most-recently-used pages, accesses the internal bus and directs the access and retrieval of the desired page. Execution then resumes.

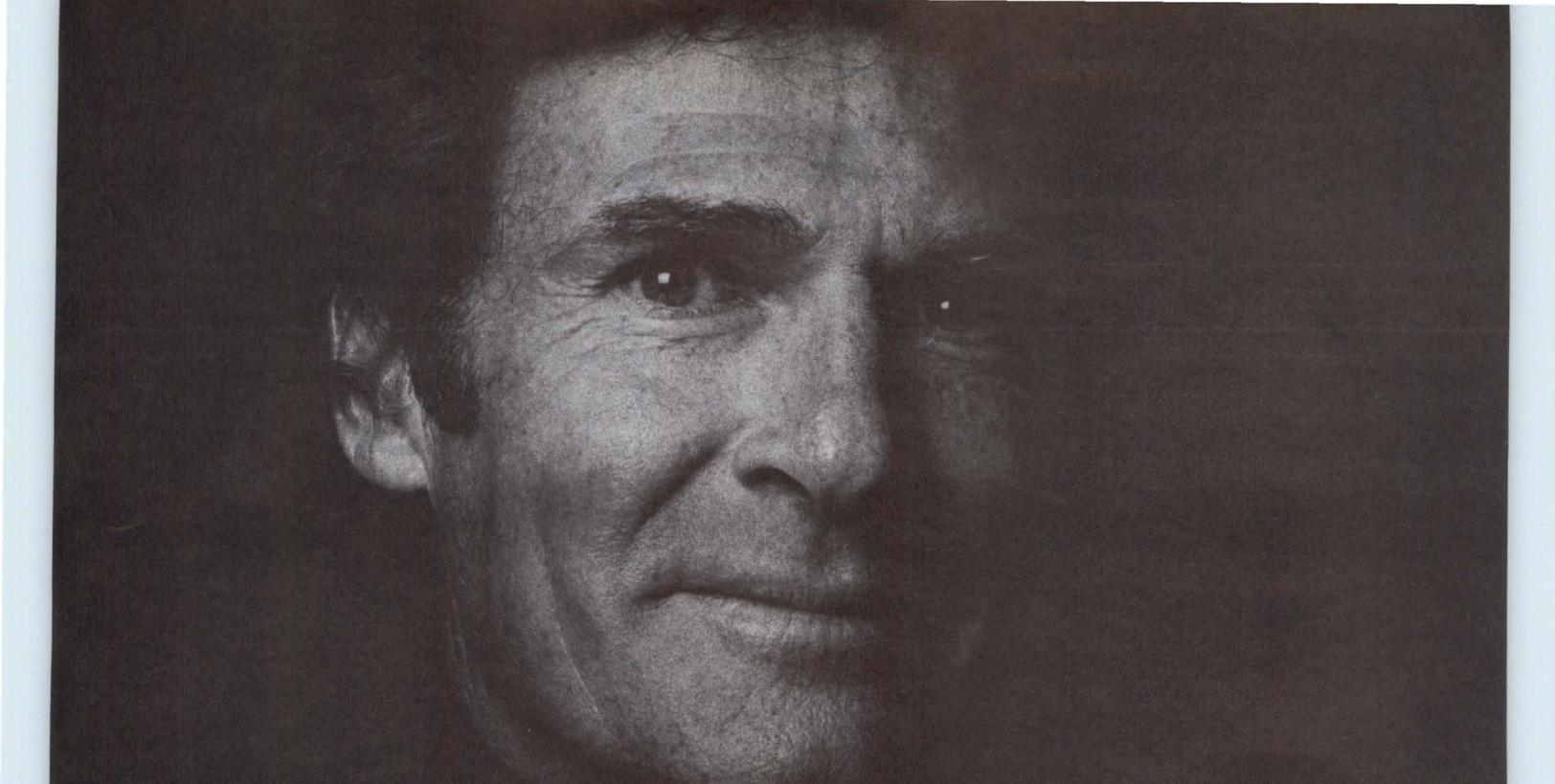
on the NS16032 at speeds approaching assembly execution.

Another result of the high-level language orientation of the 16032 chip is that the standard LMC-16032 support package uses full versions of all its languages, rather than subsets. HCR's FORTRAN 77, RATFOR, assembly language and C are part of the standard support package. Pascal is optional, and PL/1, COBOL, LISP, Ada and LOGO will be available in the future. Application programs, including spreadsheet, word-processing, relational-database and modeling programs, are available, and other common programs are slated to be available by year-end. □

Stanley M. Metcalf is chief technical officer, and **Robert M. Farber** is software general manager at Logical Microcomputer Co., Chicago.

NEXT MONTH IN MMS

Mini-Micro System's November issue spotlights CRT terminals, specifically low end display terminals. In a special survey piece, MMS will present more than 60 low end, low cost terminals.



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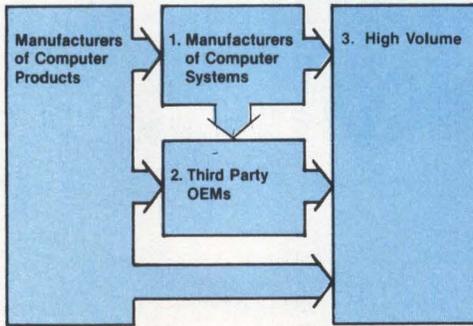
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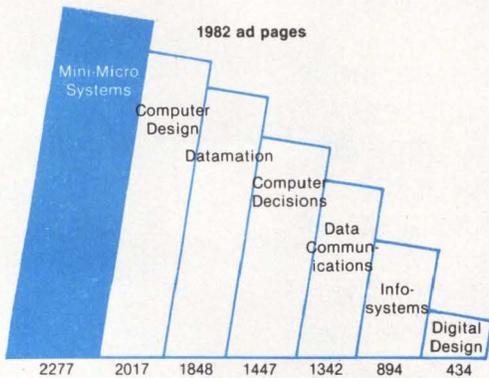
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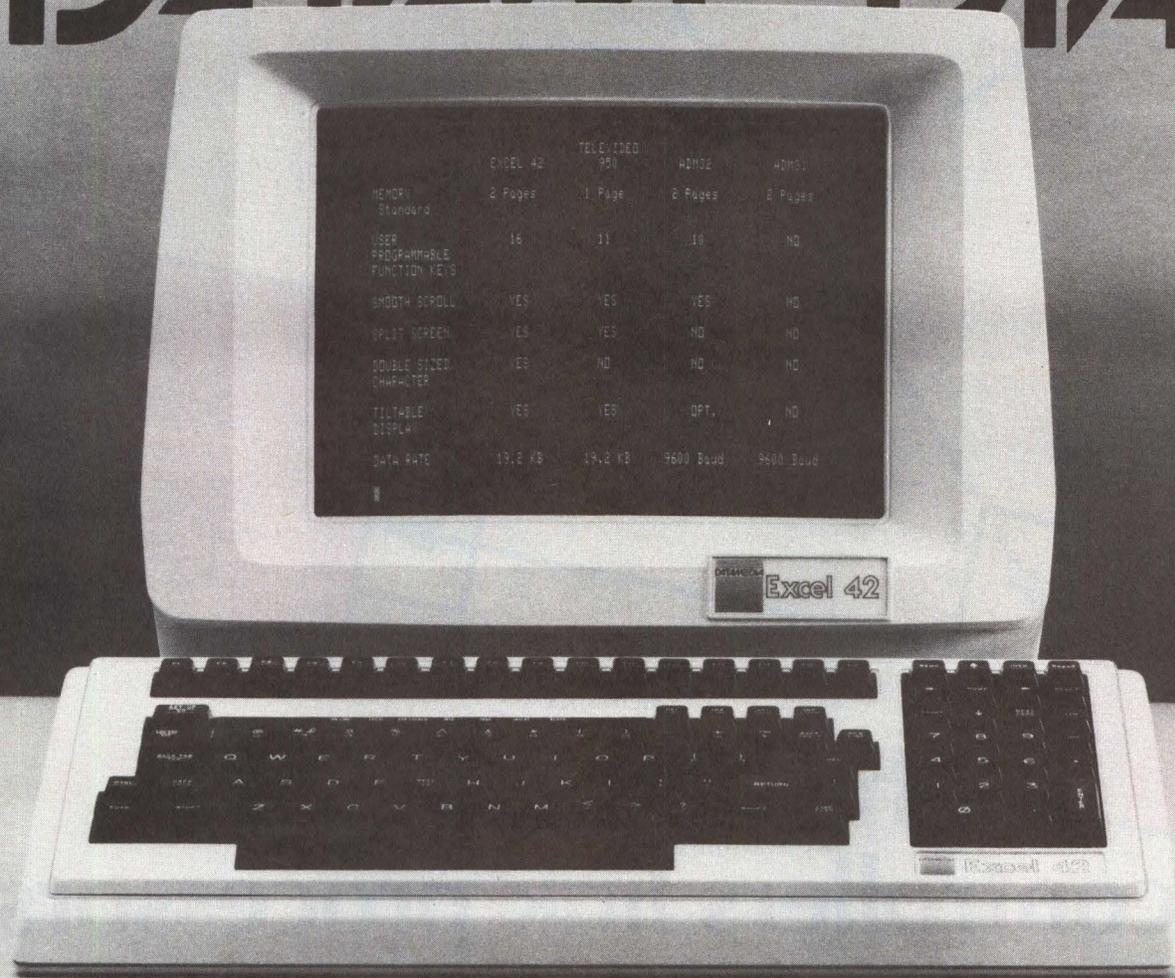
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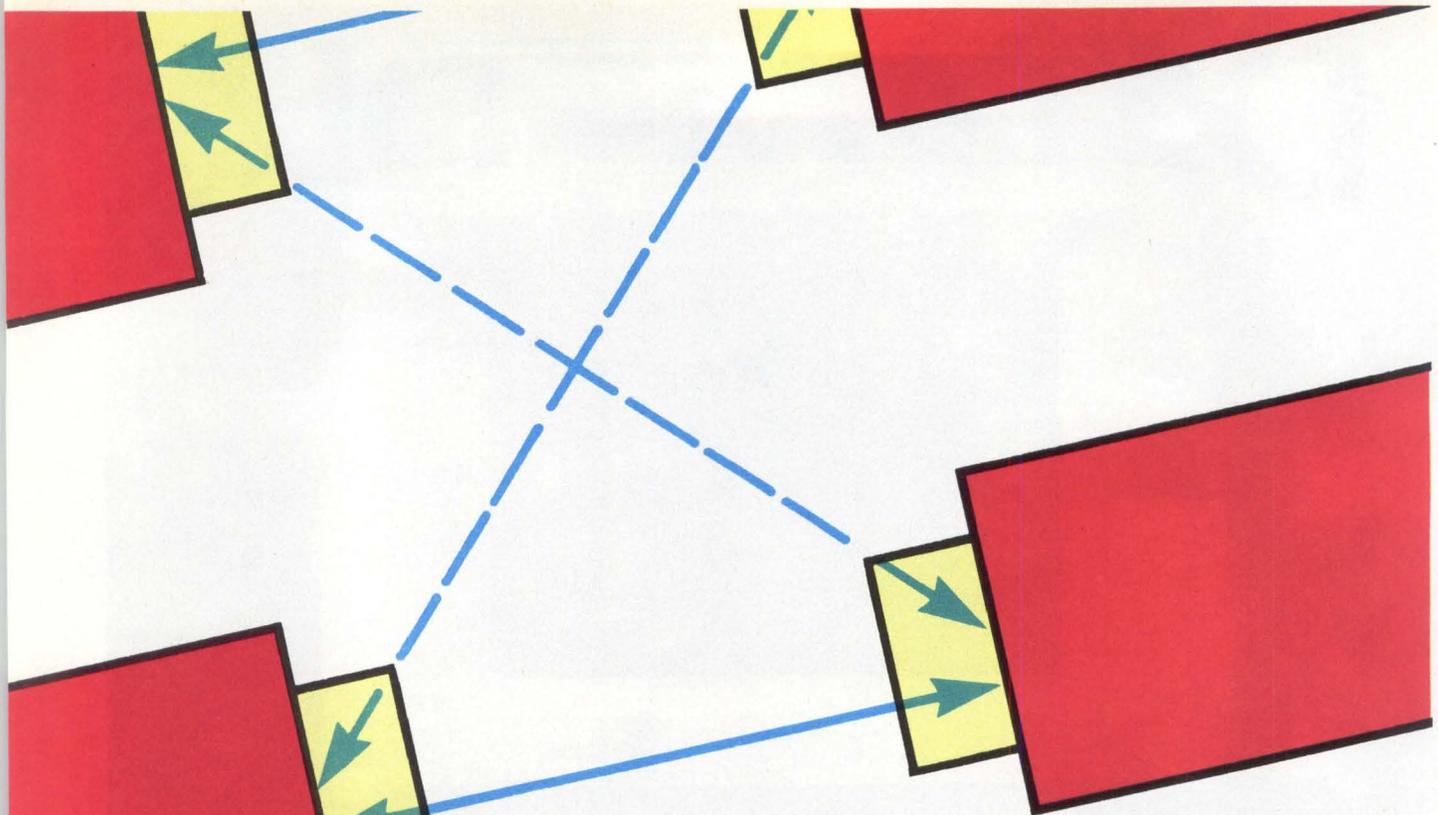
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MEMORY

Shared-memory controllers link processors

ROGER AOUIZERAT, Ranyan Computer Enhancement Systems

Logic-support boards create fail-safe, load-balanced cluster for Q-bus and Unibus systems

A major problem in configuring clustered host/satellite systems is controlling shared access to host memory. Ranyan Computer Enhancement Systems' peripheral processor link (PPL) for Digital Equipment Corp. Q-bus- and Unibus-based computers is a board-level solution. PPL benefits include load balancing, ease of upgrading and reconfiguration with minimal additional hardware.

Upgrading to a shared-memory system

Consider a pair of DEC PDP-11/24 computers, one of which does all data processing while the other is used as a "hot standby." Connected to the primary processor is a satellite PDP-11/23 used as a front-end, or peripheral, processor for transmitting data received over 64 RS232 communications lines. In the case of a host failure, a user can switch to the standby PDP-11/24.

Increasing the communications-handling abilities of the system by adding another PDP-11/23 front-end processor would typically require another PDP-11/24 host processor, because the extra communications burden would overload the primary host (Fig. 1). With PPLs, however, users can expand the configuration without adding a host while still maintaining redundant processing. The PPLs assume all memory access and transfer tasks and protocol conversions between hosts and satellites, relieving the processing burden on the hosts. Thus, in the case of a host failure, all processing is switched to the active host, which can handle all processing with only minor degradation.

Each PDP-11/23 has two shared-memory links connecting it to memory in each of the host processors. Each host supports the physical memory to be shared while, at the shared "window" (represented by the

PPL-1 board), there is no physical memory. The shared-memory portions are duplicated in each of the hosts. Two PPL-1 boards are attached to the backplane of each of the processors in the configuration (Fig. 2). The boards support the logic needed to establish the shared blocks of memory and to access and transfer data between memories.

How it works

When a satellite makes a reference to shared memory, the host PPL answers as if it were memory by translating address location, retrieving the requested data and transmitting the data back to the satellite PPL. The satellite PPL then computes the relocation address and sends the data to the satellite's memory. The host and satellite CPUs are not required to participate in this transaction.

The user assigns all specifications such as window size (the amount of memory to be shared), window base address, vector, vector base address and interrupt priority by using switches on the PPL. Window size can be set from 4K to 64K bytes in 4K-byte increments.

Each shared-memory link provides 16 vectored interrupts, 8 words each for host and satellite. An interrupt stack on each PPL board keeps track of the requested interrupts. A sequence from the satellite processor, for example, can trigger as many as eight interrupts, which can be queued in a buffer on the host PPL board. At system start-up, a reset instruction handles all initialization of the PPL at the local board and clears the interrupt stack at both sides of the link so that no interrupts are pending from either side.

The PPL also has an intelligent throttle control that allows the host side to monitor its own bus activity. If the PPL is active and another direct-memory-access (DMA) device wants access to the bus, the host PPL will relinquish the bus and throttle the peripheral for the length of time the user selects, specified by four jumpers. This enables the host to attend to other devices without being hindered by PPL activity.

The PPL monitors the CPU power supply. In the event of a power failure or brownout, the PPL finishes any shared-memory cycle then in progress. It then directs all processing to the active processor, preventing any

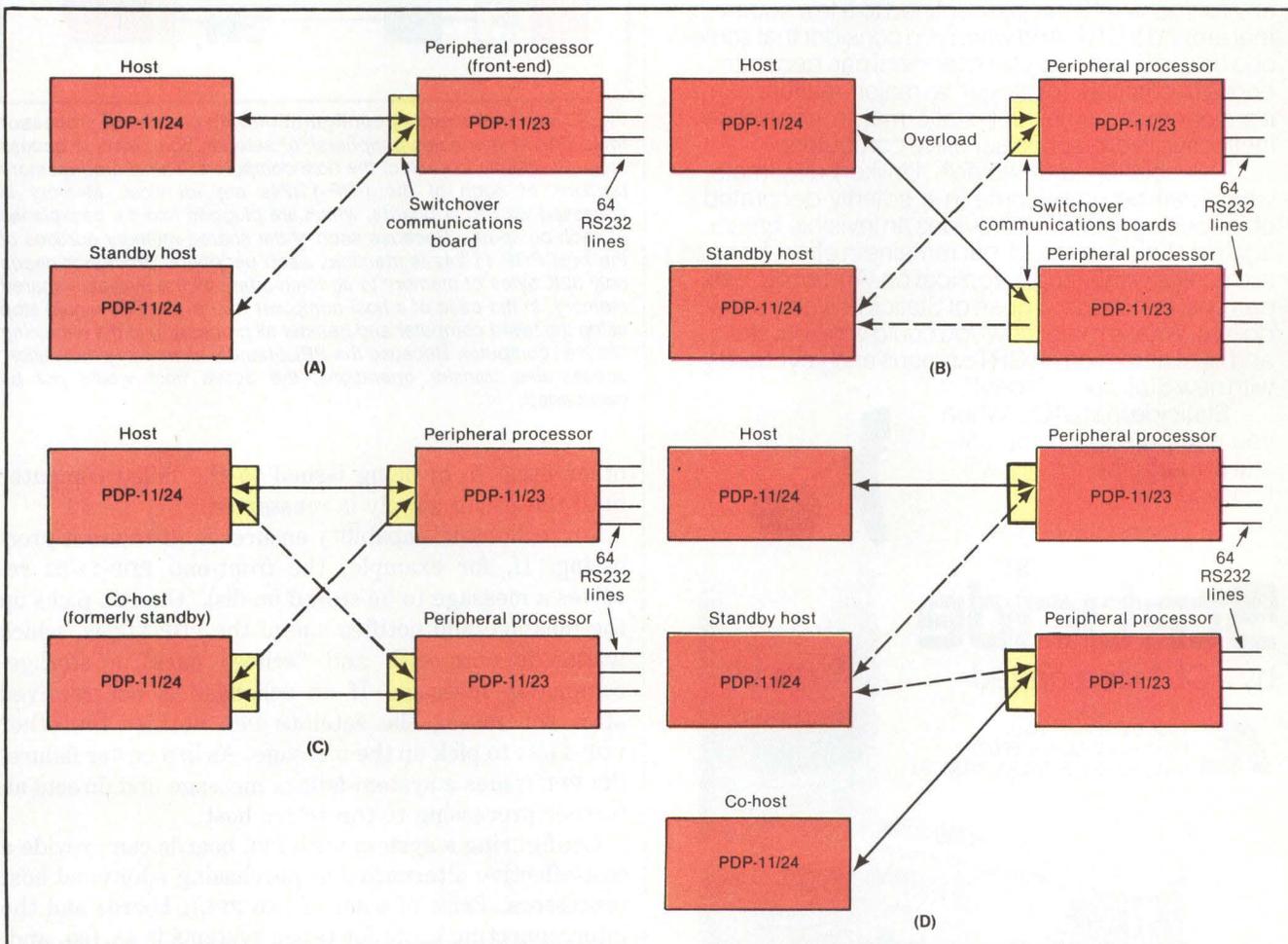
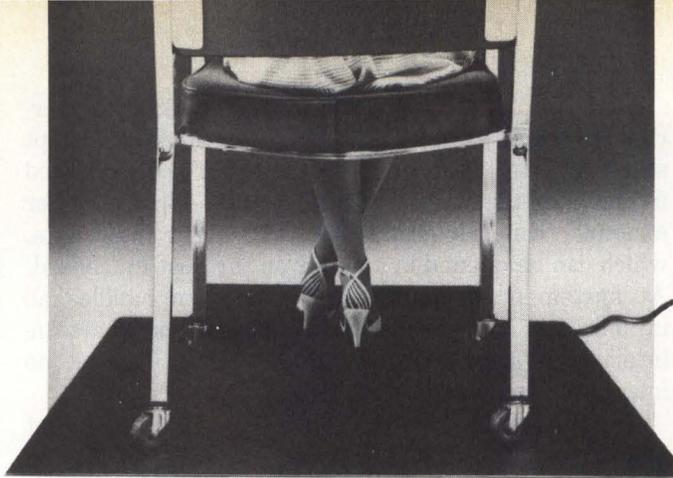


Fig. 1. Communications expansion of a host/satellite configuration typically requires the addition of another host to handle the increased processing load. The original configuration (A) consists of a host PDP-11/24 that does all processing, a "hot standby" and a peripheral, or satellite, PDP-11/23 that acts as a front-end communications processor. If another PDP-11/23 is added to double communications handling, the increased processing requirements could overload the host PDP-11/24 (B). If the standby were used for actual processing (C), a host-computer failure would result in both PDP-11/23s using one PDP-11/24, which would then be overloaded. To maintain full redundant processing, therefore, it is necessary to add another PDP-11/24 (D).



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MEMORY

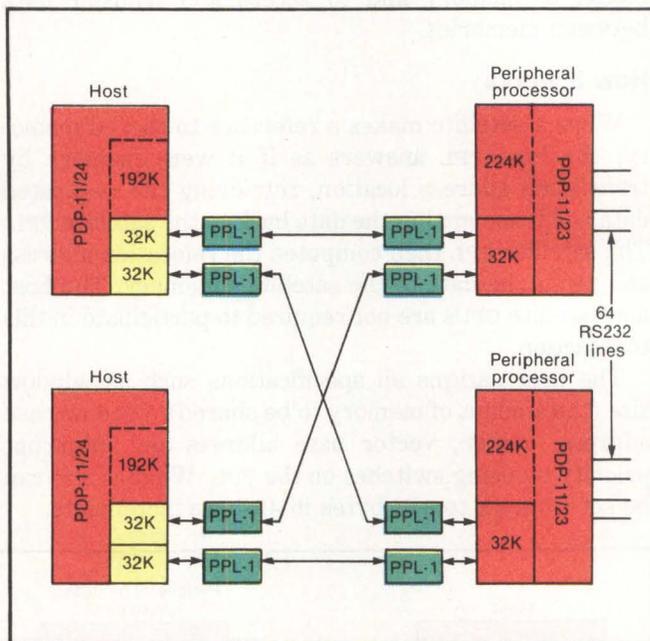


Fig. 2. A shared-memory configuration with peripheral processor links (PPL-1s) enables peripheral, or satellite, computers to access memory directly in each of the host computers. The shared-memory portions of each of the PDP-11/24s are identical. Memory is accessed via PPL-1 boards, which are plugged into the backplanes of each computer. Because each of the shared-memory portions of the host PDP-11/24s is identical, each peripheral processor needs only 32K bytes of memory to accommodate all the available shared memory. In the case of a host-computer failure, the PPL would stop using the failed computer and transfer all processing to the remaining "active" computer. Because the PPLs handle all memory translation, access and transfer operations, the active host would not be overloaded.

other cycle from being issued to the failed computer until the power supply is reasserted.

An "echoback" capability ensures fault-tolerant processing. If, for example, the front-end PDP-11/23 receives a message to be stored on disk, the PPL picks up the message and notifies one of the PDP-11/24s, which writes it onto disk and "echoes back" a storage-completion message. If an echoback is not received after 500 msec., the satellite PPL notifies the other PDP-11/24 to pick up the message. As in a power failure, the PPL issues a system-failure message and directs all further processing to the active host.

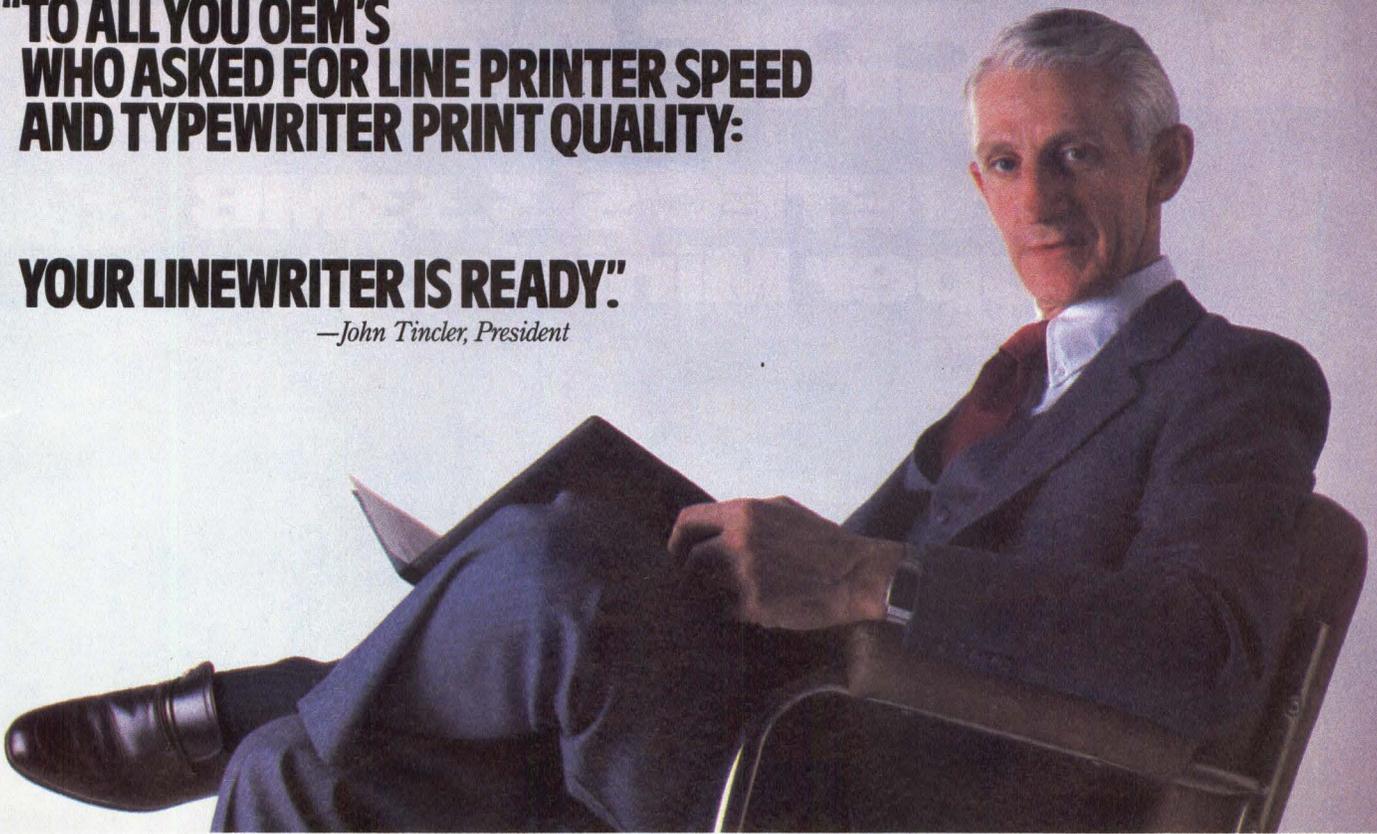
Configuring a system with PPL boards can provide a cost-effective alternative to purchasing additional host processors. Price of a set of two PPL-1 boards and the interconnecting cable for Q-bus systems is \$3,190, and, for Unibus-based systems, the price is \$3,990. □

Roger Auizerat is president of Ranyan Computer Enhancement Systems, Huntington Beach, Calif.

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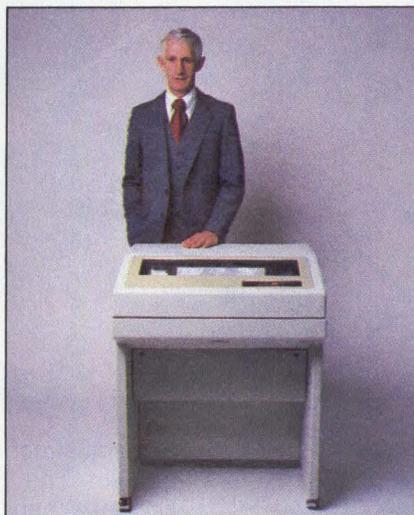
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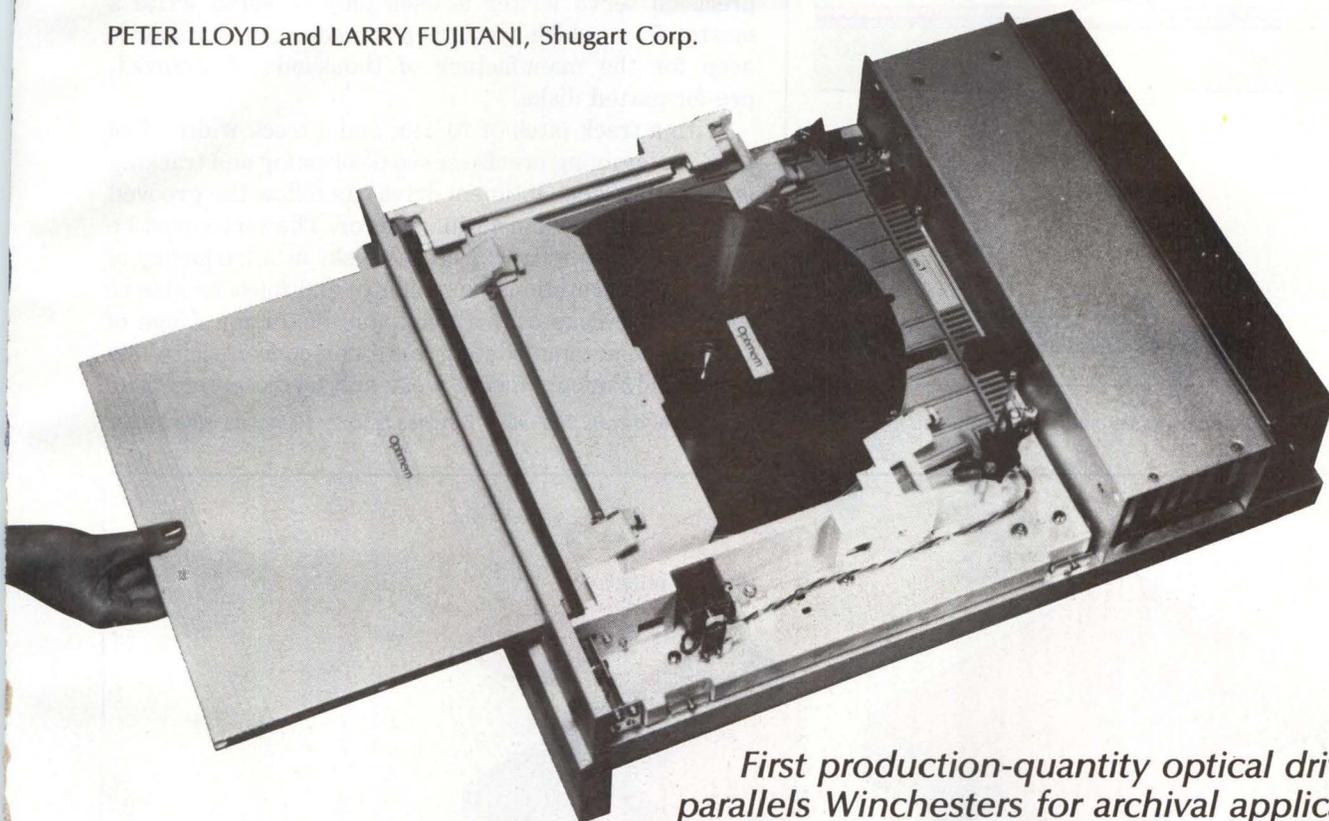
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New optical disk drive loads 1G byte on a 12-inch platter

PETER LLOYD and LARRY FUJITANI, Shugart Corp.



First production-quantity optical drive parallels Winchester for archival applications

Fueled by the movement to the fully automated office and the high-capacity demands of imaging and digital-voice applications, disk drive manufacturers have been challenged to produce higher capacity drives within traditional form factors. While magnetic-based drives are cost-effective choices for most applications, laser-based optical disk drives provide a storage solution for systems requiring large amounts of archival storage. One such drive is the Optitem 1000, developed by Shugart Corp.'s Optitem Division, which offers 1G byte on a 12-inch disk using non-erasable laser-recording technology. In addition to offering more than 17 times the areal density of today's highest capacity Winchester drives, the Optitem 1000 provides a lower cost per byte, a lower power-consumption-to-capacity ratio, media removability for long-term off-line archival storage and new marketing opportunities for system integrators.

Packing 400,000 pages on a 12-inch disk

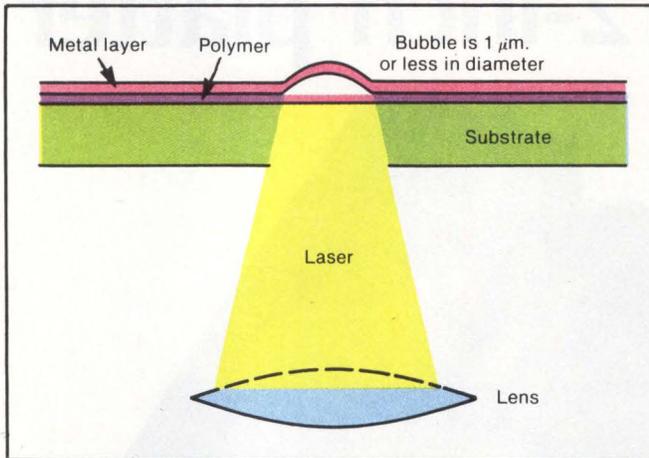
The high areal density of optical disk products is a result of laser technology. A gallium-aluminum-

arsenide (GaAlAs) semiconductor laser diode produces a 20-mW beam of coherent light that is focused onto a spot approximately 1 μm . (39 $\mu\text{in.}$) in diameter. This technique produces a linear density of 14,500 bits per inch (bpi), which today's magnetic recording technologies readily match. However, because of the smallness of the recorded spot, the track density equals the linear density. Thus, the areal density is 210×10^6 , compared to 7×10^6 for most 5¼-inch Winchesters or 0.3×10^6 for most double-sided, double-density 8-inch floppies.

To write data, the drive focuses the laser beam in high power mode on the metal layer of the disk. The laser heats the metal layer, making it ductile. The heat energy is transferred to a decomposable polymer that generates gaseous components when heated. The gaseous components push up on the metal layer, creating a bubble (Fig. 1). The laser detects (reads) the bubbles by measuring the changed intensity of the reflected light from the disk surface.

The Optitem 1000 optical disk drive (above) stores 1G byte of data on a 12-inch disk. Price of the drive is \$6,000 in OEM quantities.

Fig. 1. A bubble is formed by the laser heating the metal layer of the media. The heat energy is transferred to a decomposable polymer that generates gaseous components when heated. The gas pushes up the metal layer, creating a bubble.

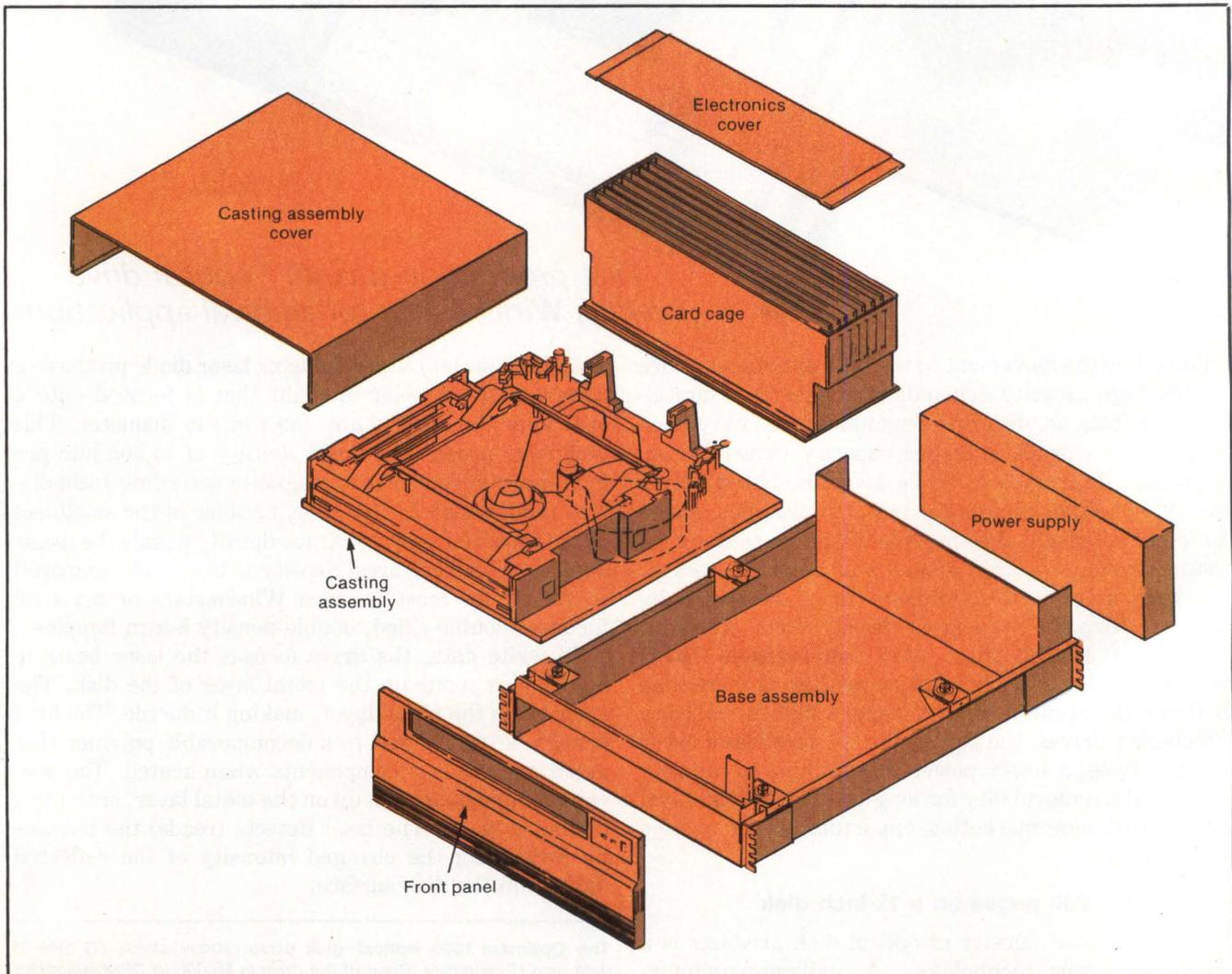


Servo positioning system ensures accuracy

There are 40,000 tracks on the Optimem disk, resulting in a track density of 14,500 tracks per inch (tpi) and a track pitch (distance between track center lines) of 70 μm . The disk uses a grooved disk technology similar to that used in laser video disk products so that each disk can be impressed with radial servo-tracking information, data-synchronization signals and pre-formatting to provide radial head-positioning feedback during disk manufacture. The precision servo writer is used only to servo write a master from which a stamper is made. The stamper is used for the manufacture of thousands of grooved, pre-formatted disks.

With a track pitch of 70 μm . and a track width of 24 μm ., maintaining precise servo positioning and tracking is essential. The Optimem drive can follow the grooved tracks with less than 4 μm . of error. The servo must be able to follow the tracks on the disks at a frequency of 19 Hz (1,122 rotations per minute) and must be able to follow the tracks over a maximum distortion range of 2.8 mils to accommodate groove non-concentricity due to spindle runout, media wear and media errors. The

The Optimem 1000 elements are similar to those used in conventional Winchester drives. The unit is 7 inches high by 19 inches wide by 24 inches deep.



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DYSAN PAT - 1 Model 850

COMMAND LIST

0. Parameters:	113. Accordion
a. Step Rate	*14. Step Rate
b. Seek Settle	*15. Hysteresis
c. Retries	116. Locate Head
d. TPI	17. Controller Status
e. Density	18. Clear Controller
f. Pre-Comp	119. Verify Format
g. Switch Current	120. Write Format
1. Drive	22. Re-Write Sector
2. Side	21. Write Sector
3. Track	23. Format Track
4. Alternate Seek	124. Random Diskette
5. Centering	125. Random Seek, Read
6. Spindle Speed	26. Random Seek, W/R
7. Index Width	27. Write Pattern
8. Index Timing	28. Constant Write
9. Skew	29. Tap Test
*10. Head Load	30. Sequence Selects
*11. Radial	31. Toggle Side
*12. Azimuth	Unit Select

*DDD™ Required †Formatted Diskette Required

CONTROLLER STATUS BIT ASSIGNMENTS

Command 17

0	1	2	3	4	5	6	7	8	9	10
Write Protect	Write Error	Write Fault	Write Ready	Write Data Error	Write Head Error					

Command 18

0	1	2	3	4	5	6	7	8	9	10
Write Protect	Write Error	Write Fault	Write Ready	Write Data Error	Write Head Error					

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CIRCLE NO. 140 ON INQUIRY CARD

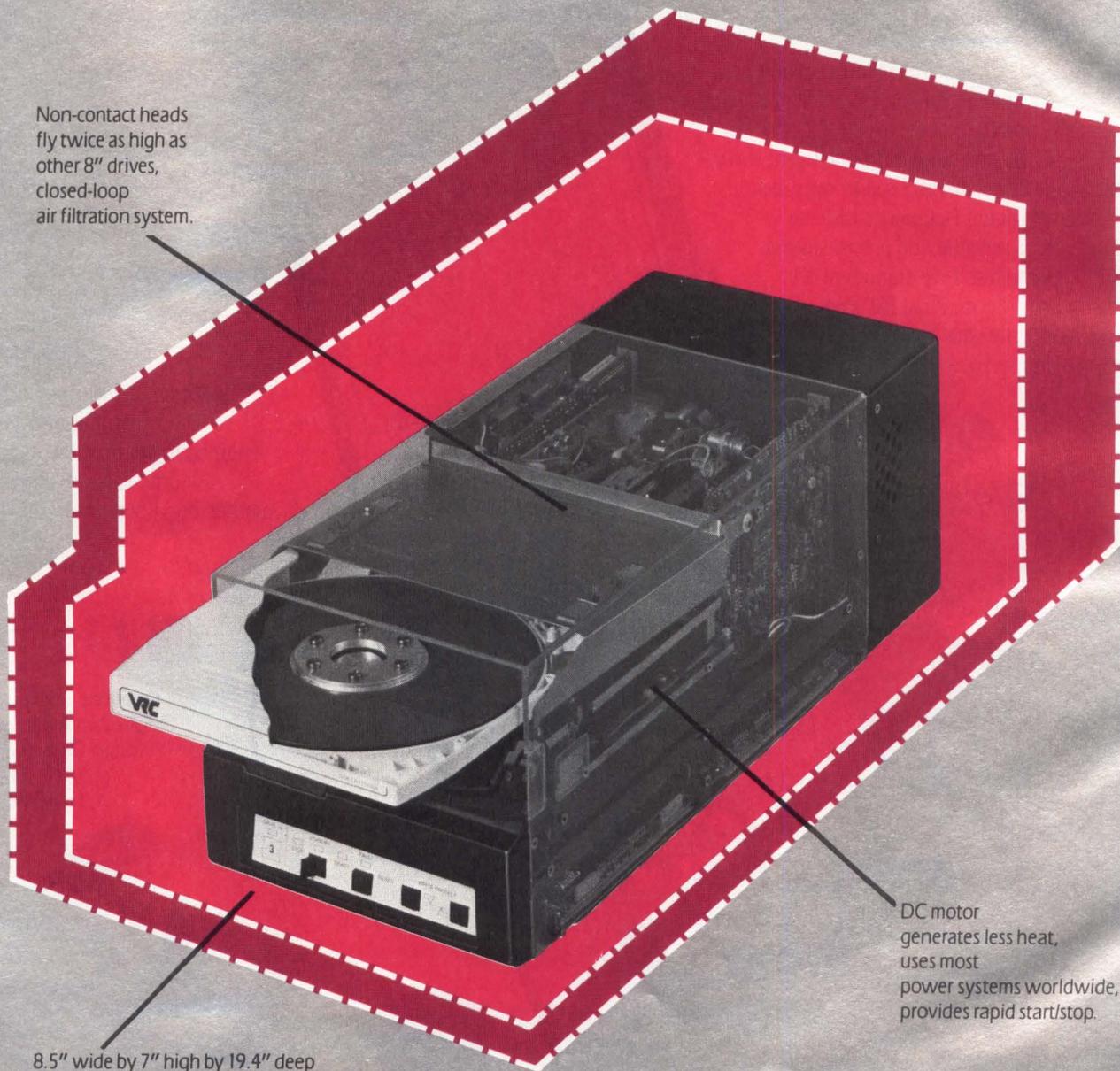
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CIRCLE NO. 141 ON INQUIRY CARD

DISK DRIVES

focus actuator must be able to attain axial acceleration of approximately 10g to maintain focus. The Optimem 1000 uses two actuators to meet these stringent requirements.

When the drive performs a seek, a coarse actuator and a fine-positioner actuator direct the read/write head. The coarse actuator is similar to the rotary voice-coil positioners used in some magnetic disk drives. The fine positioner, a small voice-coil actuator,

is mounted on the coarse actuator. It moves the final focus lens radially across the tracks as well as up and down for focus control. When a long seek is initiated, an optical scale on the coarse positioner provides positioning feedback to the coarse positioner to bring the read/write head within the access range of the fine positioner. The fine positioner servo loop is then closed to acquire a track, read an address from the disk, determine the exact track position and compute a correction factor (the difference between the located address and the desired address). The fine positioner then locates the proper track.

Design dictates cost trade-offs

The cost of optical disk products should be considered in light of the advantages and disadvantages over Winchester disks of comparable capacity. On the plus side are the high areal density and dual-positioning system combined with the grooved-disk technology. The high areal density makes it possible to keep the rotating mass small, which minimizes the cost of the spindle motor and provides a better cost-per-megabyte ratio than is available with most Winchester drives.

Offsetting these cost advantages is the non-erasable

OPTIMEM 1000 KEY PRODUCT SPECIFICATIONS

Manufacturer: Shugart Corp., Sunnyvale, Calif.
Capacity: 1G byte
Transfer rate: 5M bps
Average access time: 150 msec.
Rotational speed: 1,200 rpm
Linear density: 14,500 bpi
Track density: 14,500 tpi
Dimensions: 7(h) x 19(w) x 24(d) inches
OEM price: \$6,000 per unit in quantities of 250

INTEGRATING THE SYSTEM

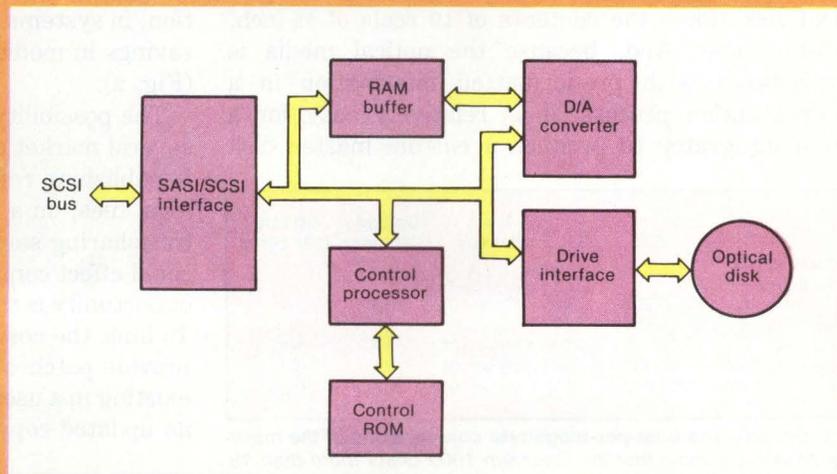
The American National Standards Institute's (ANSI's) X3T9.2 technical committee is now adopting intelligent host-level interfaces like the small computer system interface (scsi)/Shugart Associates systems interface (SASI). Such standards would facilitate the introduction of peripherals such as the optical disk drive. Because these interfaces transfer commands and status information between the host and the peripheral, it is possible to design an optical disk drive controller with the same host-to-controller interface used by other peripherals such as floppy disk drives, Winchester disk drives, streaming-tape drives and printers. Thus, a system integrator has only to write the software to interface an application program to the optical disk.

Several characteristics of the scsi help to make the optical disk more transparent to the host system. The optical disk has 40,000 tracks (about 20 times more than most Winchester disk drives), but this has little impact on users because sectors on the disk are addressed as logical blocks. The optical disk allows 1 million blocks to exist on one surface. This is not a problem because scsi can handle more than 4 billion blocks on as many as eight drives.

The controller also handles error correction. An interleaved Reed-Soloman code, implemented in Shugart Corp.'s Optimem 1000 controller, provides multiburst error correction or 300-bit-long single-burst correction (compared with 11 bits in length for most magnetic disks). In addition, the scsi provides sophisticated facilities for error reporting.

Because a controller is necessary for each drive only in applications that

are performance oriented or require redundancy, the Optimem 1000 has a drive-level interface that can be daisy-chained to share the controller with as many as eight drives. Although connecting the optical drive to any controller is not feasible because of the differences between optical and magnetic disk technologies, an Optimem Drive Interface allows multiple drives to be connected to a controller.



The SCSI is a de facto host-level industry interface standard. Together with the drive's controller and drive interface, the SCSI allows system integrators to upgrade from Winchester-based systems to systems configured with the Optimem 1000 optical drive.

nature of the media, the high cost of the read/write head and the need for a greater number of servo electronics circuits. The Optimem 1000 has several servo systems, including the spindle-speed control servo, the focus servo, the coarse and fine positioner (tracking) servos and a laser power-control servo. Additionally, semiconductor laser diodes are expensive because of their limited applications.

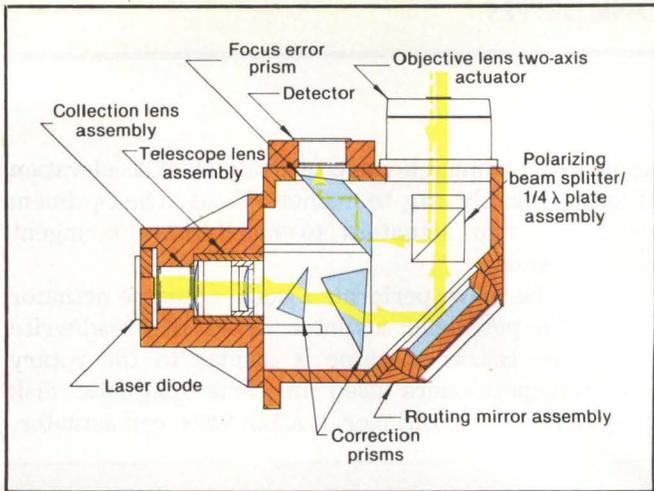
Because it is necessary to spin only one disk, the power consumption of the Optimem 1000 is less than 230W. A magnetic disk drive of comparable capacity consumes more than four times that power. Another important benefit of the high areal density is the compact footprint occupied by the Optimem 1000, which is 7 inches high by 19 inches wide by 24 inches deep.

The Optimem 1000 was designed with a minimal parts count to reduce maintenance and repair costs. The optics assembly is a drop-in module that does not require alignment during operation to meet the safety regulations concerning the operation of lasers. (The Optimem 1000 meets the safety requirements of the Bureau of Radiological Hazards.)

Modularity continues throughout the drive's design to allow a major subassembly replacement policy for field repair. In addition, the microprocessor in the drive detects and diagnoses fault conditions. This facility, used with the fault-isolation capabilities of the small computer system interface (SCSI) controller, allows the host to run high-level diagnostic programs to facilitate rapid correction of drive failures.

New technology creates new markets

The optical disk offers a cost-effective alternative to tape as the backup media for fixed Winchester. One optical disk stores the contents of 10 reels of 1/2-inch, 6,250-bpi tape. And, because the optical media is manufactured with pre-formatted information in a mass-replication process, it is relatively easy for a system integrator to produce a custom master disk



The optical head assembly channels light from a semiconductor laser diode to an objective lens. The laser diode emits a coherent, yet divergent, beam of light. The collection lens gathers the divergent light and forms a collimated (parallel), elliptical beam. The correction prism transforms the elliptical beam into a circular beam. A routing mirror reflects the beam into a polarizing beam splitter that transmits it to a quarter-wave plate. The wave plate rotates the polarization of the beam 90 degrees and passes the beam to the spot-forming objective lens. A two-axis actuator focuses the lens. The reflected light returns through the objective lens and the wave plate again rotates it 90 degrees. The beam splitter relays the beam to a photodetector, which produces feedback information for the focus and tracking servos.

with proprietary software for volume distribution.

One problem facing the computer industry is the trend toward fixed media devices and the migration of computers to users who don't want to bother with file backup. In an automated office, a network of personal computers can link to a central file server containing an optical disk that provides a central backup facility intelligent enough to handle automatic file backup.

In many facilities, magnetic disk storage is at a premium. Inactive files are kept on tertiary storage such as 1/2-inch tape. An operator must mount the tapes to transfer the information when required. An optical drive can store 10 times more information on-line, decreasing the need for operator intervention. In addition, in systems with large amounts of off-line files, the savings in media storage facilities could be substantial (Fig. 2).

The possibility of mass replication of software opens several market opportunities. One of the more obvious is publishing reference databases, such as medical and legal files, on a subscription basis. For heavy users of timesharing services, direct access to these databases could effect communications and time savings. Another opportunity is the ability to simplify software updating. To limit the cost of updating software, it is common to provide patches that must be installed in the software existing in a user's system. The optical disk can provide an updated copy of the entire software package. □

	BPI	TPI	Areal density	On-line (\$/M byte)	Off-line (\$/M byte)
Double-sided, double-density 8-in. floppy	6,800	48	0.3 × 10 ⁶	450	4
5 1/4-in. Winchester	8,800	800	7 × 10 ⁶	60	N/A
IBM 3380	15,200	800	12.2 × 10 ⁶	15	N/A
Magnetic tape	10,000	64	0.6 × 10 ⁶	70	0.10
Optimem 1000	14,500	14,500	210 × 10 ⁶	6	0.20

Fig. 2. Density and cost-per-megabyte comparisons of the major types of storage show that the Optimem 1000 offers more than 18 times the storage capacity of most Winchesters at an on-line cost of \$6 per megabyte and an off-line storage cost of 20 cents per megabyte. The density figures represent current maximums for each storage type. On-line cost-per-megabyte figures were determined by dividing the cost of the drive by the capacity. Off-line costs represent the cost of the media divided by the capacity.

Peter Lloyd is vice president and general manager, and **Larry Fujitani** is product manager of the Optimem Division of Shugart Corp., Sunnyvale, Calif.

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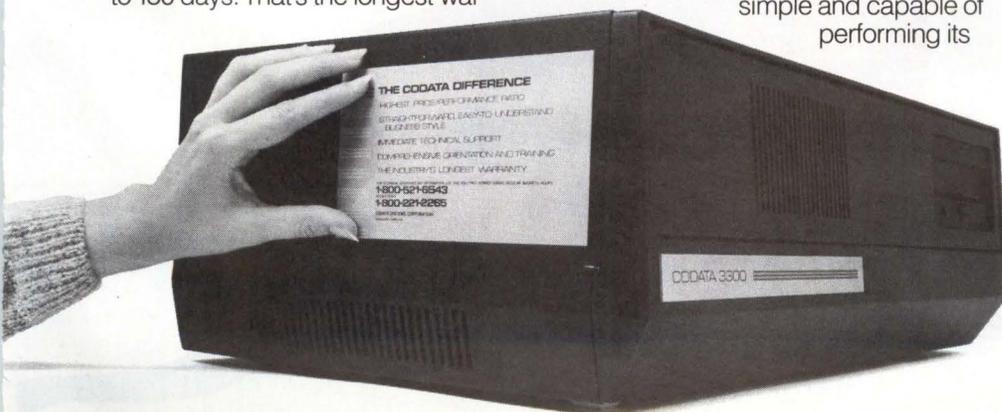
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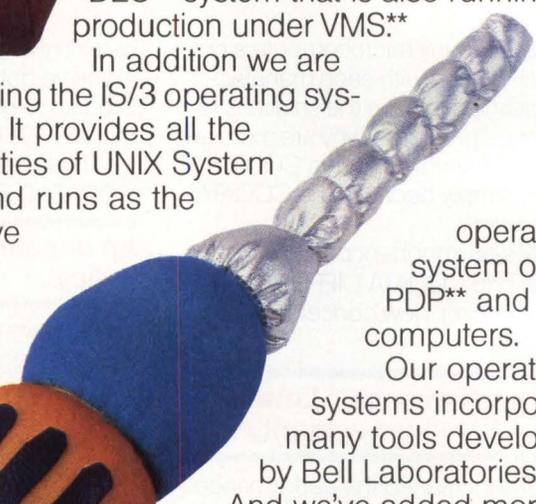
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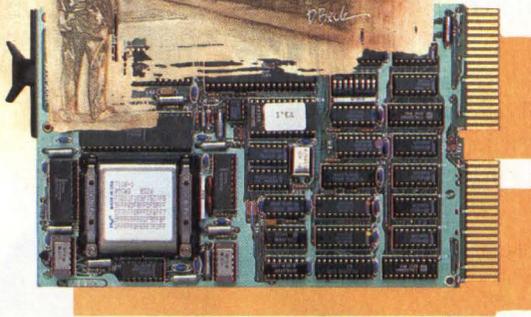
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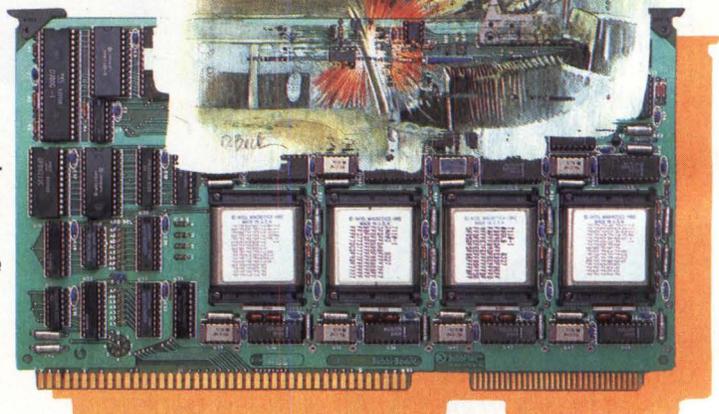
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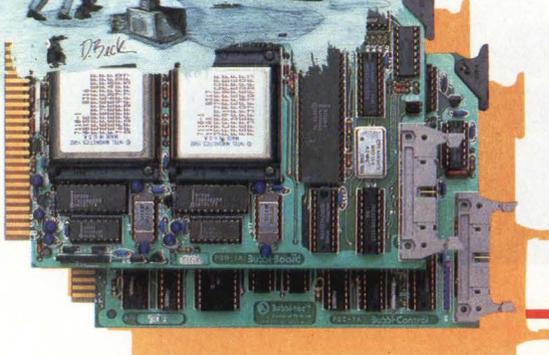
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Recording densities push the limits

STANLEY H. MILLER and
ROBERT FREESE, 3M Co.

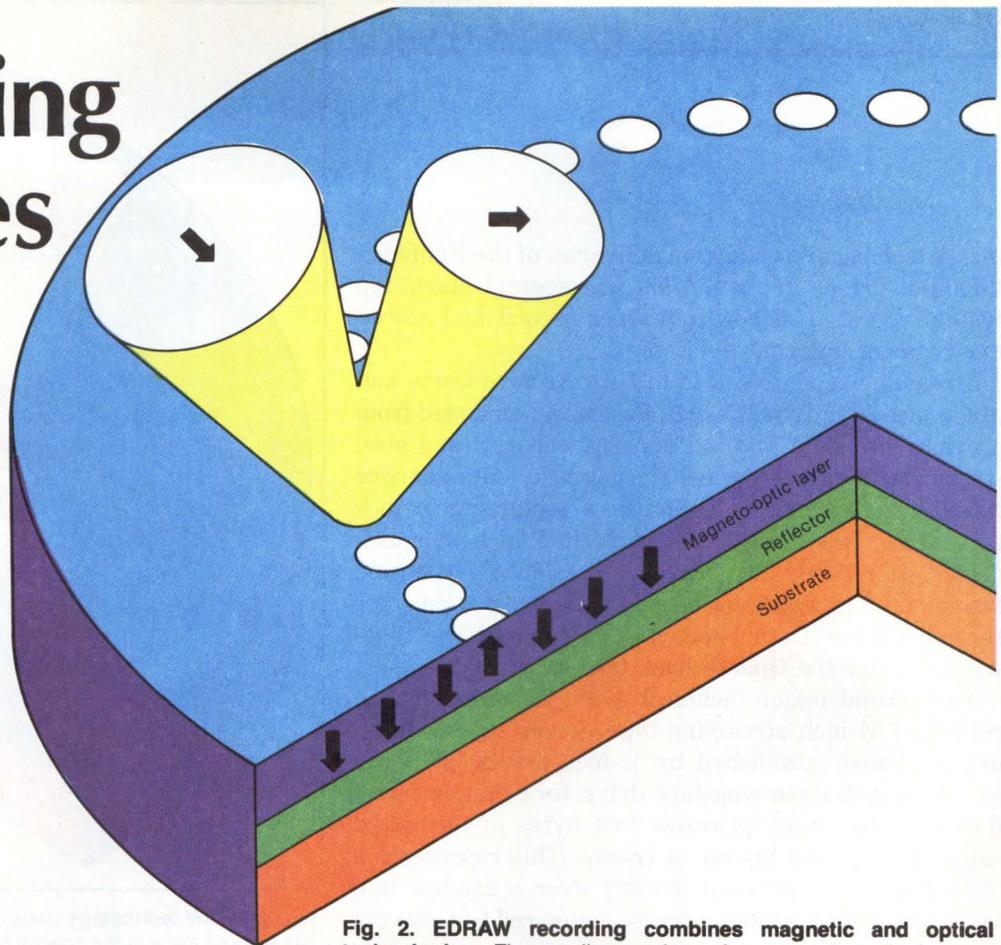


Fig. 2. EDRAW recording combines magnetic and optical technologies. The media consists of a magneto-optic layer, a reflector layer and the substrate. The magneto-optic layer is subjected to a steady magnetic field, and bit positions are recorded by a laser that inverts the polarity of the magneto-optic layer at specific locations. Reading is done via polarized laser light. The bits with unchanged magnetic polarity rotate polarized light in one direction; those with inverted magnetic polarity rotate it in the opposite direction.

A look at magnetic-tape advances and recent disk-recording techniques

Today, 1 square inch of magnetic tape holds as much data as more than 3 square feet of media did nearly 30 years ago. This 430-fold increase in tape-recording density is expected to progress at the same rate through the next decade. Startling as this advance may be, even more significant technological surges are taking place in disk-recording densities. Erasable direct-read-after-write (EDRAW) data recording, for example, promises approximately 3G bits per square inch, direct-read-after-write (DRAW) technology can pack 1.5G bytes onto a 12-inch plastic disk, and vertical recording has already produced 440,000 bpi. The evolution of tape densities provides a good backdrop for surveying recent disk-recording technologies.

A brief history of magnetic-tape advances

Technological advances in tape-drive recording densities are best indicated by the increases in areal density (bits per square inch) and linear density (bits per inch per track). After the introduction of IBM Corp.'s 726 tape drive in 1953, areal density increased 20-fold in the

first decade, and approximately fourfold and sixfold in the next two decades, respectively (Fig. 1). By 1990, densities are expected to approach seven times current capacities.

IBM Corp.'s 726 used ½-inch tape recording at 100 bits per inch on seven tracks and had an areal density of 1,400 bpsi. Areal-density capacities were doubled in 1955 by the introduction of 200-bpi tape drives. In 1959, 556-bpi products with areal densities of 7,784 bpsi were introduced.

In 1962, 800-bpi units appeared, followed in 1963 by the first nine-track units. Density doubled in 1965 with the introduction of 1,600-bpi products with an areal density of 28,000 bpsi. Eight years later, IBM introduced the 3420-4 tape drive using group-code recording (GCR) techniques at 6,250 bpi. At the same time, the first production quantities of ¼-inch tape cartridge drives were delivered. Although these drives fell short of the densities available on ½-inch drives, they were reliable and compact.

The next major advance came from Data Electronics

Inc., which began production deliveries of the Funnel, a 6,400-bpi drive, in 1977. This incremental start/stop system operated at 24K bytes per second and stored 17M bytes of unformatted data.

Streaming-tape drives from both Archive Corp. and DEI appeared in 1981. Though basically unchanged from previous products in areal density, capacity and size, streamers were designed to increase data-transfer rates. The Archive Sidewinder, a streaming 1/4-inch tape drive, was designed to back up Winchester disk drives. It records 20M bytes of data in a serpentine fashion on four tracks at speeds of 30 or 90 inches per second. Cipher Data Products has licensed the Sidewinder under the Quarterback trademark.

The second major technical event of 1981 was the return of 1/4-inch streaming-tape drives to the areal-density trend established by 1/2-inch drives. 3M Co.'s HCD-75 1/4-inch streaming-tape drive, for example, introduced in that year, provides 67M bytes of formatted capacity at 10,000 bpi on 16 tracks. This represents a sixfold increase in areal density over 6,250-bpi GCR techniques and a 22-fold increase compared to 1,600-bpi

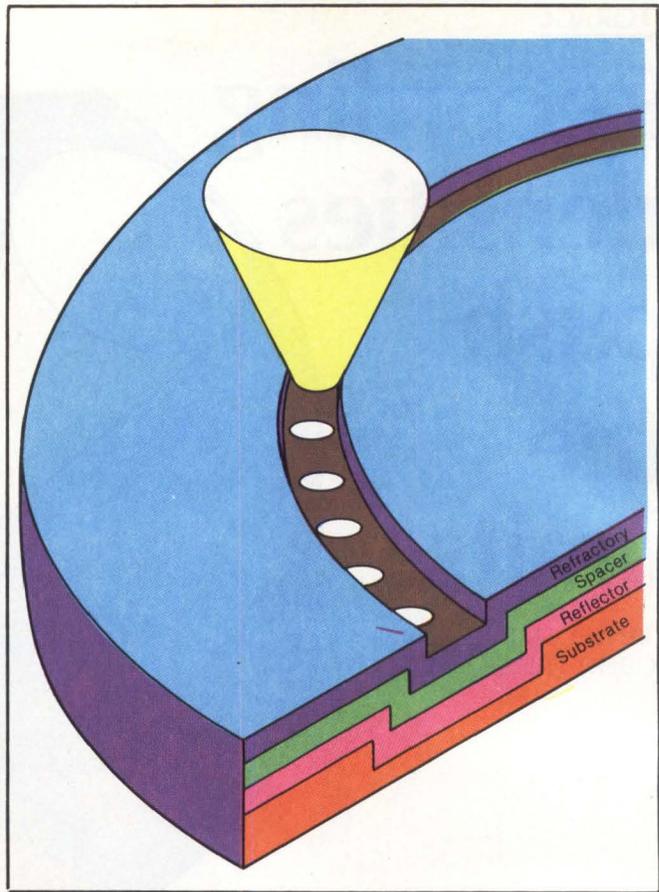


Fig. 3. DRAW technology uses optical recording to create 0.5 μm pits along a track in the special plastic refractory layer of the disk. A diode laser is used to write and read the data.

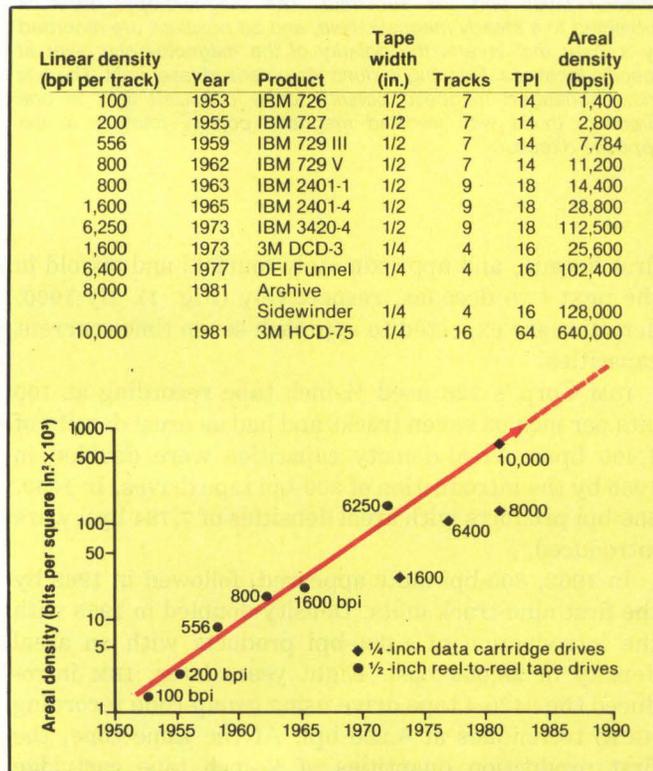


Fig. 1. Magnetic-tape recording densities are steadily increasing. Linear and areal densities have increased by factors of 100 and 450, respectively (top). Quarter-inch cartridge drives have caught up to the areal-density trend line established by 1/2-inch reel-to-reel tape drives (bottom).

1/2-inch technology. The key to the HCD's high capacity and reliability is a stepped head that uses 19 incremental steps to move from one track to another.

The HCD-75 represented the state of the art in tape-recording density when it was introduced. Today, the same density is available from a variety of manufacturers, and the scramble to develop the next generation of tapes is well under way.

The future of magnetic tapes

During the past year, developments have revolved around tape drives with 20,000 bpi and areal densities of approximately 720,000 bpsi. None of these products has been commercially introduced, however, due largely to technical difficulties in mass-producing the required media.

To increase capacities, both bits per inch and tracks per inch must be increased. The signal-to-noise ratios of the tapes currently used, as well as those under development, are more than adequate to accommodate higher densities. A major roadblock is the difficulty of attaining precise tape-guiding and mechanical/electronic head-positioning techniques at the higher density.

Another consideration is error correction. The acceptable rate is one unrecoverable error in 2.5G bytes of data. While it is technically possible to produce tape at

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Feature	DMA Systems 5¼" Drives	3.9" Drives	Other 5¼" Drives
Now in production	yes	no	no
Data interchange	yes	no	no
Contamination control	yes	no	no
Retractable heads	yes	no	no
Standard cartridge	yes	no	yes
40 ms access time	yes	no	no
5 Mb capacity (formatted)	yes	yes	yes
Capacity growth capability	yes	no	no
Removable-only drive	yes	yes	yes
Fixed/Removable drive	yes	no	no

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that rate in limited quantities, it is not easy to produce tape at that rate in large quantities. Keeping the error rate low while pushing densities toward 20,000 bpi is a major impediment to developing the next generation of tape drives.

If the problems of mass production, tape-guiding and head-positioning techniques and error-correction rates can be surmounted, tapes with 15,000 bpi on 24 tracks can be expected by 1985. Within the next 10 years, tapes will offer 20,000 bpi on as many as 32 tracks. Tape

Tapes will offer 15,000 bpi on 24 tracks by 1985.

drives will be used predominantly for backup, while new disk technologies assume the major storage tasks. A look at some impressive recording technologies puts density trends in perspective.

EDRAW recording boosts areal density

Erasable direct-read-after-write (EDRAW) data recording combines thermal and magnetic effects to cause a measurable angular rotation of a laser-generated beam of polarized light. Densities of 25,000 to 50,000 bpi have been achieved in 3M laboratories using EDRAW recording. Track width is 1.6 micrometers, which produces an areal density of about 3G bpsi (Fig. 2).

In EDRAW recording, a low-field magnetic bias is maintained on a plane perpendicular to and close to the underside of the disk. The data-recording laser is focused on the recording track on top of the disk. When the laser is fired, the resulting increase in temperature at that spot permits the bias field to overcome the residual polarity on the magneto-optic layer of the disk surface and to invert it to represent a binary 1. This is possible because the magneto-optic layer is composed of special rare-earth-transition metal materials whose magnetic coercivity is affected by temperature.

At playback, polarized laser light is focused on the spots. The bits with unchanged magnetic polarity rotate the polarized light in one direction, while those with inverted magnetic polarity rotate it in the opposite direction. A polarizer and detector combination reads the results, differentiating between 0s and 1s. Rewriting a sector with the magnetic bias field at the opposite polarity causes partial erasure. Increasing the intensity of the bias field accomplishes bulk erasure to override the previously written data and orient it in

one direction. Because writing, reading and erasing are accomplished through the use of light, no magnetic heads are needed.

Increasing the rotation angle of the polarized light achieves higher signal-to-noise ratios. The angle can be increased through the use of certain disk materials and thin-film interference structures. The lower the intensity of the reflected light or the higher the interference between the directed light and the light reflected from the disk surface, the better the signal quality. Certain disk materials produce low reflected-light intensity, which in turn increases the rotation angle of the polarized light. In 3M laboratories, carrier-to-noise ratios exceeding 50 decibels have been achieved at recording frequencies as high as 20M bits per second at areal densities exceeding 300M bpsi.

DRAW recording expands linear density

Non-erasable direct-read-after-write (DRAW) techniques can record as much as 1.5G bytes on a 12-inch plastic disk, representing an areal density of 300M bpsi. The disk has 45,000 concentric tracks (3,750 tpi) to guide a laser beam in both the recording and read-back modes. The media includes a substrate layer and reflector and refractory layers that are separated by an optical spacer (Fig. 3). On both the top and bottom of the disk's outer surface is a 1.2-millimeter rigid plastic sheet for environmental protection and rigidity.

A series of pits is formed when the sensitive layer of the groove is exposed to a data-transmitting diode laser. The presence or absence of these pits represents binary 0s and 1s. The pit edges are smooth and well-formed (Fig. 4), resulting in a high signal-to-noise ratio and low second-harmonic distortion. The precise contour of the pits and absence of debris require special materials to form the refractory layer of the disk. Reflectivity of light in the pits is very high, enabling a diode laser to read the data. A detector reads and modulates the reflected light.

The pits can be as small as 0.5 μm . long, permitting recording densities of more than 50,000 bpi. The ultimate capacity depends on a user's decoding scheme and the allowance for error-correction overhead. Significantly higher capacities are possible by using more advanced drives. 3M has manufactured DRAW recording

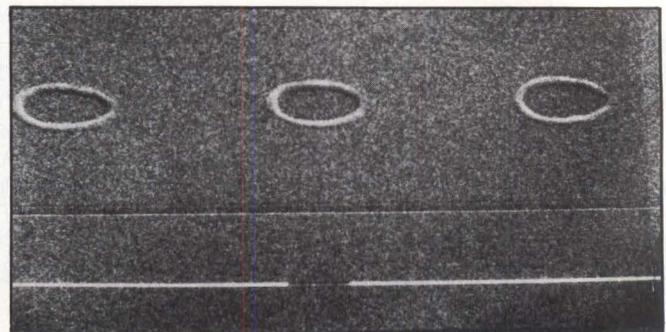


Fig. 4. Scanning electron microscope view of diode-laser-recorded pits. The gap in the baseline measures 0.5 μm .

media and implemented them with drives manufactured by NEC of Japan.

Vertical recording promises high capacity

Vertical, or perpendicular, recording promises capacities of more than 400,000 bpi. Although most claims come from research laboratories, Vertimag Systems Corp., Minneapolis, has developed a 5¼-inch floppy disk drive with 36,000 flux reversals per inch and 96 tpi that stores 3.46M bytes of unformatted data. And Toshiba Corp., Tokyo, has produced a 3½-inch floppy

disk drive that stores 3M bytes using vertical recording, although the drive will not be commercially available for two more years. Other reports from Japan indicate audio recording densities of 440,000 bpi.

Conventional recording orients magnetic domains parallel to the disk surface. To increase density, the size of the domains must be decreased, which eventually leads to self-demagnetization. The poles neutralize each other if they come too close to each other. Vertical recording increases density by placing the "magnets" vertical to the disk surface. The widths of the magnets

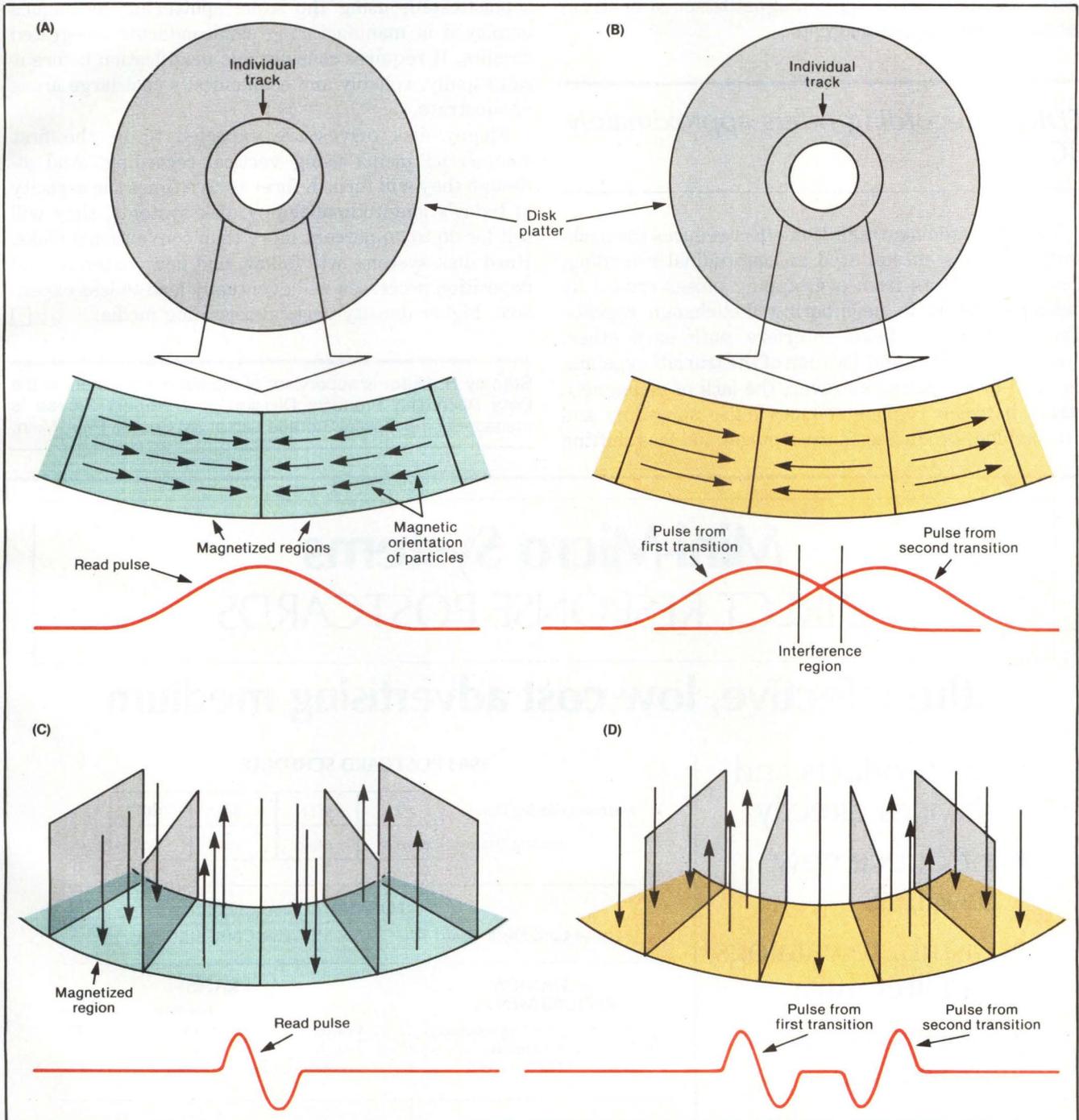


Fig. 5. Vertical vs. longitudinal recording. In longitudinal recording, the interaction of oppositely magnetized regions on a disk results in demagnetization and read pulse spreading (A). The overlapped pulses from adjacent flux changes interfere with each other (B), causing peak shift and displacement of the apparent location of the transition points. In vertical recording, the perpendicular orientation of the magnetized regions creates sharper pulses (C) and minimizes the effects of demagnetization, pulse spreading and peak shift (D).

are decreased to increase density. No neutralization effect exists between poles of the same magnet because the length remains the same. Moreover, the magnets are aligned north pole/south pole/north pole and so forth, which decreases the demagnetization or neutralization effect between magnets.

EDRAW recording offers approximately 3G bpsi.

The decreased neutralization effect reduces the peak-shift problems encountered in longitudinal recording. Peak shift results from overlapping pulses caused by demagnetization in neighboring flux-change regions. These overlapped fields interfere with each other, displacing the apparent location of the transition points. In vertical recording, however, the lack of demagnetization between regions reduces pulse spreading and overlapping, producing sharper pulses and less shifting

of the transition point (Fig. 5). Thus, the resulting transition distances are nearly as short as those generated by the recording pulse from the magnetic head.

The problem of finding a magnetic material that suits vertical recording has limited the development of the technology. Today's most promising approach is an alloy of chromium and cobalt deposited on the recording medium's surface in the form of hexagonal crystals that can support vertical magnetization; that is, the crystals' magnetizable axis lies at right angles to the medium's surface. The depositing process, however, is sophisticated, using the same sputtering techniques employed in manufacturing semiconductor integrated circuits. It requires considerable modification before it can rapidly, reliably and economically coat large areas of substrate.

Floppy disk drives are expected to be the first commercial media using vertical recording. And although they will furnish three to five times the capacity of today's longitudinal floppy disk systems, they will sell for 30 to 70 percent more than conventional disks. Hard disk systems will follow, and new materials and deposition processes will eventually lead to less expensive, higher density vertical recording media. □

Stanley H. Miller is supervisor of market development in the Data Recording Products Division, and **Robert Freese** is manager of the Optical Storage Lab at 3M Co., St. Paul, Minn.

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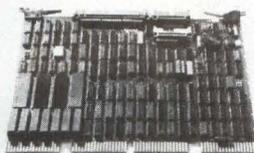
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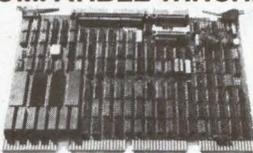
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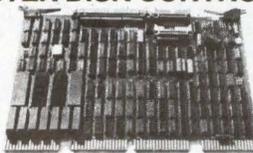
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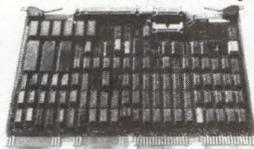
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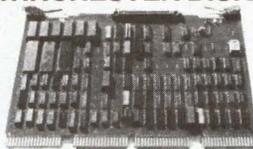
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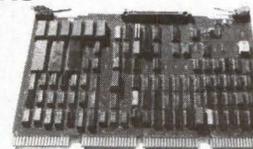
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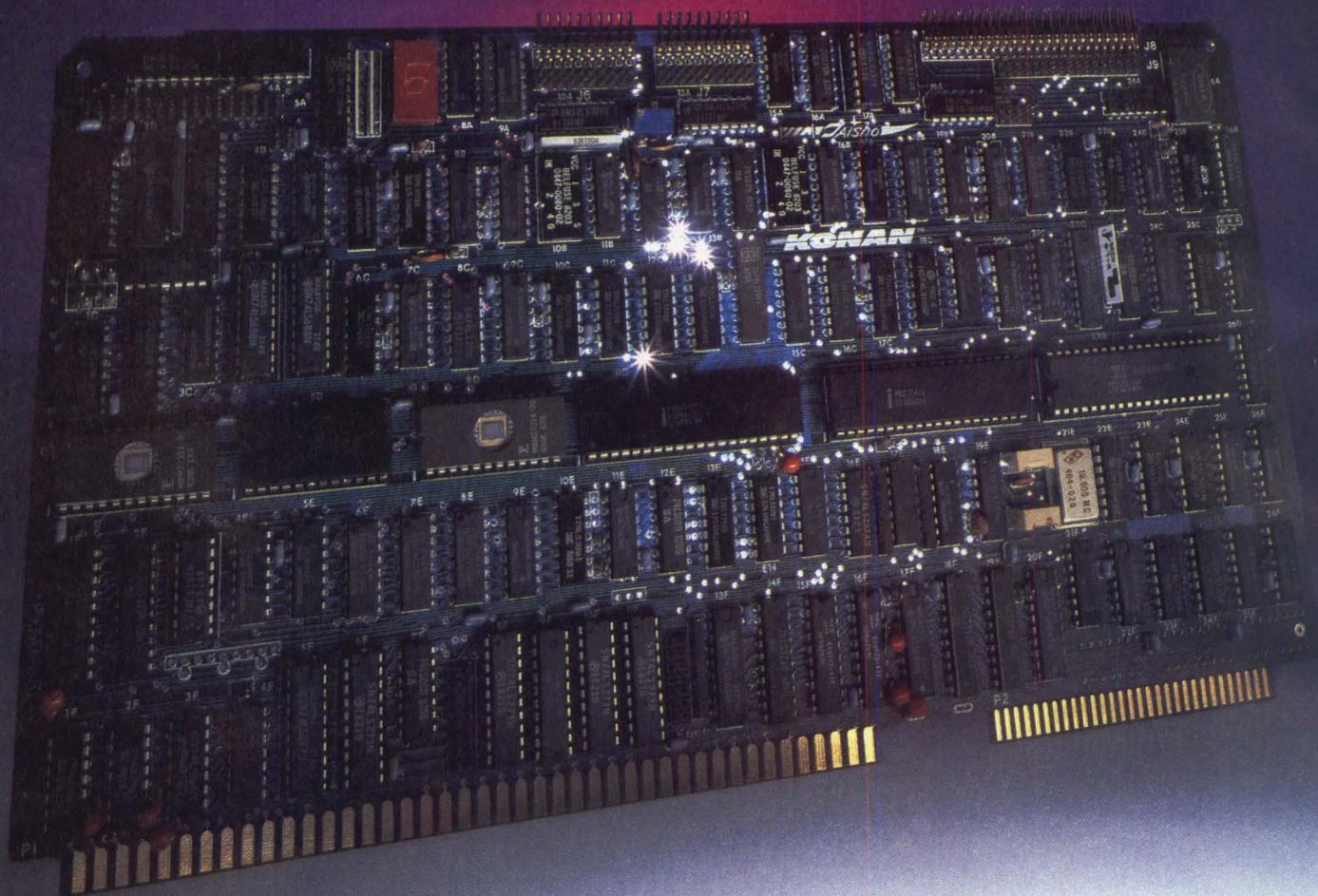
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Evolving strategies shape floppy disk media market

DAVID L. BUNZEL, Santa Clara Consulting Group

The U.S. market for floppy disk media should approach \$1 billion by 1986

Spurred by dramatic increases in the sales of small business computer systems, sales in the floppy disk market registered a 53 percent compound annual growth in 1981 to 1982. This represents 175 million diskettes valued at nearly \$350 million. Although the floppy disk media market should continue to show healthy growth, yesterday's market is not a reliable guide to tomorrow's trends. System integrators planning to use floppy disk technology should be aware that the driving forces behind the market are changing. Although technology is still important, marketing and production are playing bigger roles.

As with many data storage products, the floppy disk drive began life as an IBM Corp. product. It was introduced in 1973 as a read-only device for loading diagnostic programs. IBM later added read/write capability, and the 8-inch, 250K-byte floppy disk drive became a de facto standard.

In 1976, Shugart Corp. announced the 5¼-inch mini-floppy drive, which suited desktop computer systems better than the larger 8-inch drives. Five years later, manufacturers reduced the height of the minifloppy drive from 3¼ to 1.6 inches, and, in 1982, 5¼-inch floppy disks displaced 8-inch diskettes as the leading format, with 56 percent of the U.S. market (Fig. 1).

In 1982, the floppy disk drive industry launched a new generation of "microdisk" drives that use media smaller than 5¼ inches. The sizes of these new drives

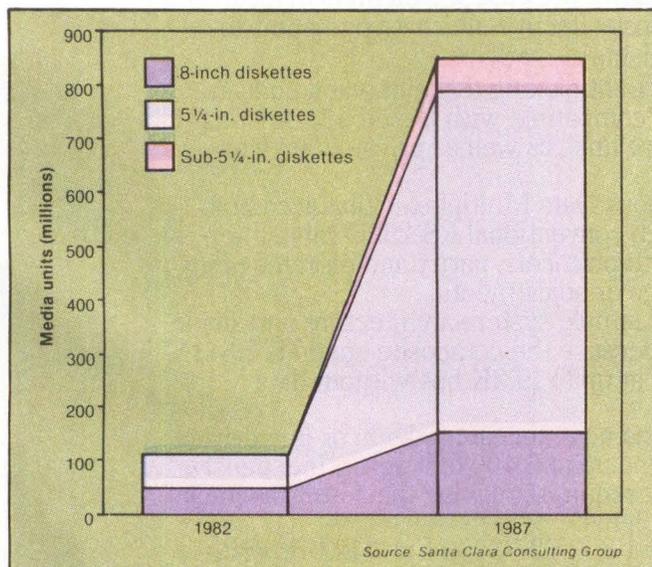
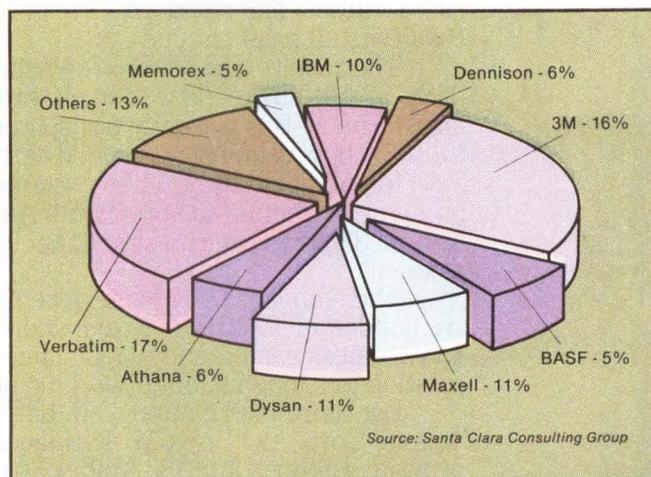


Fig. 1. The market for floppy disk media from 1982 to 1987 shows sales growing at a compound annual rate of 37 percent. In 1982, 5¼-inch diskettes outsold 8-inch diskettes by 23 million. By 1987, 5¼-inch diskettes are expected to outsell 8-inch diskettes by 461 million units. Sub-5¼-inch "microdisks" were not a factor in 1982 but will make up 7 percent of unit sales in 1987.



Verbatim and 3M dominated the U.S. floppy disk media market in 1982. Both companies have strong retail and OEM business. IBM is the largest manufacturer of 8-inch diskettes but has limited production in the 5¼-inch floppy disk market.

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are as varied as the media packaging techniques. For example, Sony Corp. of America offers a 3½-inch microdisk system, and Hitachi America Ltd. and Maxell Corp. of America offer a 3-inch microdisk system. These companies offer diskettes in a rigid envelope with a spring-loaded shutter to cover the media. Tabor Corp. provides a flexible envelope with no shutter for its 3¼-inch microdisk system, and IBM provides a rigid envelope with no shutter for its 4-inch microdisk system. The market standard for a microfloppy disk format will likely be determined by the company that sells the most disk drives.

Driving forces behind market change

The floppy disk media industry is evolving rapidly. Technology initially drove the market. In the 1970s, companies invested money to develop coating techniques and formulations to produce a product that worked. They concentrated on boosting yields and building manufacturing capabilities. Manufacturers that produced a high-quality product with reliable delivery could command premiums as high as 20 percent over competitors. The market was growing modestly, with most manufacturers operating at capacity.

In the current market, most diskette manufacturers have resolved their technical problems and can produce a product that is acceptable to the end user. Companies are now emphasizing packaging, brand management and merchandising avenues to gain market share. This has opened the diskette industry to many new companies that also have the advantage of market experience in other forms of magnetic media.

Last year, many established companies in the OEM market started aggressive advertising programs, seeking recognition in consumer markets. Newer companies relied on advertising to create brand awareness and to establish a foothold in the industry.

Consumer-oriented packaging became more evident this year. Companies new to the market, such as Xidex Corp., Ultra Magnetics and Eastman Kodak Co., packaged their products with eye-catching graphics to attract consumers' attention, while established companies such as 3M Co., Wabash Datatech Inc. and Memorex Corp. also developed packaging that could be better displayed in point-of-sale locations. Innovative companies such as Verbatim Corp. and Sentinel Computer Corp. pioneered a smaller, two-diskette carton for users who don't need "the whole box" and as an effective rack-display package. Verbatim, Syncom, Sentinel and Dennison Manufacturing Co. are promoting brand names.

Floppy diskette media manufacturers are also exploring new merchandising channels and techniques (Fig. 2). Companies such as Memorex are distributing their products through national merchandisers, such as Sears Roebuck and Co. and J.C. Penney, and through major local department stores.

In the future, the focus of the floppy disk media market may shift from marketing to pricing. Floppy disk media manufacturers are beginning to gear their operations toward high productivity, economies of scale, maximum yield and low costs. Survivors of the coming price war will have high-level vertical integration and a market share that allows high-volume/low-cost production.

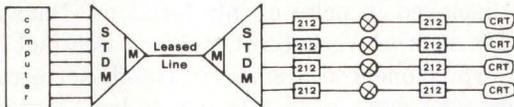
Xidex, for example, is addressing the needs of a commodity market with a \$3.5 million plant for high-volume production. With only three employees per shift, the plant produces 100 million diskettes yearly.

FLOPPY DISKETTE INDUSTRY EVOLUTION

Driving force	Technology	Marketing	Production
Company characteristics	Developing coating technology Boosting yields Building manufacturing Vertical integration	Building brand awareness Increased advertising expenditures Merchandising to consumers Converters & resellers enter market	Increasing productivity High yields Vertically integrated High-volume producers
Companies entering market at this stage	BASF Systems Corp. IBM Corp. 3M Co. Memorex Corp. Maxell Corp. of America Verbatim Corp. Wabash Datatech Inc.	CRI Leading Edge Products Inc. Memron Sentinel Computer Corp. Ultra Magnetics	Eastman Kodak Co. Fuji Photo Film U.S.A. Inc. TDK Electronics Corp. Xidex Corp.
Price/distribution criteria	Premium price Sold on quality OEM market significance	Prices become more competitive Consumer-oriented packaging Distributor sales growing Brand name is more important	Very price competitive Multitiered pricing Distributor/direct sales
	1973	1980	1983
			1985

A Case of Mass Murder

Phones at the computer center just wouldn't quit ringing as irate remote systems users called to complain that their sessions were being abruptly and, it turned out, simultaneously disconnected. The terminal users were all connected to the computer via a statistical multiplexer and dial-up modems.



The system had just been expanded and a new and larger STM installed. The older multiplexer had worked for years without difficulty. Similar mass disconnection episodes had occurred at random since the new multiplexer had been installed. Disconnection in this case meant a mux end modem hang-up of the dial-in connection. Our operative arrived at the scene and remembered that his data detective manual specified that the only natural causes of dial-up modem expiration are loss of central office line current, loss of carrier, receipt of long space or the lowering of data terminal ready. Since the long space option was not activated and the central office was unlikely to open all these lines simultaneously, only DTR seemed not to have an alibi. Sure enough, observation of the DTR light on the modems showed that when a terminal ended a session with a bye character, the computer responded by dropping DTR — not to just that line but to all other channels as well. But, you ask, how come the older system did not exhibit the same homicidal tendencies? An exhumation of the older budget mux revealed that it could not transmit any control signals end to end and that therefore the lethal computer command never reached the modems. Killing the control signal transmission option in the new mux ended forever the murderous proclivities of this computer. —R.G.

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MEDIA

New products move to higher capacities

Research and development in magnetic media hardware promise higher capacity floppy disk drives as backup devices for small fixed Winchester drives. Amlyn Corp. and Drivetec Inc., to name only two, offer floppy drives with megabytes of storage. Amlyn's drive uses five diskettes in an accordion-like cartridge to

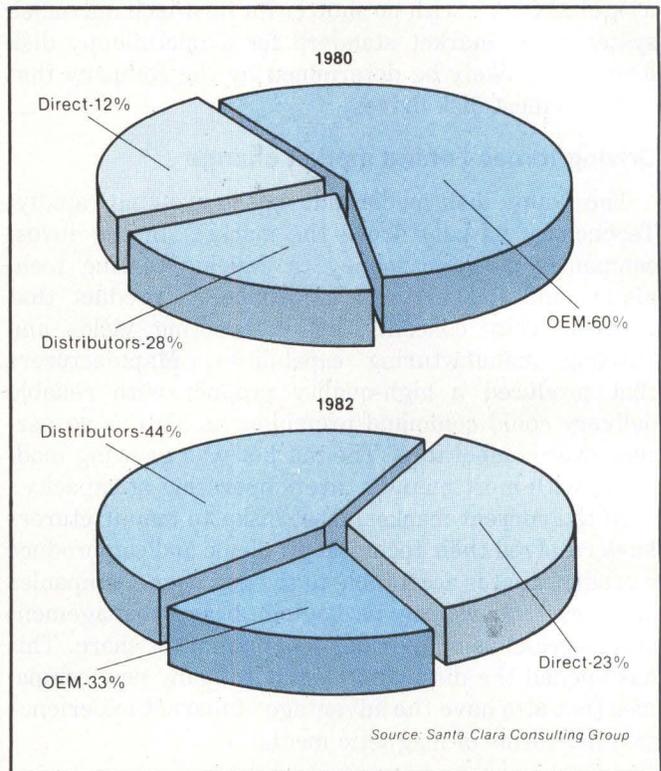


Fig. 2. Sales channels for diskettes are changing. Distributor and direct (retail) sales gain share as more personal computers are sold directly to consumers.

provide 16M bytes of on-line storage. Drivetec's 192-tpi, double-sided, 5¼-inch floppy drive stores more than 3M bytes.

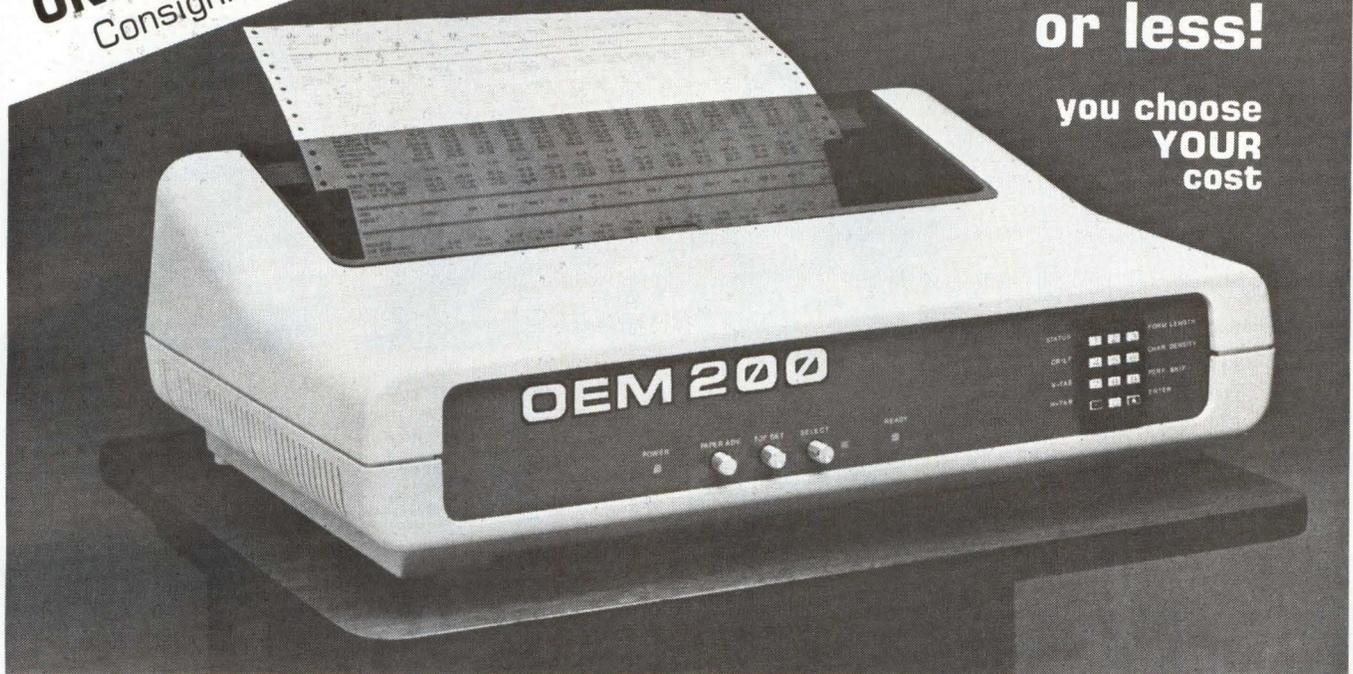
Perpendicular recording is the latest development in magnetic media technology. The Spin Physics subsidiary of Eastman Kodak has announced a perpendicularly recorded, 10M-byte floppy disk substrate, called Isomax, using cobalt-enhanced magnetic particles. An Isomax-coated diskette could be available next year. □

David L. Bunzel is a member of the Santa Clara Consulting Group, publisher of "The Flexible Media Industry for Data Recording—U.S. Market." The group is also compiling a report on the European flexible media market to be published in late 1983. For more information on these reports, contact the Santa Clara Consulting Group, 50 W. Brokaw Rd., Suite 64, San Jose, Calif. 95110, (408) 947-4665, Telex: 171618.

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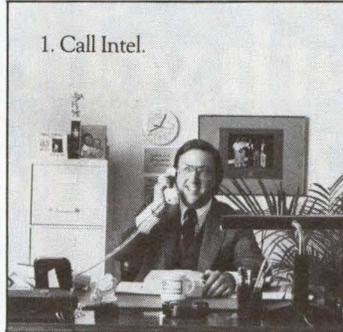
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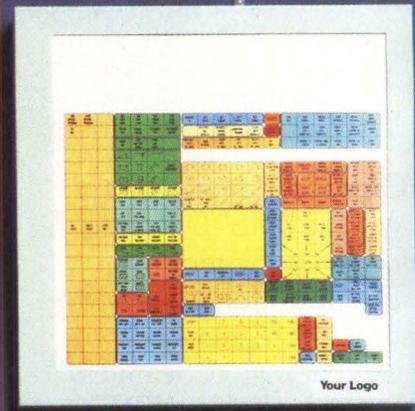
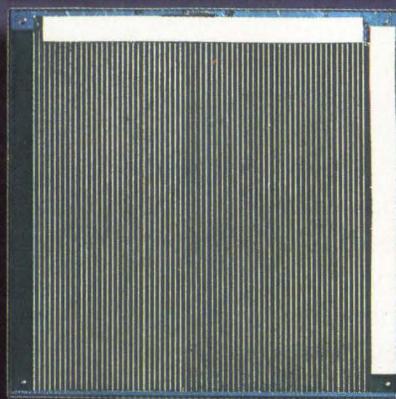
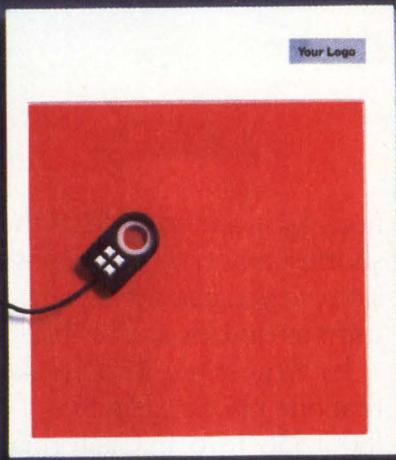
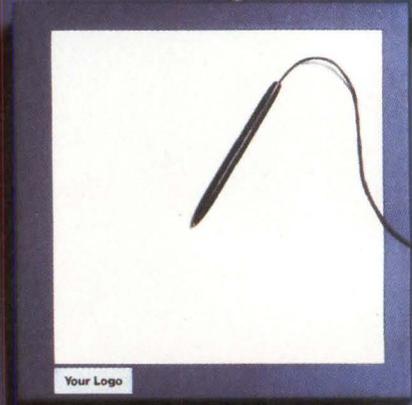
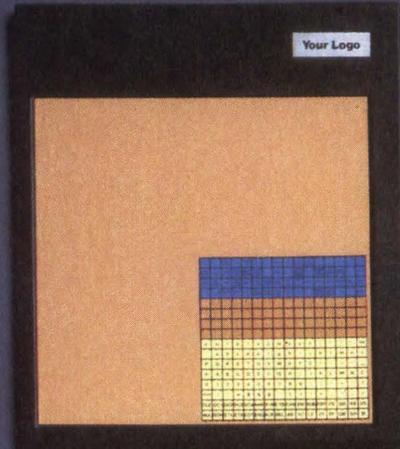
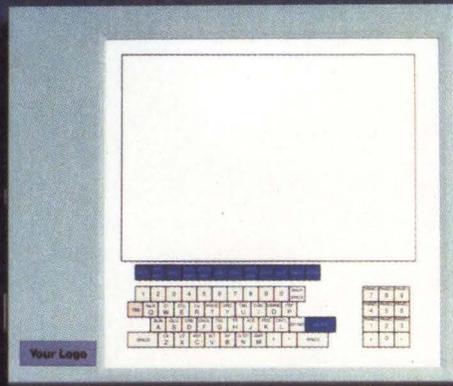
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Bridge software transports applications to UNIX-based supermicros

JAMES R. GROFF and PAUL N. WEINBERG,
Plexus Computers Inc.

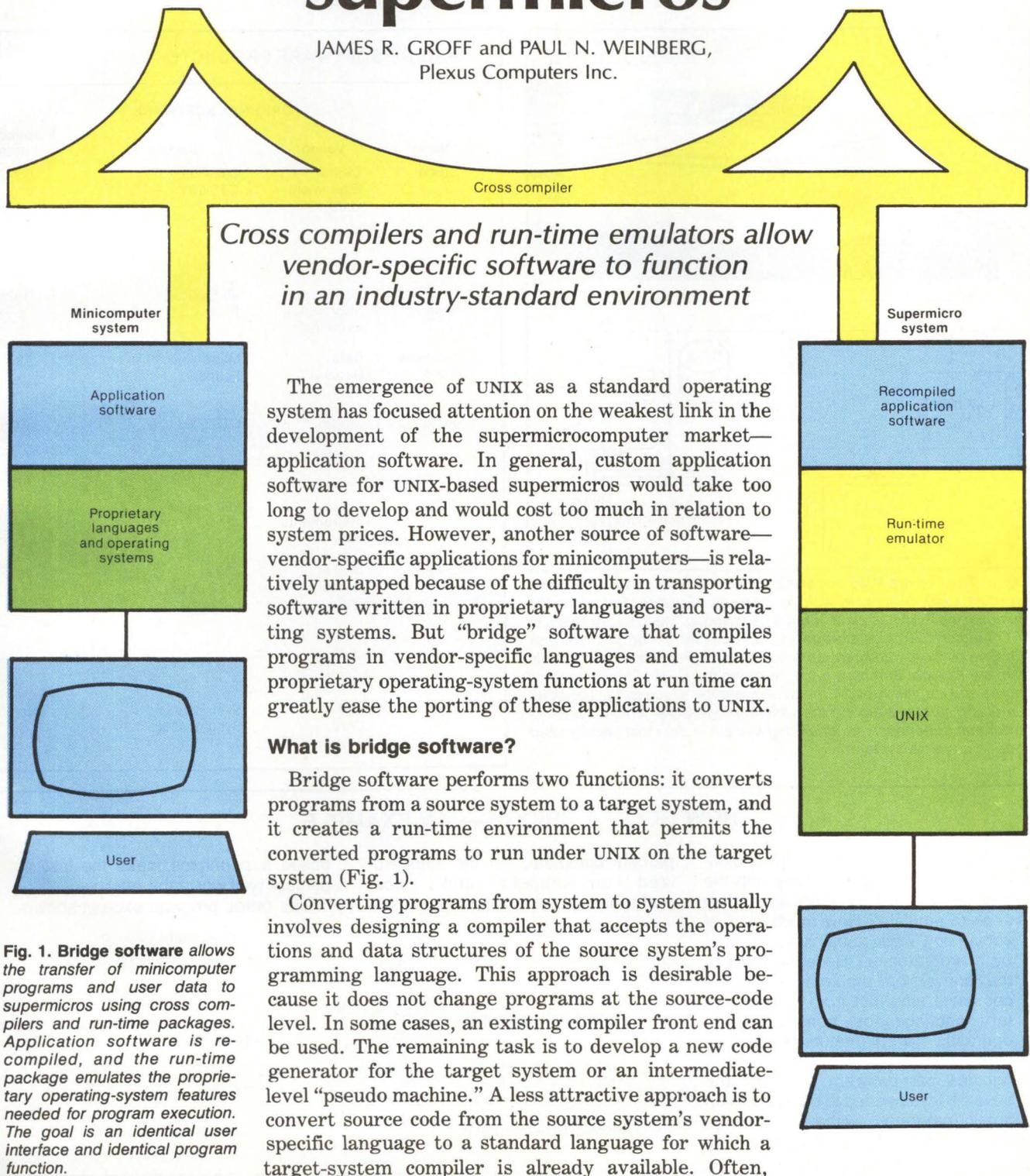


Fig. 1. Bridge software allows the transfer of minicomputer programs and user data to supermicros using cross compilers and run-time packages. Application software is recompiled, and the run-time package emulates the proprietary operating-system features needed for program execution. The goal is an identical user interface and identical program function.

source-code conversion can be done automatically by a utility program, but the result can be poorly structured and difficult-to-read programs.

Creating a run-time environment for converted programs can be more complex than developing a new compiler or conversion utility. The bridge product's

run-time package must emulate the proprietary operating system's features used by the source system's language but which are not available in exactly the same form under UNIX. For example, many vendor-specific languages include a built-in indexed-sequential file structure. For these languages, the bridge software's run-time routines must create an indexed-sequential capability on top of the native UNIX file system. Other functions that the package might be required to perform are spooling, terminal emulation and process-to-process communication. Unfortunately,

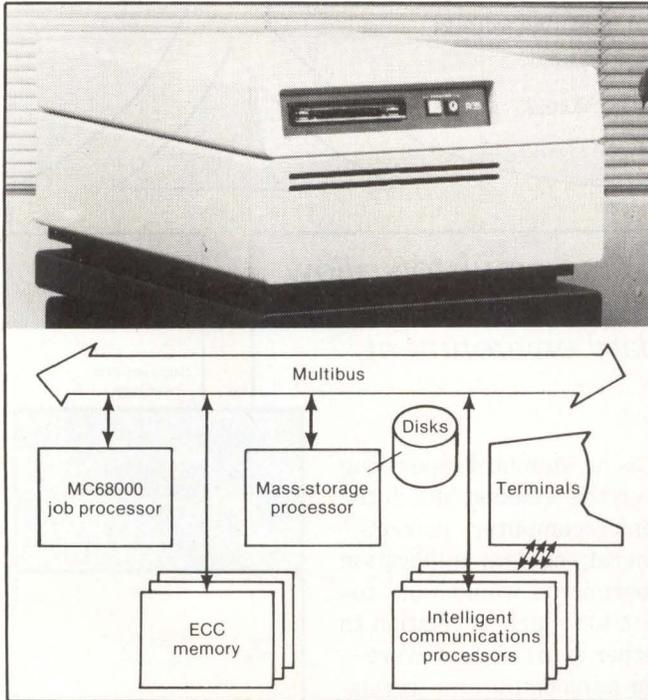


Fig. 2. The Plexus P/35 supermicro, selling for less than \$20,000, supports UNIX System III with as many as 16 users. Based on the Multibus, the P/35 has an MC68000 CPU and as much as 4M bytes of ECC memory. A mass-storage microprocessor off-loads UNIX disk I/O. One or more intelligent communications processors can handle as many as eight terminals each, relieving the CPU of housekeeping chores and the interrupt overhead of character processing. The UNIX kernel is distributed among the various processors, which increases performance because the operating system is the most heavily used code in a typical system.

BRIDGE SOFTWARE PRODUCTS

ORIGINAL SOFTWARE			
Name	Vendor	System	Introduction date
DIBOL	Digital Equipment Corp.	CTS-300, CTS-500	1977
Business Basic	Basic Four Information Systems	all Basic Four	1975
Business Basic	Data General Corp.	MicroNova, Eclipse	1977
Basic Plus	Digital Equipment Corp.	CTS-500	1975
COBOL	Texas Instruments Inc.	990 series	1976
CP/M	Digital Research Inc.	Z80 and 8080-based micros	1975
RPG II	IBM Corp.	System/3/34 System 1360, 1370	late 60s

HOW GOOD A BRIDGE — AN EXAMPLE

Just how good are "bridge compilers" at creating compatibility with the original, proprietary languages they seek to emulate? How much manual conversion work remains to be done by a programmer? Because most of the conversion problems of bridge compilers arise not from the proprietary languages but from underlying operating-system features, the conversion required is typically a few minutes per program, far from the several days needed to translate even small programs without a bridge compiler. The bridge may be only 99

percent complete, but the standardized environment and price/performance ratios offered by UNIX-

based supermicros make the last 1 percent well worth the effort.

The DIBOL program excerpt shown

DIBOL code	Comments
PROC	; customer inquiry procedure
count = 0	; initialize count to zero
OPEN (15,SU,'KB:')	; open terminal for i/o
OPEN (2,SI,'customer')	; open isam customer file ; as file #2
loop, DISPLAY (15,prompt)	; prompt for customer number
ACCEPT (15,custno)	; and read it from terminal
IF (custno .EQ. 0) GOTO done	; check for end-of-inquiry
READ (2,custrec, custno)	; isam read, key = custno
count = count + 1	

some language features can't be emulated in UNIX. For example, in Digital Equipment Corp.'s DIBOL (a hybrid of BASIC and COBOL), the *detach* statement allows an executing program to detach itself from a terminal and wander freely in "background mode," independent of a user. This feature cannot be emulated because the concept of a free-running process is foreign to UNIX. Happily, such features tend to be infrequently used.

Some notable examples

Although all bridge products perform essentially the same function, their suppliers are as diverse as their

environments (see table, below). One of the earliest and most successful bridge products is SMC BASIC, from Science Management Corp. (SMC). SMC BASIC is compatible with the Business BASIC language that runs on the Basic-Four Corp. family of business minicomputer systems. Since its introduction in 1979, SMC BASIC has converted thousands of application programs from Basic-Four hardware to 8086-, Z8000- and MC68000-based supermicros. Another BASIC language bridge—designed for Data General Corp. minicomputers—is the Technical Analysis Corp. (TAC) Business BASIC. One of DG's largest OEMs, TAC developed Business BASIC in

BRIDGE SOFTWARE				
Name	Vendor	System	Introduction date	Implementation language
SIBOL	Software Ireland 100 Wall St. New York, N.Y. 10005	UNIX	1982	C
SOFTBOL	Omtool Corp. 212 Bacon St. Waltham, Mass. 02154	UNIX, XENIX CP/M, MS-DOS	1982	C/assembly
SMC Thoroughbred BASIC	Science Management Corp. 1011 Route 22 Bridgewater, N.J. 08807	UNIX	1979	assembly
Business Basic	Technical Analysis Corp. 120 W. Wieuca Rd., N.E. Atlanta, Ga. 30042	UNIX, XENIX	5/83	C
BASIC PLUS	Silicon Valley Software 10011 Foothill Blvd. Suite 111 Cupertino, Calif. 95014	UNIX, XENIX, IDRIS, CROMIX, UNOS, REGULUS, CP/M	1982	Pascal/assembly
RM/COBOL	Ryan McFarland Corp. 609 Deep Valley Dr. Rolling Hills Estates, Calif. 90274	UNIX, XENIX, CP/M, OASIS, MS-DOS, TRS-DOS	1977	
The Bridge	Virtual Microsystems Inc. 2150 Shattuck Berkeley, Calif. 94704	PDP-11, VAX-11, UNIX	1982	C/assembly
MIMIX	Touchstone Software 909 Electric Ave. Suite 308 Seal Beach, Calif. 90740	PDP-11, UNIX, XENIX	1982	C
RPG II	Translation Systems Inc. 530 Atlantic Ave. Boston, Mass. 02210	UNIX	4Q83	PL/1

illustrates the compatibility issues that arise in using a bridge compiler such as Software Ireland's SIBOL. The excerpt is part of a simple customer inquiry program—a user enters a customer number at the terminal, and the program retrieves customer information, by key, from a master file and displays it on the screen.

The statements shown in yellow, constituting most of the program, can be compiled by SIBOL and run under UNIX without manual conversion. Assignment statements, conditional tests and branching—features available in virtually all high-level languages—are no problem for either

SIBOL or UNIX. The statements that perform terminal I/O are similarly not a problem because the SIBOL compiler can simply generate calls to UNIX's C language I/O library routines that perform these functions.

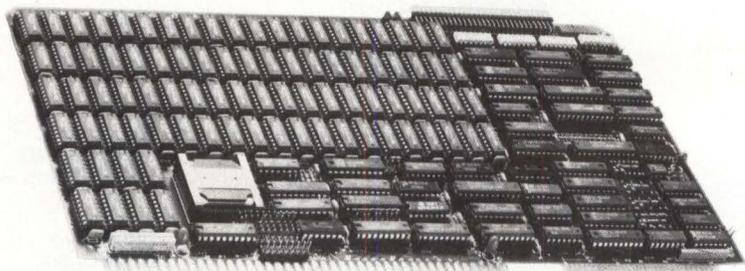
The statement shown in green poses more difficulty. Unlike DIBOL's underlying CTS-300 operating system, UNIX has no built-in indexed-sequential-access-method (ISAM) file capability. The solution lies in the SIBOL run-time package, which includes an ISAM facility. The SIBOL compiler generates calls to this run-time package, which manages ISAM file access as a layer above the

UNIX file system.

The statement shown in blue is the one statement in the program that will almost certainly require manual change. On the Digital Equipment Corp. system on which this program originally ran, the file to be opened was named "customer" on the main system disk. However, UNIX replaces this "flat file" arrangement with a hierarchical file system. Unless the customer data file will reside in the same UNIX file directory as the program (which is unlikely), the statement will have to be changed to include a UNIX filename such as */data/customer*.

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performance back into your system. And by lowering the cost-per-user, it gives you a more cost-effective product.

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1977. DG licensed the product two years later, and it became the DG-supported BASIC for the Nova and Eclipse products. In 1983, TAC rewrote the Business BASIC compiler in C language to provide compatibility with UNIX and XENIX.

A similar history surrounds SIBOL. SIBOL's developer is Software Ireland, a subsidiary of the major DEC OEM and service company in Ireland, which has created a library of business applications written in DIBOL and therefore able to operate only on DEC systems. To free itself from this vendor dependence, Software Ireland decided to build a DIBOL look-alike for the UNIX environment. Not surprisingly, the company discovered that there were hundreds of other DEC OEMs dependent on DIBOL that were eager for an alternative hardware source. The project was refocused to produce a commercial product, SIBOL, which was introduced in November 1982.

A significant effort is under way to bridge applications from personal computers to UNIX-based supermicros. Thousands of people use WordStar and various "calc" programs popular on personal computers. These

users will wish to retain their knowledge when moving to supermicros. Thus, there will be upward porting of personal-computer applications to UNIX-based systems as well as lateral and downward porting from minicomputers.

UNIX-based supermicros prove attractive

Bridge software for minicomputer and personal-computer applications would be of little value were it not for the standardized multiuser environment provided by UNIX and the attractive price/performance ratios of supermicrocomputers. More than 40 supermicro vendors support UNIX, and Western Electric Co. has recently lowered its UNIX licensing fees to OEMs.

Supermicros can be augmented by Winchester disks storing more than 500M bytes, low-cost cartridge-tape backup and local-area networks such as Ethernet, allowing them to outperform many minicomputers. An example of such a system is the Plexus Computers Inc. P/35 (Fig. 2), which supports several bridge software products including SIBOL, SMC BASIC and RM COBOL. □

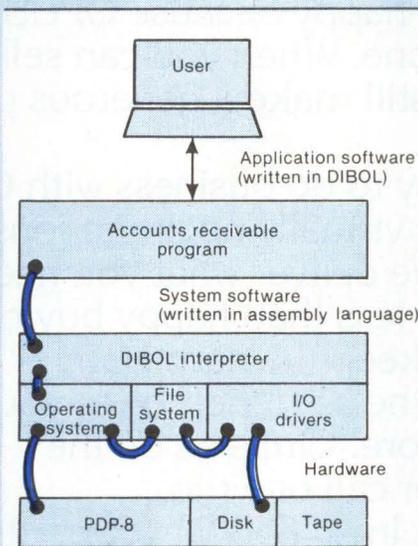
James R. Groff is director of marketing, and **Paul N. Weinberg** is software product manager for Plexus Computers Inc., Santa Clara, Calif.

THE MINICOMPUTER SOFTWARE 'TOWER OF BABEL'

Competition in the commercial minicomputer market shifted during the 1970s from hardware to system software. Major vendors such as Digital Equipment Corp., Data General Corp., Hewlett-Packard Co., Micro Data Systems and Basic-Four Corp. stopped touting execution speed, floating-point performance and disk-access times and instead focused on operating systems, languages and application-program support. Vendors debated the relative merits of AOS, MPG, RSTS, Reality, DIBOL and Business BASIC, and each vendor offered its package of software tools to lock in system houses and OEMs to proprietary hardware.

At the same time, awareness of BASIC was growing, and the capabilities of small-business minicomputers provided a good fit for this interpreted language. But simple Dartmouth BASIC was not flexible enough for many business applications, so each vendor developed a version of enhanced BASIC: DEC with BASICPlus II, Basic-Four with Business BASIC, DG with its Business BASIC and Micro Data with Data BASIC. DEC went even further and created DIBOL, a hybrid of BASIC and COBOL, for its PDP-8 series, which was strongly promoted as the ultimate solution for interactive business applications.

Several minicomputer vendors offered business applications such as



The "software lock." Application programs written in a proprietary language lock users into not only the language, but also the operating system and the underlying hardware. For example, an accounting program written in DEC's proprietary DIBOL language is locked into the DIBOL interpreter, which in turn requires the proprietary operating system of the PDP-8 to provide file management that relies on hardware-dependent data formats and control codes.

accounting and word processing to go along with the proprietary languages. Although widespread availability of application packages promoted the growth of the business minicomputer market, the proprietary languages and operating systems on which they were based posed problems. Once an OEM or software house developed a software package for a vendor, it became difficult to switch vendors because, in most cases, it was impossible to convert previously written software economically. When a competing hardware vendor offered a new system with better performance at a lower price, an OEM had no choice but to wait until its own vendor responded with a competitive system.

For end users, hardware and vendor dependence were more than minor irritants. For example, DEC initially supported DIBOL only on PDP-8 systems. When a DEC user tried to upgrade to a larger system, he found that his DIBOL application programs wouldn't convert to the more powerful PDP-11 series.

Hardware vendors themselves were inconvenienced by proprietary systems because of the support problems inherent in multiple product lines and incompatible languages and operating systems.

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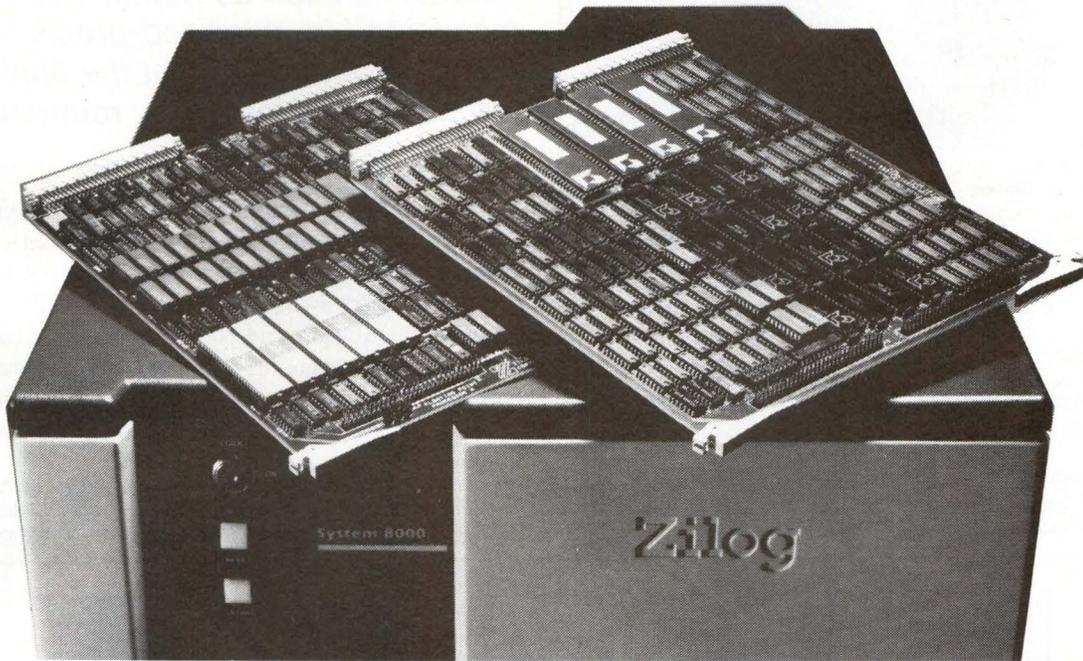
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A floating-point coprocessor option for Zilog Inc.'s System 8000 family of microcomputers performs 125K floating-point operations per second (FLOPS), making the 8000 a low-cost (less than \$40,000) alternative to minicomputers with accelerator boards for laboratory and graphics processor applications. The FPP-8/01, a two-board hardware implementation of the full IEEE standard for double-precision floating-point arithmetic, combines accuracy and user-transparent operation with bipolar, bit-sliced speed.

Hardware approach to standard combines benefits

Zilog's System 8000 multiuser microcomputer systems are based on the Z8001 16-bit microprocessor running UNIX. The system supports as many as 24 users, 4M bytes of error-correcting-circuitry (ECC) memory, as much as 320M bytes of Winchester disk storage and cartridge or nine-track tape backup stor-

age. A 32-bit bus, the Z-bus Backplane Interconnect (ZBI), connects the FPP-8/01 floating-point board set to the CPU module.

The FPP-8/01 board set conforms to the IEEE 754 standard (Draft 10.0) for binary floating-point arithmetic (see "IEEE standard fosters portability...", Page 317). Besides easing the transport of numerical programs from system to system, the standard describes floating-point operations to be performed entirely in software, hardware or a combination of both. A full hardware implementation offers high speed and straightforward

The Zilog FPP-8/01 two-board set (above) contains only 400 equivalent integrated circuits (ICs), which compares favorably with the approximately 700 ICs on the VAX-11/780 system with floating-point accelerator. Fast bipolar and MOS ICs, such as 4K-by-4-bit static RAMs, 16-bit-by-16-bit multipliers and 4-bit microprocessor slices, provide high performance while minimizing board space. Two 60-pin connectors join the two boards.

application software. Accuracy is another benefit: the standard specifies support for an extension to the basic format and for rounding bits to increase the precision of the extended format. The FPP-8/01 performs internal operations in double-extended precision. It accommodates a range of numbers from 10^{-4932} to 10^{4932} .

User-transparent coprocessing unburdens CPU

The FPP-8/01 consists of five functional units: the ZBI interface, a microcode sequencer and control store, a sign engine, an exponent engine and a fraction engine (Fig. 1).

The ZBI interface is the communications path be-

	Multiply	Divide	Add	Subtract
Zilog	3.82	11.27	3.64	3.64
FPP-8/01	(3.82)	(16.36)	(3.64)	(3.64)
DEC	1.2	4.2	0.8	0.8
FPA 780	(3.4)	(8.8)	(1.4)	(1.4)
DEC 11/34	16.2	16.2	8.91	8.91
(FP11-A)	(25.36)	(35.36)	(8.91)	(8.91)
DEC 11/23	79.95	90.	37.05	37.95
(KEF11)	(193.05)	(239.)	(42.45)	(43.35)
Intel IAPX	11.9	24.4	10.6	10.6
286/20 (8 MHz)	(16.9)	(24.4)	(10.6)	(10.6)
National	4.8	8.9	7.4	7.4
Semiconductor	(6.2)	(11.8)	(7.4)	(7.4)
NS16081 (10 MHz)				

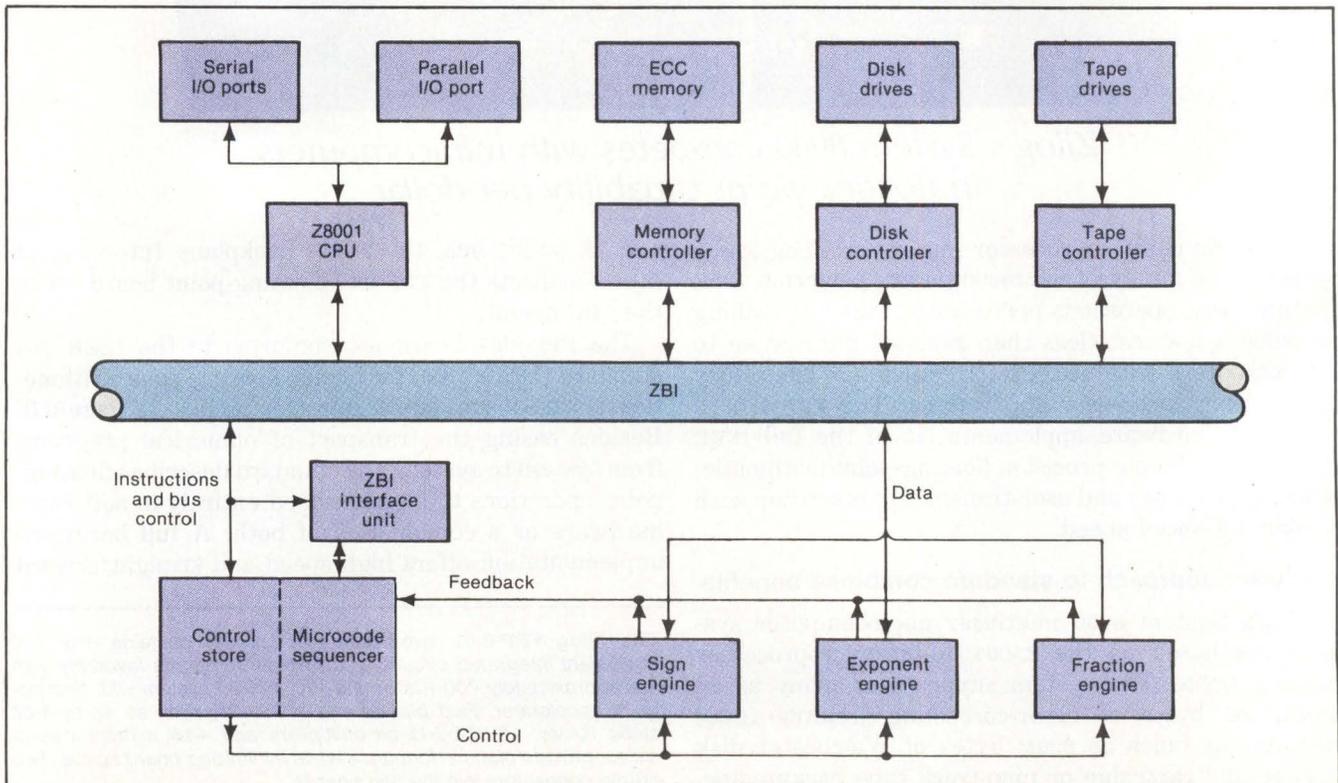
(Numbers in parentheses are for double-precision operands.)
Source: Zilog Inc.

Computation time comparisons (in $\mu\text{sec.}$) of various floating-point processors. The figures assume that operands are already in floating-point registers and the instruction to be performed has been fetched and decoded. Because the figures do not include load, store and control operations, they represent a theoretical upper bound on floating-point speed, rather than numbers that can be attained in real-life applications. The Zilog FPP-8/01 multiplication time of 3.82 $\mu\text{sec.}$ translates into 262,000 floating-point multiplications per second. Because the FPP-8/01 performs all multiplications, additions and subtractions in 80-bit-wide, double-extended precision, no time difference exists between single-precision and double-precision data for these operations.

Intermediate results in complex operations such as matrix inversion are maintained in extended-precision format; it is unlikely that the final result will be contaminated by rounding errors.

tween the FPP-8/01 and the rest of the System 8000. This communication uses FPP-8/01 instructions that are extensions of the basic Z8000 instruction set. When the CPU encounters an FPP-8/01 instruction, it performs the address calculation and the data-transfer timing, leaving the manipulation of the data to the FPP-8/01. While the FPP-8/01 is performing number crunching, the CPU continues its normal functions. But if the CPU detects a

Fig. 1. The FPP-8/01 floating-point processor consists of five functional units. The Z-bus Backplane Interconnect (ZBI) interface detects a floating-point instruction on the ZBI bus and directs the microcode sequencer to execute the instruction by running the appropriate microprogram in the control store. The sign, exponent and fraction engines perform the operation as dictated by the microprogram.



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second FPP-8/01 instruction while the first is being executed, the new instruction is stored in a pipeline and the CPU is prevented from executing any more instructions. This coprocessing architecture is transparent to users and is compatible with Zilog's planned Z8070 floating-point chip.

The microcode sequencer unit is an AMD 2910 microprogram controller. The associated 4K-by-96-bit control store is loaded with floating-point microprograms when power is applied to the system. The sequencer executes microcode instructions such as conditional jump, conditional call, return, go to top of loop and reset. When no FPP-8/01 instructions are waiting to be serviced, the sequencer is in "sleep mode." It "wakes up" when the ZBI interface unit decodes an FPP-8/01 instruction and directs the sequencer to the appropriate microprogram. To execute floating-point operations rapidly, the sequencer employs a multiway branching mechanism assisted by three hardware multiplexers (Fig. 2).

The sign engine, exponent engine and fraction engine perform the actual floating-point operations. Three

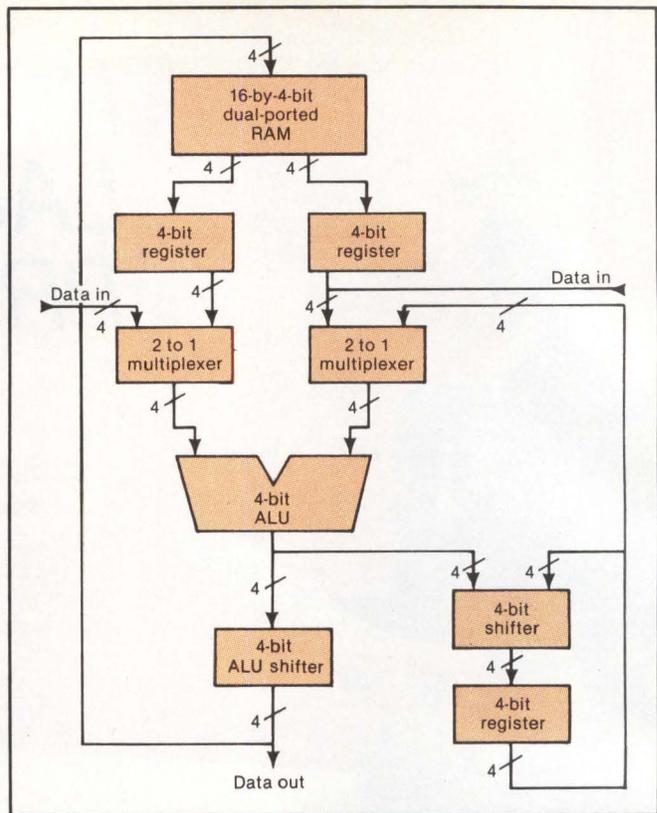
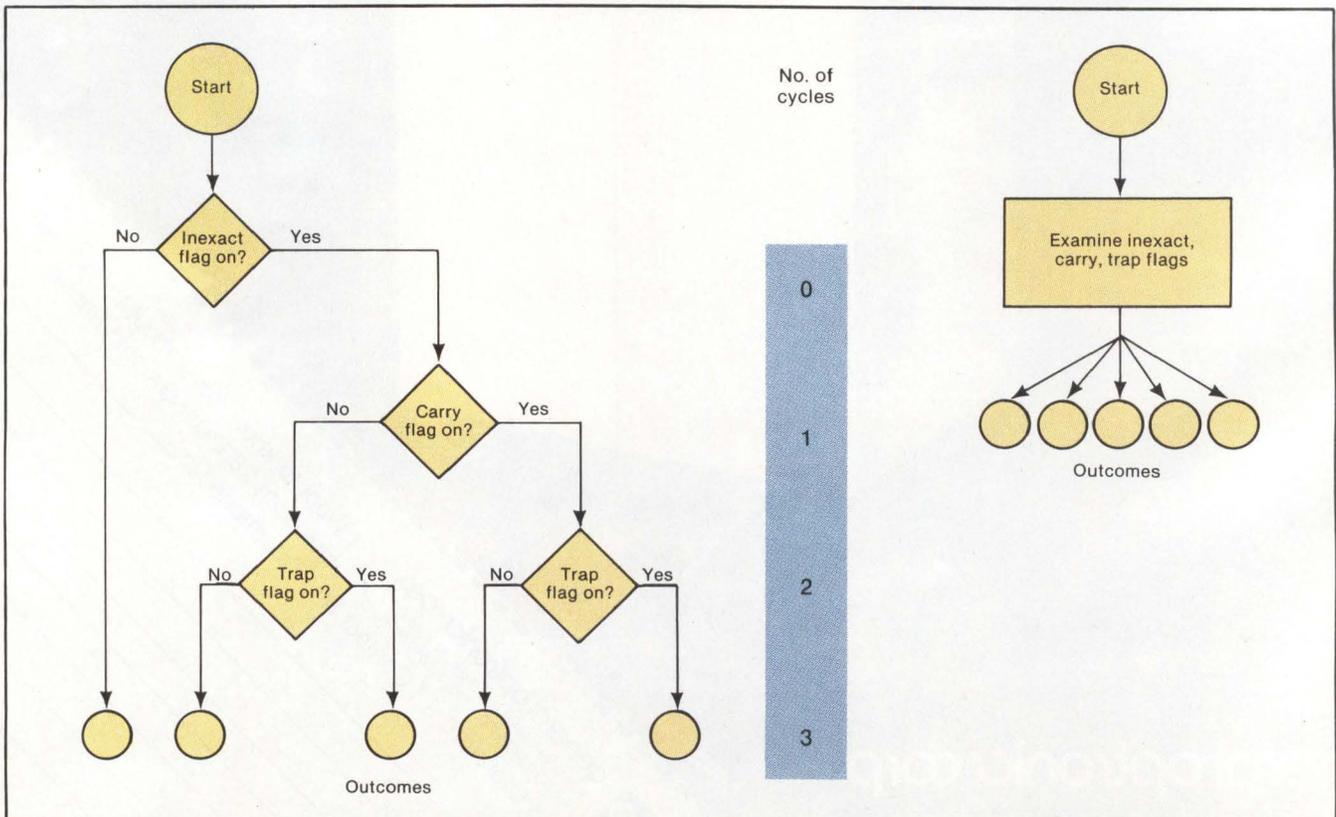
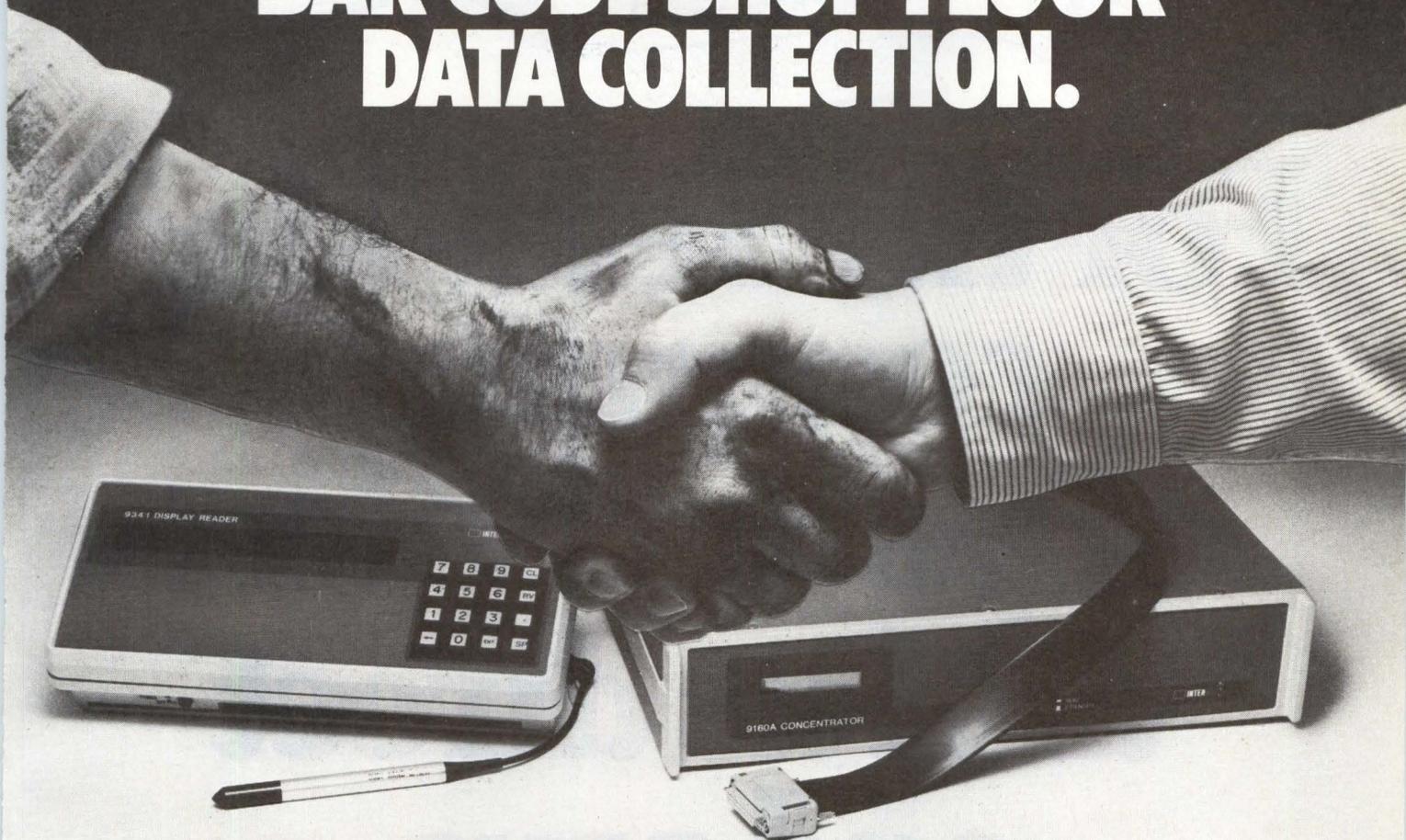


Fig. 3. Sign-engine architecture uses a bit-slice microprocessor, 16-by-4-bit two-port memory and a 4-bit arithmetic logic unit (ALU). Exponent and fraction engines operate on wider words but use similar architectures.

Fig. 2. Two branching methods. In conventional two-way branching (left), the inexact, carry and trap flags are checked sequentially, resulting in as many as three microcode cycles. The FPP-8/01 implements multiway branching (right) by employing multiplexers that allow the microcode sequencer to jump directly to the appropriate outcome in only one cycle. The hardware to implement this speed advantage is contained in only three chips.



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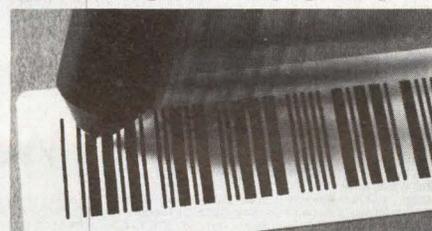
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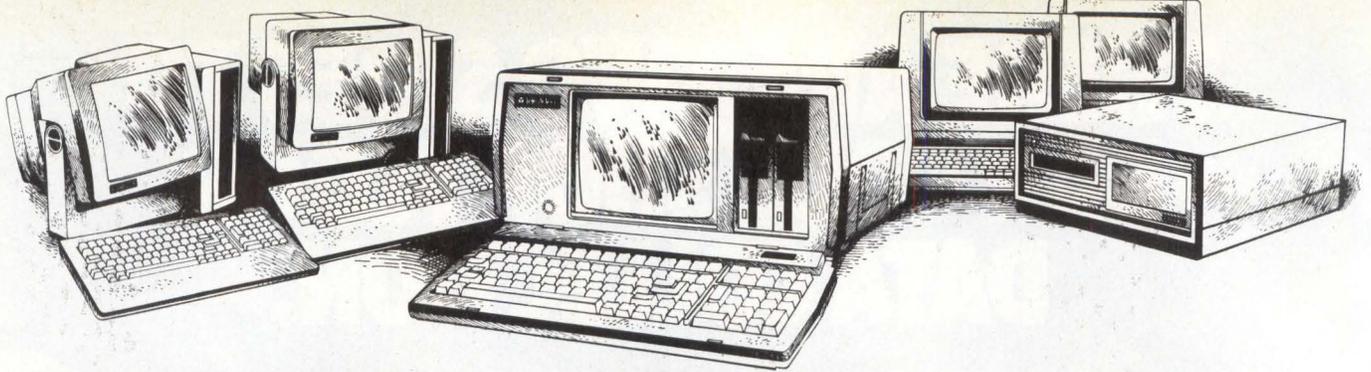


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engines provide specialization for the three components of floating-point numbers. All three engines use the same two-ported storage elements, which consist of 16 registers. Eight are accessible only to the microprograms, and eight are available to the host CPU. The storage element is 4 bits wide in the sign engine, 16 bits in the exponent engine and 64 bits in the fraction engine.

The sign and exponent engines are configured from AMD 2903 4-bit slices. The sign engine (Fig. 3) performs Boolean operations on the sign bit of the floating-point number and works with the fraction engine to perform division and binary-coded decimal (BCD) conversion. The exponent engine adds and subtracts exponents. The storage element in this engine holds trap enable bits and rounding-mode information.

The fraction engine adds, subtracts and multiplies the mantissa fields and performs rounding. It consists of a 16-bit-by-64-bit hardware multiplier, an 80-bit shifting multiplexer and an 80-bit adder.

Challenging minicomputer performance

Although the performance of a floating-point processor usually is measured in FLOPS, no agreement exists on the types and proportions of operations included in FLOPS. Based on the most common multiplication operation, the FPP-8/01 theoretically can perform 262 KFLOPS (see table, Page 312). But this figure is not attainable in practice because it excludes instructions such as load, store, clear and jump.

A more appropriate benchmark can be designed by performing a real-life task such as the dot product of two 1,000-element vectors. To eliminate the effect of high-level language code generators, the dot-product program should be written in assembly language. Using such a benchmark, a Zilog System 8000 model 31 with an FPP-8/01 selling for \$37,400 can be compared with a Digital Equipment Corp. VAX-11/780 with floating-point accelerator selling for \$230,000. The Z8000 operates at 125 KFLOPS vs. the VAX's 250 KFLOPS. This means that the Z8000 operates at one-half the speed of the VAX for one-sixth the price. □

Naushik Desai is a systems engineer, **Craig Nelson** is a software engineer, and **Craig Wright** is a hardware engineer at Zilog Inc., Campbell, Calif.

IEEE STANDARD FOSTERS PORTABILITY OF NUMERICAL PROGRAMS

Historically, computer manufacturers have incorporated proprietary implementations of floating-point arithmetic. As a result, even if a program can operate without modification on systems from two or more vendors, the same set of program data can generate a different result on each system. While recompiling programs solves the problem of different numerical bit representations, there is no easy "work-around" for differences in the floating-point operations themselves. For example, the expression $(y - x) + x$, which is mathematically equal to y , computes instead to x whenever $y - x$ underflows on systems without "gradual underflow." On these systems, any result that is too small in absolute value to be represented by a normalized floating-point number is "forced to zero," so $(y - x) + x = 0 + x = x$. However, systems incorporating gradual underflow allow a result to be expressed as a very small denormalized number, which preserves the mathematical validity of the outcome.

The IEEE 754 standard assists program portability by eliminating anomalies such as the underflow example cited above. The standard

specifies:

- The minimum number of bits to represent exponents and mantissas in each data format (single precision, single-extended precision, double precision and double-extended precision).
- The set of floating-point operations that must be supported.
- Bit representations for plus and minus infinity, denormalized numbers, and NaN, which is a "not a number" indicator used to denote an uninitialized variable or an ambiguous result such as 0/0.

- Acceptable rounding methods (round to nearest, round to plus infinity, round to minus infinity or round to zero).

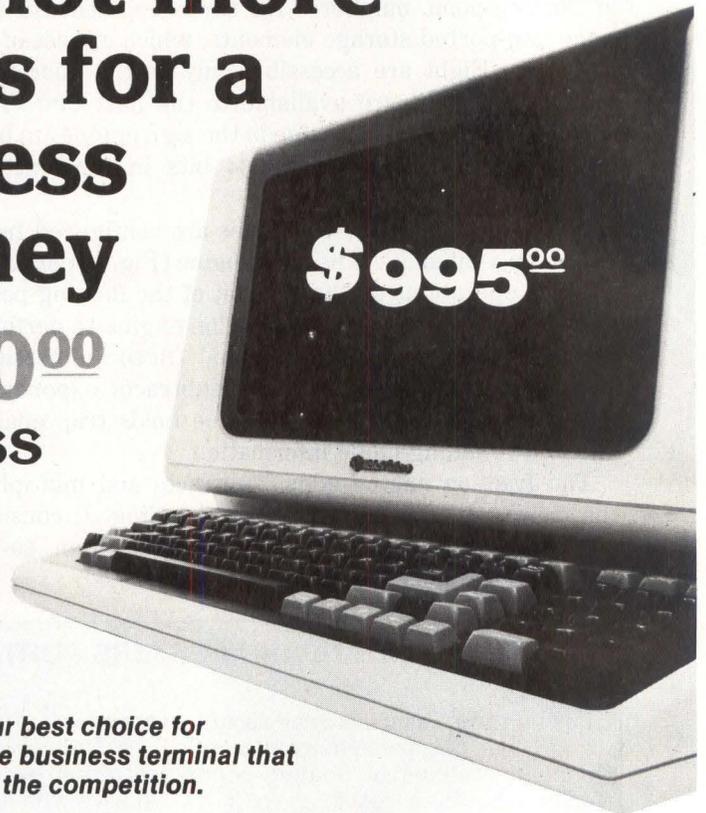
- Exceptions for overflow, underflow, division by zero, square root of negative number and operation on an NaN.

Draft 10.0 of the standard was approved in December 1982 by a 92-member committee that represented such diverse groups as microprocessor manufacturers, academics and physicists specializing in high energy.

Data format	Minimum no. of exponent bits	Minimum no. of mantissa bits	Minimum no. of total bits
Single precision	8	24	32
Single-extended precision	11	32	43
Double precision	11	53	64
Double-extended precision	15	64	79

Floating-point numbers consist of a sign bit, an exponent and a mantissa. Single precision and double precision are standard data types supported by high-level programming languages, while the extended-precision formats are used internally to prevent round-off error in intermediate results. The range of absolute values representable is determined by the number of exponent bits and varies from 10^{-38} to 10^{38} for single precision to 10^{-4932} to 10^{4932} for double-extended precision. The accuracy of representable numbers, determined by the number of mantissa bits, varies from one part in 10^7 for single precision to one part in 10^{19} for double-extended precision.

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*Choose product and company names with care
and guard them vigilantly to ensure legal protection*

A well-chosen product or company name protected by trademark can do much to increase a company's market share and customer awareness. However, suitable names are not easy to come by, and the proliferation of products and companies in the computer industry has only compounded the problem. Each year, fewer worthwhile names become available, and more competitors result in potential trademark infringers. Moreover, a name cannot be changed without significant expense and loss of competitive advantage. Knowing how to create a name that is protected by law and how

to enforce that protection are therefore essential in today's highly competitive market.

What is a trademark?

As defined by U.S. federal law, a trademark is "any word, name, symbol or device, or any combination thereof adopted and used by manufacturer or merchant to identify his goods and distinguish them from those manufactured or sold by others." In other words, a trademark serves to emphasize and distinguish the *source* of a product rather than the product itself. For a

THE PARKER BROTHERS 'MONOPOLY' CASE: PRECEDENT OR ABERRATION?

A recent decision by a federal court in California addressed the question of whether the name *Monopoly* is a protected trademark or a generic designation for a type of board game. "Monopoly" has been produced exclusively by Parker Brothers since 1935, and Parker Brothers owns two U.S.-registered trademarks for it. In 1971, another company began to market a board game called "Bust the Trust," which was financially unsuccessful. In 1973, the company changed the name of the game to "Anti-Monopoly," and the product

began to sell exceptionally well. Parker Brothers promptly sued for trademark infringement. The trial court's decision in favor of Parker Brothers was reversed on appeal.

Because Parker Brothers own registered copyrights to Monopoly's playing cards, rules and board, no other board-game manufacturer can sell an exact copy of Monopoly. But anyone can now market a game and call it *Monopoly*. Consumers who want to purchase the original game might now unintentionally buy the "wrong" Monopoly, which is exactly the kind of confusion trademark laws were intended to prevent.

By invalidating the Monopoly trade-

mark, the court has effectively encouraged parties other than the legitimate manufacturers of trademarked products to use these same trademarks to identify their own, possibly inferior products. Should this ruling be adopted by other courts, it would have serious consequences for all trademark owners—including those in the computer industry. But it is also possible that courts will come to view the Monopoly decision as an aberration and either modify it or decline to apply its reasoning to other trademark cases.

—Linda Bierman, Esq.

trademark to be valid, it does not have to convey the *identity* of the product's source, but it has to make potential purchasers aware that every product on which the trademark appears originates from the same source as every other product bearing that trademark. As long as the trademark performs that function, it can legally be used only by the trademark owner.

In the United States, a company establishes exclusive ownership of a trademark by demonstrating "priority of use"—being the first in the market to use a name. This is accomplished by using the trademark in interstate commerce for as little as one day, provided the user has a *bona fide* intention to continue using it.

Outside the United States, many countries permit trademark registration without intent to use. Manufacturers must therefore register in countries where they plan to do business, or they may find that someone else has already registered their mark in those countries. Widespread foreign trademark registration can be costly and time-consuming, but the process can be simplified under a treaty known as the the Madrid Arrangement, a treaty that extends a single registration to all member countries (Fig. 1).

When a name ceases to identify the *source* of a product but identifies the product itself, it becomes a generic term and can no longer be protected as a trademark. Examples of names that originally functioned as trademarks include thermos, zipper, aspirin,

cellophane, escalator, linoleum and trampoline (see "The Parker Brothers Monopoly case," Page 319). Because these trademark owners failed to take certain simple but necessary steps, their names fell into the public domain. They now describe product categories, and competitors are free to use them at will, just as anyone can use such generic names as *microcomputer* and *word processor*.

Explaining the naming process

There are three kinds of non-generic names: descriptive, suggestive and distinctive. **Descriptive** names define the nature, characteristics or origin of a product, as in *pocket book* for a paperback book or *food fair* for a food market. In general, a descriptive name cannot be protected unless it has been used for a long time or has acquired another meaning as in the *Yellow Pages*. Misspelling a descriptive name does not change its meaning or make it any more or less protected by trademark. *Nu-Enamel* was successful in establishing itself as such a name because it was used for a long time without being challenged by competitors. But Miller Brewing Co. has been less fortunate. Miller introduced *Lite Beer* and lost its trademark-protection case against low-calorie competitors using the same term for their low-calorie beers when the U.S. Court of Appeals ruled that misspelling an otherwise descriptive term does not entitle the owner to trademark protection.

Suggestive names, which hint at a product in too general a way to be considered descriptive, are generally defensible. *Compugraphic*, for example, is a suggestive name for typesetting equipment, as is *7-11* for stores open from 7 a.m. to 11 p.m.

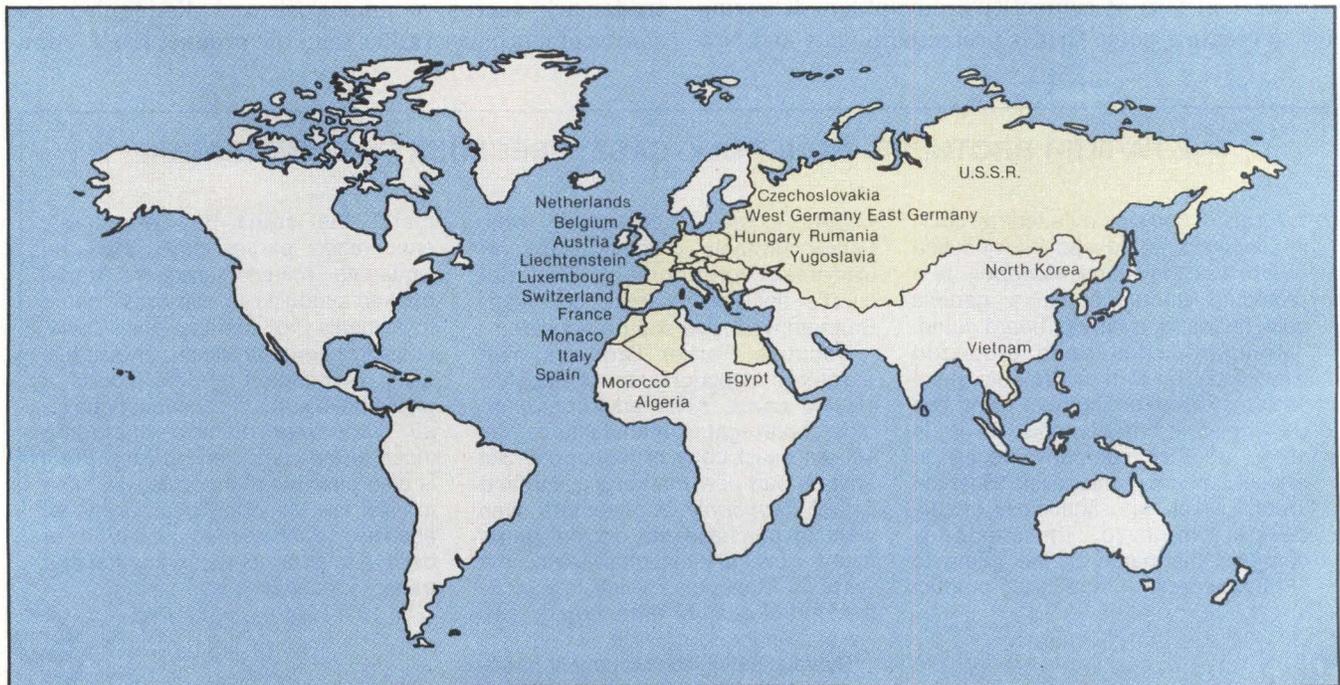


Fig. 1. Trademark registration in any country belonging to the Madrid Arrangement extends to all other members. Countries that have legal systems based on English common law—including the United States, the United Kingdom and Canada—are not members of the Union because they require that trademarks be in commercial use before they qualify for registration. U.S. companies can register trademarks through a subsidiary or affiliate in a member country.

In the computer field, the numbers used to designate models represent suggestive names. For example, Zilog Inc.'s System 8000 suggests incorporation of the Z8000 microprocessor. Model numbers by themselves generally are not usable as trademarks, but when combined with a company name, they can usually be registered and protected.

Distinctive names can be developed by merging a corporate name with a generic description, as in *HowardSoft* (Howard Software Services), *VisiCalc* (software from VisiCorp) or *Quadboard* (a memory expansion board from Quadram Corp.); or by coining a new word, as in *Ascom*, a software program by Dynamic Microprocessor Associates. The naming process is becoming so involved that more and more companies are retaining a brand-naming specialist (Fig. 2).

Protecting your trademark

Ironically, the more successful a product is, the more likely it is that people will refer to it as if it were a product category, as in "IBM cards" instead of "punched data cards." How dangerous this can be for a company should be apparent by now. The best way to prevent a product name from becoming generic and thus losing its trademark protection is to use it as an adjective and the real generic term as a noun, as in *Scotch Brand Cellophane Tape*, *Sanka Brand Decaffeinated Coffee* and the *VisiCalc* program. A trademark should never be used as a verb or noun, as in "Xerox this article" or "give me a Xerox of this."

Another important issue in trademark protection is style. Once a trademark is established, it must be used consistently. *VisiCalc*, for example, should not be writ-

ten as *Visicalc*, *Visicalc's* or any other variation. In the United States, trademarks should be followed by a TM before registration with the United States Patent and Trademark Office and by an R enclosed in a circle thereafter.

A company must literally police its own trademark for effective protection. When the trademark is used improperly, the company must so advise the offenders and insist that the trademark always be shown properly. The company should also monitor all press releases, advertising and written documents emanating from the company, its licensees and its affiliates to be sure they reflect correct usage.

If the company discovers a competitor using its trade name, it should notify its attorneys at once. The attorneys should immediately begin documenting inquiries that indicate confusion in the market and, assuming they can prove registration and "priority of use," should write a "cease and desist" letter, demanding that the competitor discontinue use of the mark. If the competitor persists, the company must go to court.

Before a firm starts to advertise a product, it should make the necessary investment in creating a name and establishing the mechanisms to protect it. The trade name will then embody the goodwill the company has created toward customers through product performance, advertising and public relations. It deserves a company's best efforts. □

Mark Peroff is a partner in the New York law firm of Bierman, Bierman and Peroff. He has served as trademark counsel for Diamond Shamrock Corp. and as trademark examiner with the U.S. Patent and Trademark Office.

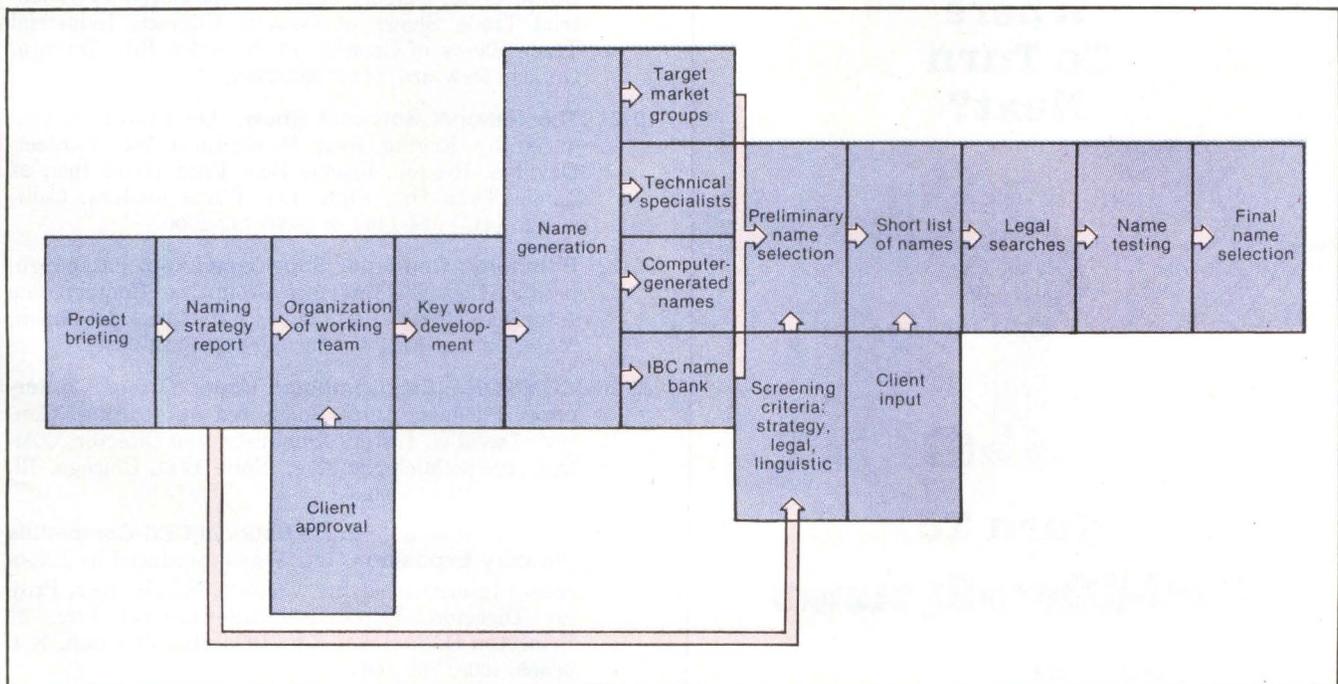


Fig. 2. Guiding the brand-naming process, a brand-naming consultant can speed the complex task of choosing effective names for new computer industry products. Interbrand Corp., New York, for example, takes a product-naming project from initial objectives through name development, availability and name testing to final name selection, using input from trademark attorneys, technical specialists, target market groups and computer-generated lists.

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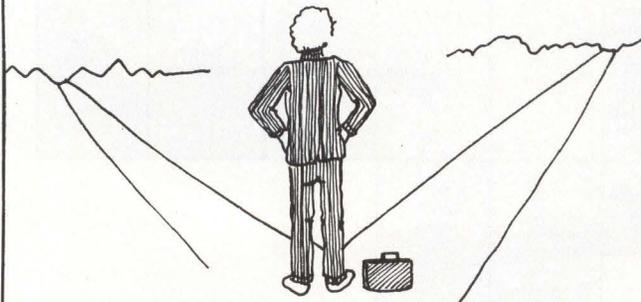
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- 18-19 Sixth Annual Newport Conference on Fiber-Optic Markets**, Newport, R.I., produced by Kessler Marketing Intelligence. Contact: Conference Coordinator, Kessler Marketing Intelligence, 22 Farewell St., Newport, R.I. 02840, (401) 849-6771.
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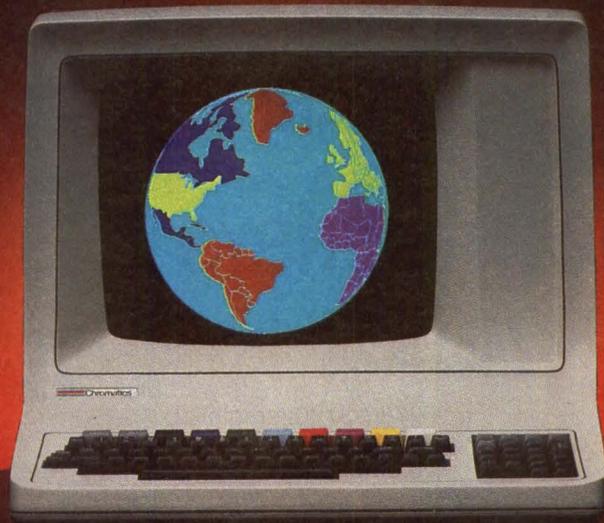
Calendar

- 24-26 Annual ACM Conference**, New York, sponsored by the Association of Computing Machinery. Contact: Thomas A. D'Auria, Assistant Commissioner, City of New York, Computer Service Center, 111 Eighth Ave., 11th Floor, New York, N.Y. 10011, (212) 621-5055.
- 26-27 SEMICON/Southwest '83**, Dallas, sponsored by Semiconductor Equipment and Materials Institute (SEMI). Contact: Susan Castillo, SEMI, 625 Ellis St., Suite 212, Mountain View, Calif. 94043, (415) 964-5111.
- 27-30 South Florida Computer Showcase Expo**, Miami, produced by The Interface Group Inc., Contact: The Interface Group Inc., 300 First Ave., Needham, Mass. 02194, (617) 449-6600 or (800) 325-3330.
- 27-30 Mid-Atlantic Computer Show & Office Equipment Exposition**, Washington, produced by Computer Expositions Inc. Contact: Computer Expositions Inc., P.O. Box 3315, Annapolis, Md. 21403, (800) 368-2066.
- 28-30 Applefest**, San Francisco, produced by Northeast Expositions. Contact: Northeast Expositions, 822 Boylston St., Chestnut Hill, Mass. 02167, (617) 739-7000 or (800) 842-7000.

NOVEMBER

- 1-3 Federal Office Automation Conference**, Washington, sponsored by the National Council for Education on Information Strategies. Contact: National Council for Education on Information Strategies, P.O. Box N, Wayland, Mass. 01778, (617) 358-5356 or (800) 343-6944.
- 1-3 INTECH '83 Integrated Office Technology Conference and Exposition**, Chicago. Contact: Jacqueline Voigt, National Trade Productions Inc., 9418 Annapolis Rd., Lanham, Md. 20706, (301) 459-8383 or (800) 638-8510.
- 2-4 Edmonton Computer & Office Automation Show**, Edmonton, Canada, sponsored by Industrial Trade Shows of Canada. Contact: Industrial Trade Shows of Canada, 20 Butterick Rd., Toronto, Ontario M8W 3Z8, (416) 252-7791.
- 7-9 Satellite Communications Symposium**, Atlanta, sponsored by Scientific-Atlanta Inc. Contact: Betsy Crawley, Symposium Coordinator, 3845 Pleasantdale Rd., Atlanta, Ga. 30340, (404) 449-2274.
- 8-10 CAM-I's 12th Annual Meeting and Technical Conference**, Dallas, sponsored by Computer Aided Manufacturing-International Inc. Contact: Rhonda Gernagess, Manager, Conference Services, or John R. Forton, Marketing Manager, CAM-I Conference Services, 611 Ryan Plaza Dr., Suite 1107, Arlington, Texas 76011, (817) 860-1654.
- 8-10 The Hammer/Seybold Executive Forum: "Directions in Office and Professional Computing,"** New York, sponsored by Hammer and Co. Inc. Contact: Cheryl McManamy, Seybold Publications Inc., 44 Bromfield St., Suite 801, Boston, Mass. 02108, (617) 542-2261.

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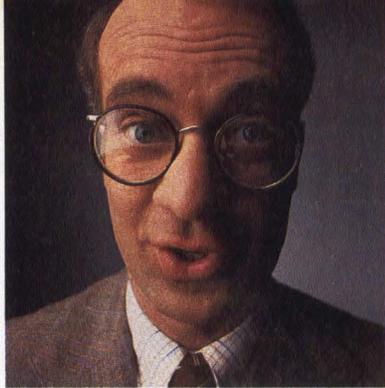
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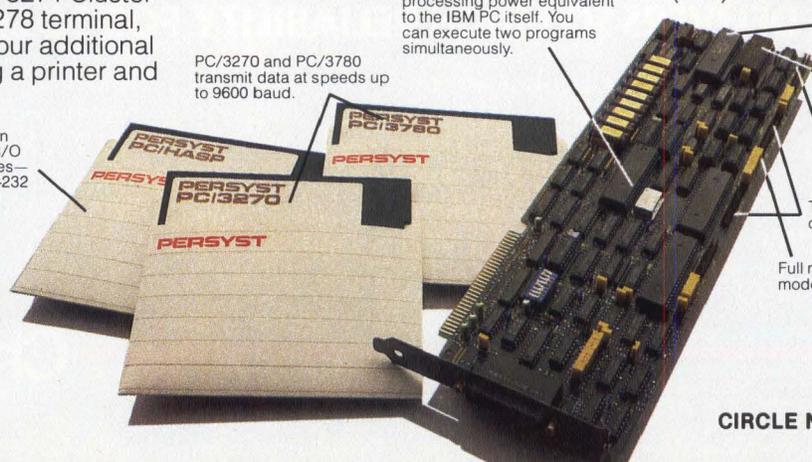
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CIRCLE NO. 163 ON INQUIRY CARD

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New Products

SYSTEMS

Intel announces development system

Intel Corp. has introduced the latest model in its Intellec series of microcomputer development systems. The Series IV is designed for use with products based on Intel's iAPX 86, 88, 186, 188 and 286 microprocessors.

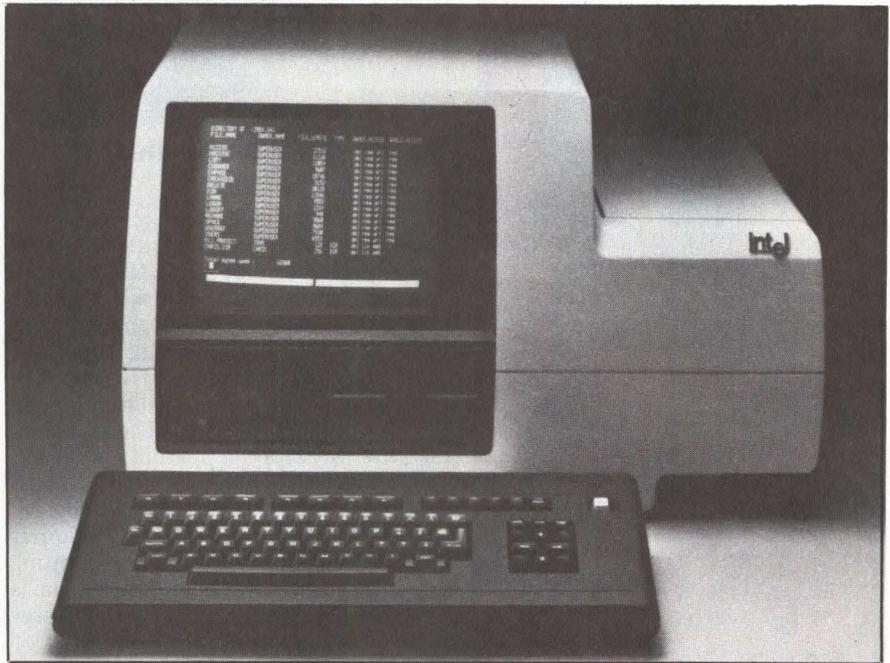
As a stand-alone system, the Series IV supersedes the Series III in developing 16-bit systems. As a networked workstation, the system connects to the Intel NDS-II distributed development network. The Series IV is compatible with its predecessors and offers enhancements, including an advanced human interface, a new operating system, a hierarchical file system, new program-management tools, foreground/background processing and integrated mass storage.

The Series IV can operate in 8- or 16-bit mode. To execute 8-bit 8088/8085 programs, the system uses the ISIS-IV operating system with an 8085 processor. To handle 16-bit programs, the Series IV uses an 8088 processor and the INDX operating system that provides the hierarchical file system, program-management tools and the AEDIT text editor.

The INDX operating system supports Pascal, PL/M, C and FORTRAN. Programmers can produce compatible object code, permitting several languages to be used on one project. The Series IV can also run any programs written for the Series II or III development systems.

The foreground/background processing capability of the Series IV enables the processor to perform user-independent tasks in the background during the idle time of a user-interactive job. For example, a user might work on a debugging job in the foreground while the processor performs a compiling task in the background. In a networked configuration, users can dedicate one Series IV workstation to a specific function and use the other workstations for user-interactive processing.

The Series IV includes PSCOPE, an interactive, symbolic debugging system for Pascal, PL/M and FORTRAN projects. All debugging operations are performed in high-level language statements. The system also incorporates Intel's integrated instrumentation and in-circuit



The Intellec Series IV microcomputer development system is designed to develop systems based on the iAPX 86, 88, 186 and 286 microprocessors. A variety of configurations is available, with prices ranging from \$19,900 to \$34,900.

emulator (I²ICE), which combines in-circuit emulation, high-level-language software debugging and logic analysis in a single unit.

There are six configurations for the Series IV—four standalone systems and two network workstations, each including 384K bytes of RAM. Priced at \$30,900, the iMDX 430WD standalone system has two floppy disk drives and a separate 35M-byte Winchester disk drive. Priced at \$24,900, the iMDX 431

standalone system has one floppy disk drive and a 10M-byte Winchester disk drive. Priced at \$19,900, the iMDX 430WS network workstation has two floppy disk drives and communications boards. All three systems can be upgraded with an 8086 option (\$4000) that increases throughput and adds 128K bytes to the system's main memory. **Intel Corp.**, 3065 Bowers Ave., Santa Clara, Calif. 95051. Phone (408) 987-8080. **Circle No 300**

68000 micro has 80M-byte Winchester disk

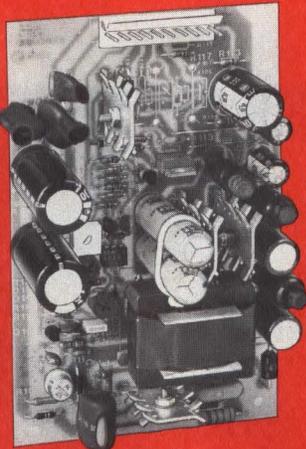
The System 83/80 68000-based microcomputer system features an 80M-byte Winchester disk drive with a proprietary SMD controller. The controller has an average access time of 25 msec. and can drive two 600M-byte hard disk drives. Other features and expansion options include a 20-slot proprietary multilayer IEEE 696/S-100 bus with 11 unused slots for additional memory, graphics or other special application

cards; four RS232C ports with DMA for all character output; and a 256K-byte buffer for all character input and one 8-in., 1M-byte floppy disk drive. The system can accommodate as many as 16 users. The UNIX Version 7 operating system is standard. BASIC+, BASIC-4, FORTRAN 77, RM/COBOL, Pascal and C are optional \$20,990. **Dual Systems Corp.**, 2530 San Pablo Ave., Berkeley, Calif. 94702. **Circle No 301**

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New Products

SYSTEMS



Multi-user computer is expandable

The DBS 16 multi-user computer for business features an 8-MHZ, 16-bit 80186 microprocessor, 256K or 512K bytes of RAM and two disk drives available in any combination of 5¼-in. floppy or Winchester disks with storage capacities ranging from 720K to 15M bytes. The entry-level desk-top DBS 16 handles one to four DBS workstations. The ergonomic DBS workstation features a 14-in., tilt-and-swivel green CRT and a separate movable, low-profile keyboard. Single-workstation, desk-top configuration DBS-16s use the CP/M-86 operating system. An MP/M-86 operating system is available for expansion to the multi-user DBS-16 environment. An entry-level desk-top DBS 16 is priced at \$3495. DBS workstations are priced at \$1095 each. **Digilog Business Systems Inc.**, Welsh Rd. and Park Dr., P.O. Box 355, Montgomeryville, Pa. 18936.

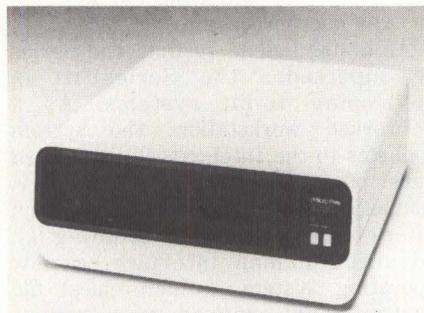
Circle No 302

Package adds CP/M to DG minicomputers

The Mirage is a combination of hardware and software that adds CP/M capabilities to Data General Nova and Eclipse computers running DG's RDOS, DOS, AOS and AOS/VS operating systems. The package includes the Mirage M102 processor, a DG-compatible 15- × 15-in. circuit board and the CP/M 2.2 operating system. The M102 board supports two users, each with his own 4-MHZ Z80A processor and 64K bytes of RAM. Users can alternate between CP/M and host-computer operating modes. Processing can take place on one system while a user is connected to the other. The Mirage hardware handles all computer-bound and character I/O tasks, while a server program running on the host machine handles disk accesses. The server software uses standard disk files on the DG system and gives each user

access to as much as 32M bytes of on-line virtual floppy disk storage. It supports as many as 32 Mirage 102 processors. Single-unit price is \$3295 including an M102 processor, an RS232C connector panel, CP/M 2.2 and manuals. **Rational Data Systems**, 205 E. 42nd St., New York, N.Y. 10017

Circle No 303



Microcomputer features 19M bytes of disk storage

The model 1540 microcomputer features a 16-bit Intel 8088 CPU with 128K bytes of main memory, one 1M-byte, 5¼-in. floppy disk drive, one 19M-byte, 5¼-in. hard disk drive and two RS232 ports. With an operating system of the user's choice, this configuration is priced at \$8995. Operating-system software available includes SMC Business BASIC, which is compatible with application programs developed for Basic Four, CP/M-86, MP/M-86, MS-DOS, MicroCOBOL and the vendor's proprietary STARDOS operating system. The 1540 can be upgraded to include 512K bytes of main memory and a total of six RS232 ports. **Micro Five Corp.**, 17791 Sky Park Circle, Irvine, Calif. 92714.

Circle No 304

Business system supports 12 users

The Poppy line of 16-bit personal business systems supports as many as 12 users in a multitasking environment. The Poppy uses a dual-processor architecture based on Intel's 80186 and 80286 microprocessors. Standard hardware features include an RS232/RS422 communications port, a parallel printer port, an asynchronous/bisynchronous/bit-synchronous communications port with RS232/RS422 line drives, a 14-in. CRT screen with tilt-and-swivel adjustment and a detached slimline keyboard.

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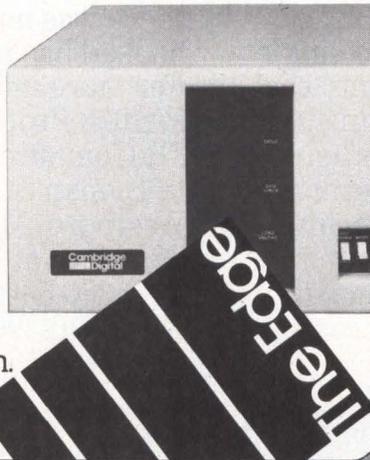
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CAS-41 4 Port ASCII Code Activated Switch

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Your Computer may select one or any combination of up to 4 RS232 ports by a user selectable code sequence.

CAS-161 16 to 64 Port Code Activated Switch

\$795

Your Computer may select between any one of 16 ports by a two character ASCII code sequence. The unit is field expandable to 32, 48, or 64 ports.

SMRT-1 8 Port "Smart Switch"

\$895

This flexible microprocessor controlled 8 port switch allows a user on any port to communicate with an RS232 device on any other port. Up to 4 pairs of users can communicate simultaneously. "User Friendly" commands aid in port selection, port status and sign off. The unit's so smart, it even signals you when the port you wanted is no longer busy! Each port can be configured for DTE or DCE by pressing a button.

PSU-41 Printer Port Sharing Unit

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Allows up to 4 CRTs to share one Printer automatically without software changes! The PSU-41 scans each CRT and locks on until the screen has been sent to the Printer, then resumes scanning.

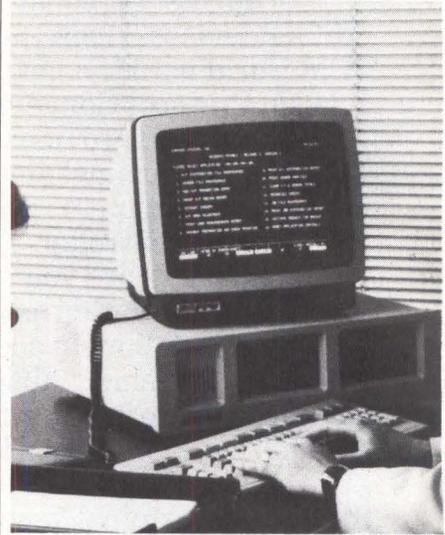


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SYSTEMS



The Poppy's modular design allows flexibility in the choice and use of peripherals and add-ons, and it uses MS/DOS, CP/M-86, MP/M-86 and XENIX software operating systems. The vendor's Star BASIC business-oriented language operates under XENIX or MS/DOS. A basic Poppy, consisting of a 16-bit microprocessor with 128K bytes of RAM, two 800K-byte, 5¼-in. floppy disk drives, a CRT screen, a keyboard and the MS/DOS operating system, is priced at \$4395. **Durango Systems Inc.**, 3003 N. First St., San Jose, Calif. 95134.

Circle No 305

Personal computer has half-height Winchester drive

The TS1603 and TS1603H personal computers are based on the 16-bit Intel 8088 microprocessor and offer 128K bytes of internal RAM, two RS232C ports and a high-speed RS422 port capable of interfacing with the vendor's personal-computer network. The TS1603 and TS1603H support MS-DOS Version 2 and CP/M-86. The TS1603H offers 10M bytes of half-height, 5¼-in. Winchester disk storage and 1M byte of floppy disk storage. The TS1603 offers twin floppy disk drives with a total storage capacity of 2M bytes. Options include internal memory expansion to 256K bytes and graphics capability featuring a 640 × 240 resolution. Single-unit prices are \$2995 for the TS1603 and \$4495 for the TS1603H. **TeleVideo Systems Inc.**, 1170 Morse Ave., Sunnyvale, Calif. 94086.

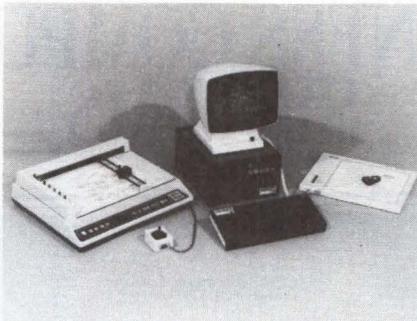
Circle No 306

New Products

CAD/CAM

Turnkey CAD system serves drafting needs

The A-CADS/1 computer-aided-drafting system features a DEC LSI-11/23 CPU, 64K bytes of RAM, five RS232C ports, a video display controller, a floppy/Winchester disk controller, a joystick interface and several expansion slots. Standard mass-storage devices are a 5M-byte Winchester disk drive and a 512K-byte floppy disk drive. I/O devices include the vendor's VDT11-C graphic display terminal with a 512-by-256 resolution raster display, a B-sized plotter, a joystick and an 11-by-11-inch digitizing pad with a four-button cursor. The terminal emulates the Tektronix 4010 in the graphics mode and the DEC VT52 in the alphanumeric mode. The system uses a version of the Design Graphix software package. CAD packages for applications such as electrical schematics, piping layouts, logic dia-



grams and flowcharts are available. \$24,000. **Andromeda Systems Inc.**, 9000 Eaton Ave., Canoga Park, Calif. 91304, (213) 709-7600. **Circle No 307**

Workstation offers high-resolution displays

The Pixel 80G graphics/engineering workstation for CAD/CAM and real-time

typesetting offers a bit-mapped high-resolution screen that displays 1728 by 2180 pixels. The workstation is served by the Pixel 80 microcomputer running a 10-MHz 68010 processor with UNIX. The engineering core of the Pixel 80G consists of the Graphics Execution Module, the Multipurpose Adaptive Graphic Image Component and the CAULDRON video-processing and mix-down component. A multi-window Lisa-style user interface, a SigGraph CORE-based 2D and 3D graphics tool kit and typesetting and proofreading software are also available. The workstation package, including 1M byte of main memory, 1M byte to 2M bytes of graphics refresh memory, 40M bytes of hard disk storage and a choice of backup devices, costs \$19,000. **Instrumentation Laboratory Inc., Pixel Division**, 1 Burt Rd., Andover, Mass. 01810, (617) 470-1790. **Circle No 308**

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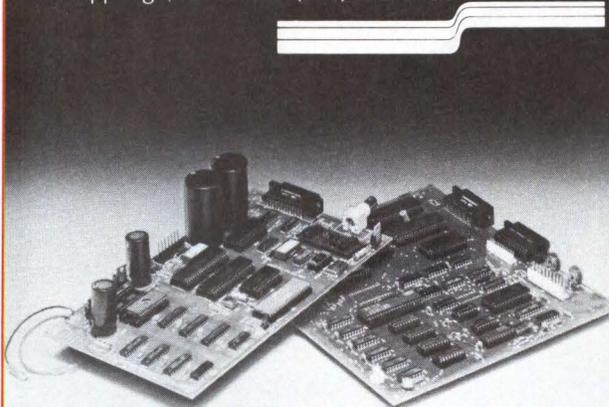
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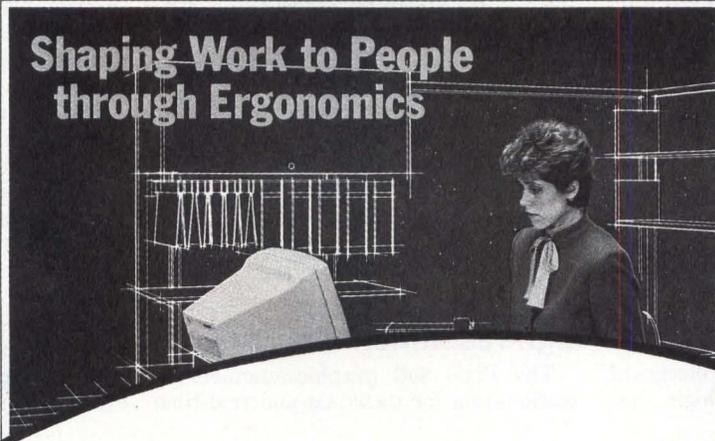
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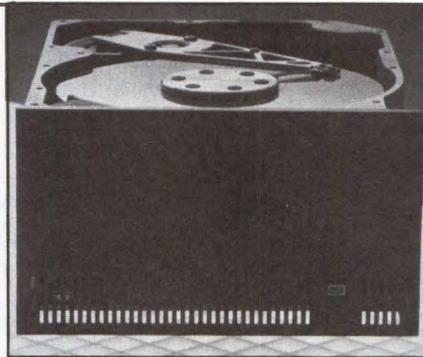
New Products

DISK/TAPE

5¼-in. Winchester stores 380M bytes using enhanced small disk interface

Maxtor Corp. has announced a 5¼-inch Winchester disk drive family that incorporates the enhanced small disk interface (ESDI). The EXT-4000 disk drives are available in capacities of 75M bytes (two disks), 175M bytes (four disks), 280M bytes (six disks) and 380M bytes (eight disks). The ESDI allows double the 5M-bit-per-sec. data-transfer rate of the ST506/412 interface standard.

The high storage capacities of the EXT-4000 drives are made possible in part by increased recording densities of 14,873 flux changes per inch. In addition, by using a run-length-limited encoding scheme, the drives achieve an



Maxtor Corp.'s EXT-4000 family of disk drives is compatible with the enhanced small disk interface standard that allows a 10M-bit-per-sec. data-transfer rate.

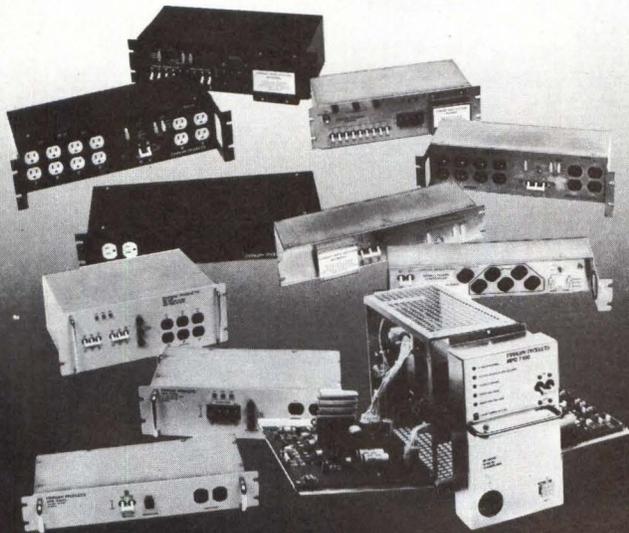
effective bit density of 22,310 bpi. Although the new drives feature 980 tpi—the same as earlier Maxtor drives—they have a storage capaci-

ty of 25.52M bytes per disk surface. Average access time is 30 msec.

The EXT-4000 family uses 3380 Whitney-type sliders and flexures. The recording gap on the mini-composite, two-rail construction sliders is on the outermost rail. This placement, coupled with the smaller size of the sliders, permits better use of the disk surface than conventional Winchester heads. The drives use plated media with 1224 tracks per surface.

Other features of the EXT-4000 family include a rotary voice-coil actuator, a closed-loop servo system with a dedicated servo service, a single MAXPAK PC board with surface-mounted devices for control

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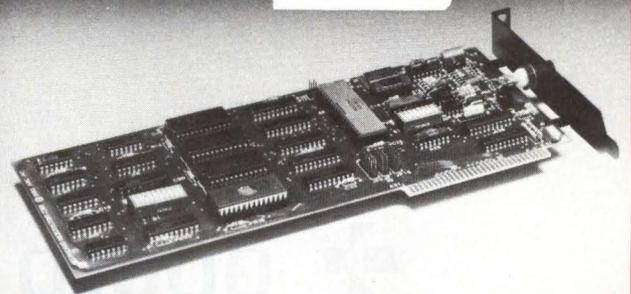
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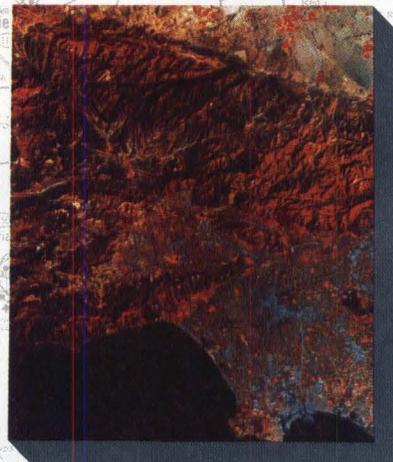
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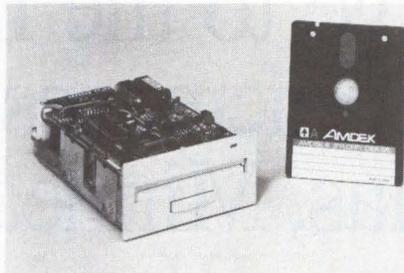
New Products

DISK/TAPE

and read/write electronics, and the vendor's motor-in-the-spindle that allows as many as eight disks to be placed in a standard 5¼-in. form factor. Prices range from \$1,295 to \$3,695 each in 1000-unit quantities. Production is scheduled for early 1984. **Maxtor Corp.**, 61 E. Daggett Dr., San Jose, Calif. 95134. Phone (408) 942-1700. **Circle No 309**

Floppy disk drive uses protected 3-in. media

The Amdisk OEM 3-in. floppy disk drive offers as much as 500K bytes of unformatted, double-density storage capacity and is compatible with standard 5¼-in. disk controllers. The drive's performance specifications include a 55-msec. average access time and a 250K-bit-per-sec. data-transfer rate. It accommodates one 3-in. diskette and uses a brushless, direct-drive flat

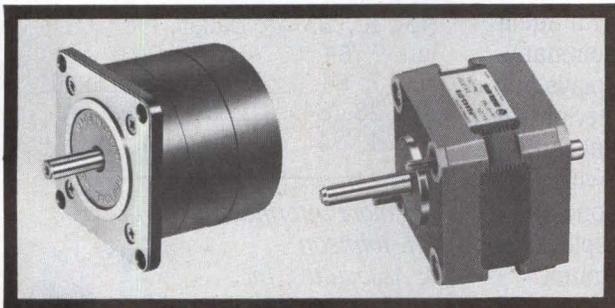


motor. Measuring 90 × 40 × 153 mm., the drive has an automatic cartridge door and interfaces via a standard connector. The diskette is enclosed in a 0.179- × 3.15- × 3.94-in. hard-plastic cartridge that includes a flip-type, hinged-head cover and a write-protect mechanism. Formatted capacity per disk side depends on the host computer's operating system. Engineering evaluation samples of the Amdisk OEM are priced at \$250 in single-unit quantities. **Amdex Corp.**, 2201 Lively Blvd., Elk Grove Village, Ill. 60007. **Circle No 310**

Winchester subsystems store 20.8M bytes

Packaged in a 5¼-in. chassis with integrated power supply, the model 212 mass-storage subsystem includes a 20.8M-byte, 5¼-in. Winchester disk drive and a choice of one or two 1M-byte floppy disk drives or one 20M-byte, ¼-in. cartridge-tape drive for backup and archival storage. The model 212 is compatible with DEC LSI-11 processor-based systems including the vendor's Series/6000 computers. The subsystem accommodates a variety of operating environments for DEC LSI-11/23 and LSI-11/23 Plus systems such as RSX-11M V4.0, RSX-11M-Plus V2.0, TSX-Plus V3.0 and UNITY-based systems. The unit is offered with or without a controller. Single-unit prices range from \$4550 to \$11,250, with OEM quantity discounts available. **Plessey Peripheral Systems, Computer Systems Division**, 17466 Daimler Ave., P.O. Box 19616, Irvine, Calif., 92714. **Circle No 311**

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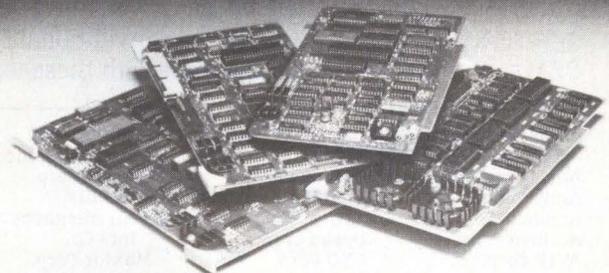
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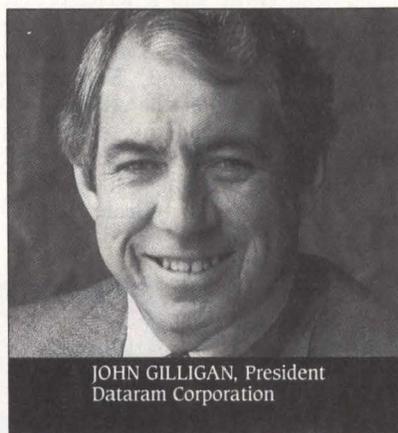
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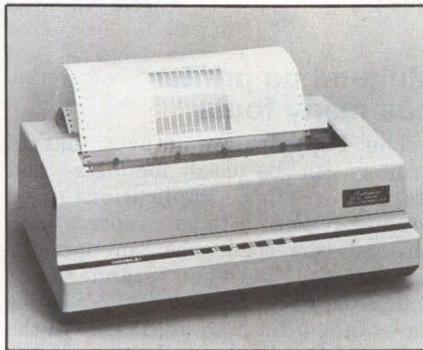
New Products

PRINTERS

Ink-jet printer is designed for reliability, maintainability

Advanced Color Technology has introduced the ACT-II, a color ink-jet printer designed for high reliability and ease of maintenance. The ACT-II is the result of two years of engineering development and field experience with the company's first printer, the ACT-I. Improvements in the ink-jet system and a modular electronics design that has achieved a 35-percent parts reduction compared to competitive models contribute to the ACT-II's MTBF rating of 6000 hr. and MTTR rating of 15 min.

The ACT-II's ink-jet system features automatic purging and waste ink disposal, quick disconnect components and peristaltic pumps that provide constant ink pressure and prevent ink supply contamination. The automatic jet-cleaning mechanism, combined with



Advanced Color Technology's ACT-II color ink-jet printer features an advanced ink-jet system and a low parts count for high reliability and ease of maintenance. The printer is available with RS232 and Centronics-type interfaces that are externally accessible for quick configuration changes.

the company's proprietary non-water-based inks, reduce the clogging problems characteristic of other ink-jet designs.

The ACT-II prints an 8½ × 11-in. image with a resolution of 140 × 85 dpi in 90 sec. The ACT-II's DuraPulse ink-jet head, whose nozzle array of 12 piezoelectric crystal jets is arranged as four jets for each of the three primary ink colors, can print 125 color shades. The ACT-II also has an instant color overhead transparency capability that enables a user to print any image displayed on a color CRT directly on a special transparency material. Single-unit price of the ACT-II is \$6400. **Advanced Color Technology Inc., 21 Alpha Rd., Chelmsford, Mass. 01824.**

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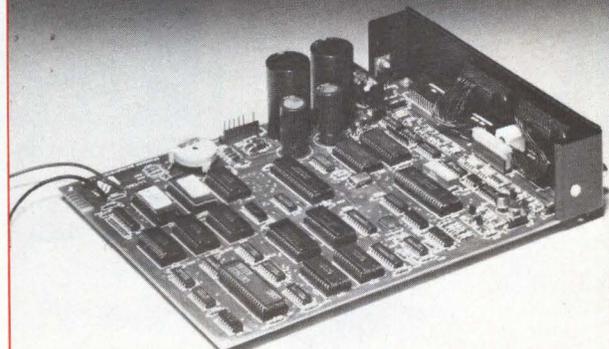
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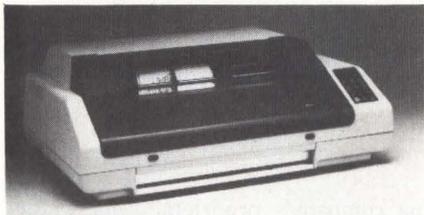


STANDARD MICROSYSTEMS. THE ONE TO WATCH.

CIRCLE NO. 178 ON INQUIRY CARD

New Products

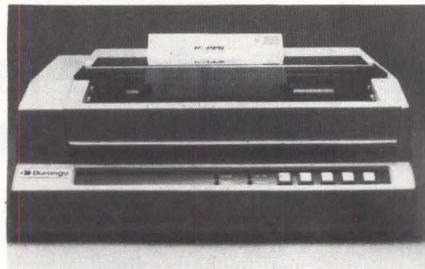
PRINTERS



Printer stores many character sets, formats

The multipurpose model 4570 impact matrix printer can store a variety of character sets and formats and handle nearly all types of paper. The printer can store as many as eight basic character sets, each containing as many as 16 national variants. Fixed and proportional characters can be printed as well as graphics, and a choice of character resolutions is available. Maximum print speeds range from 50 to 250 cps. Text can be positioned on the printed page using tabulation or xy coordinates. The 4570 incorporates a software VFU. A user can define as many as seven formats and call them up

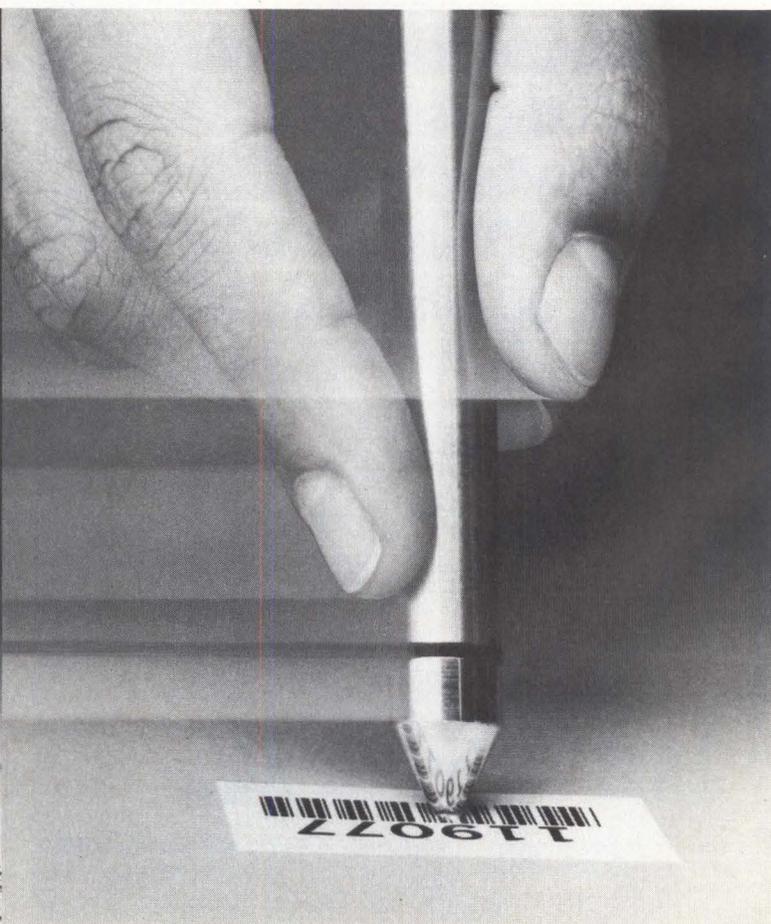
either locally or remotely. The 4570 is fitted with a dual-purpose paper-feed system with friction and tractor feed capable of handling fan-fold paper and cut sheets of varying sizes. Single-unit price is \$3295. **Facit/Dataroyal Inc.**, 235 Main Dunstable Rd., Nashua, N.H. 03061. **Circle No 313**



Multi-mode printer has many fonts

The Poppywriter impact matrix printer can be used for data- and word-processing applications and graphics. For listings, reports and internal correspondence, an operator can choose between standard or compressed type produced with a single pass of the print head at 218 cps. In the word-processing mode, sharp quality is provided by the 36 x 18 character matrix for 10-cpi size characters at a bidirectional printing speed of 40 cps. Five concurrently down-line-loadable fonts for correspondence-quality applications are also standard. Foreign-

language characters and special type styles can be created or modified with the vendor's Startext word-processing software. Poppywriter graphics feature a resolution of 480 x 144 dpi. Other standard features include underlining, superscripting, subscripting, vertical tabbing, logic seek and self test. The printer can handle continuous forms and single sheets. A parallel data interface is standard, and an RS232C serial interface with optional RS422 line receivers/drivers for remote operation will be available before the end of the year. Single-unit price is \$2495. **Durango Systems Inc.**, 3003 N. First St., San Jose, Calif. 95134. **Circle No 314**



New Products

TERMINALS

Color graphics terminal features high resolution

Featuring a resolution of 1024×768 pixels, the AED 1024 color graphics terminal is suited for CAD, CAM, CAE, process display, simulation, graphic arts and medical applications. The AED 1024 emulates the Tektronix 4010 family of storage-tube terminals and offers a $1024 \times 1024 \times 8$ virtual-address space and anti-aliasing. The terminal simultaneously displays 256 colors from a palette of 16.8 million. Other capabilities include eight memory planes, a bit-map mode, user-definable symbols that can be stored locally in the terminal, a stipple-fill feature that allows rectangles to be filled with colored patterns for emphasis, a vertex-fill polygon capability, a programmable zoom function with as many as 16 stages, a pan feature and horizontal and vertical scrolling. Price is \$13,295 including keyboard and monitor. **Advanced Electronics Design Inc.**, 440 Potrero Ave., Sunnyvale, Calif. 94086. **Circle No 315**



Display station supports two printers

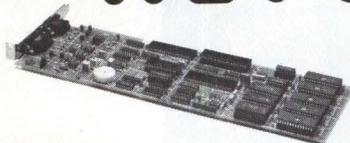
The model 1000A display station is compatible with IBM 2740 and 3767 keyboard printers. It is an enhanced version of the model 1000 with improvements such as more compactness, a movable keyboard with programmable function keys and a green phosphor display. It also supports two printers as slave units or is directly

addressable by the host processor. The microprocessor-based 1000A displays 24 lines of 80 characters each on its 12-in. diagonal screen. A 25th line displays operator status and diagnostic information. Other features include local editing, high-speed selective printing and variable line transmission speed. Single-unit price is \$2350, with quantity discounts available. **CTi Data Corp.**, 5275 North Blvd., Raleigh, N.C. 27604. **Circle No 316**

Electronic workstation features ergonomic design

The model ET1100 general-purpose input and display system features a 14-in. CRT screen with 26 lines containing 80 characters each. The screen has tilt-and-swivel adjustments, an optional height adjustment, a fine-etched non-glare surface and adjustable brightness and contrast controls. The terminal's movable, slimline keyboard features 10- programmable

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New Products

TERMINALS

function keys, a numeric input area, N-key rollover, LED status indicators, adjustable tilt and an optional palm rest. Other features include a maximum of 10 pages of display memory and an RS232C port. Single-unit price is \$1895. **Burroughs Corp.**, Detroit, Mich. 49232. **Circle No 317**

Terminal produces ASCII, APL characters

The model TDV 2221 CRT terminal with a detachable keyboard and an adjustable stand can alternate between APL and ASCII modes. In ASCII mode, the terminal can act as an advanced Teletype. The TDV 2221 can produce 72 overstrike characters, and the keyboard has ASCII/APL dual-color, engraved keytops. The terminal's 15-in. green screen features an 80-character × 25-line display format. Other features include character-by-character and line-mode transmission, insert, delete and

erase functions and an optional one-page print buffer. Single-unit price is \$2050, and quantity discounts are available. **Tandberg Data Inc.**, P.O. Box 99, Labriola Court, Armonk, N.Y. 10504. **Circle No 318**

Block-mode terminal is HP compatible

The model 820 block-mode, HP 3000- and HP 1000-compatible terminal features two pages of display memory and on-screen program function keys, enabling system users to run a variety of HP software application programs, such as V/3000, MM/3000 and VPLUS. Additional model 820 features are a standard line-drawing set, an 80-column display and user-preference features, including screen intensity and scroll rates that can be modified from the keyboard. Setup of the terminal can be accomplished via a single-page menu, and configuration data can be saved in



nonvolatile RAM that requires no battery backup. Data communication between the terminal and the HP host is via an RS232 interface. Data-flow control is performed with x-on/x-off or ENQ/ACK protocols. The 820's block transmissions are compatible with HP's DC1-DC2 handshake protocol. Single-unit price is \$1495, with volume discounts available to OEMs. **Direct Inc.**, 4201 Burton Dr., Santa Clara, Calif. 95050. **Circle No 319**

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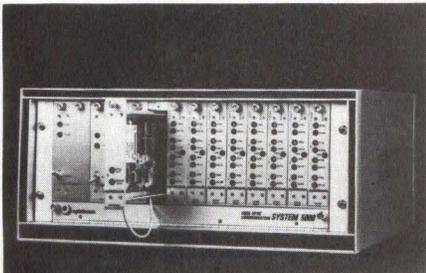
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DATACOMM



Multiplexer supports 64 RS232C channels

The model 5100 is a high-capacity RS232C communication system that uses time-division-multiplexing techniques and fiber-optic communication cables. The unit accepts as many as 64 discrete RS232C signals and assigns a unique address/time slot to each. Information is sent over as much as 1 mi. of optical fiber and reconstructed into standard RS232C voltages at the receiving end. As many as 32 full-duplex channels can operate asynchronously at speeds as high as 19.2K baud or synchronously at speeds as high as 38.4K baud at six selectable clock rates. The remaining 32 channels can be used for low-speed asynchronous data or as control signal lines. Front-panel indicators continuously monitor communication status and verify that data from remote centers are being received. The model 5100 is mounted in a 19-in. rack with an optional console cabinet. Prices start at \$3227.50 for the four-channel version. **Optelecom**, 15940 Luanne Dr., Gaithersburg, Md. 20877.

Circle No 320

Statmux handles two/four asynchronous channels

The PIN 9106 statistical multiplexer handles two asynchronous channels operating at speeds as high as 9600 bps or four asynchronous channels operating at speeds as high as 4800 bps. The aggregate data rate is 19.2K bps. The composite link operates synchronously or asynchronously at speeds as high as 9600 bps, and hardware and software flow controls are provided. The PIN 9106 provides answer control that is compatible with 212-type 1200-bps, full-duplex modems. It has a 2K-byte buffer per channel to handle standard CRT screens and long links. The PIN 9106 also features menu-driven parameter selection and front-panel LED diagnostic

indicators. Each channel can be configured for DCE or DTE operation. Single-unit prices are \$895 for the PIN 9106-02S and \$1085 for the PIN 9106-04S. **Gandalf Data Inc.**, 1019 S. Noel Ave., Wheeling, Ill. 60090. Circle No 321



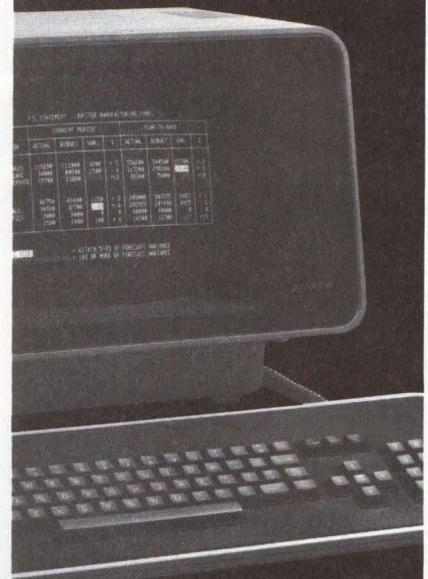
Interface links Xerox PCs to Ethernet

The Shared Interface Unit gives Xerox personal computers direct access to the Ethernet local-area network. This desk-top unit connects two Xerox 820-II personal computers to Ethernet using two industry-standard RS232 ports. A user can connect the 820-II directly to the SIU or indirectly with a modem over normal telephone lines. The SIU can be connected to the Ethernet cable like any other Ethernet-compatible device. Measuring approximately 4 x 16 in., the SIU can serve as a base on which to place the 820-II display processor. The unit and operating software is priced at approximately \$1500. **Xerox Corp., Office Products Division**, 1341 W. Mockingbird Lane, Dallas, Texas 75247.

Circle No 322

Modem features auto dialer

The SAM 212A is a Bell-compatible, FCC-registered modem with an auto-dialer. The modem operates in full-duplex mode over two-wire switched or leased lines at 300 bps (FSK) and 1200 bps (DPSK). The integral auto-dialer allows direct pulse dialing using the



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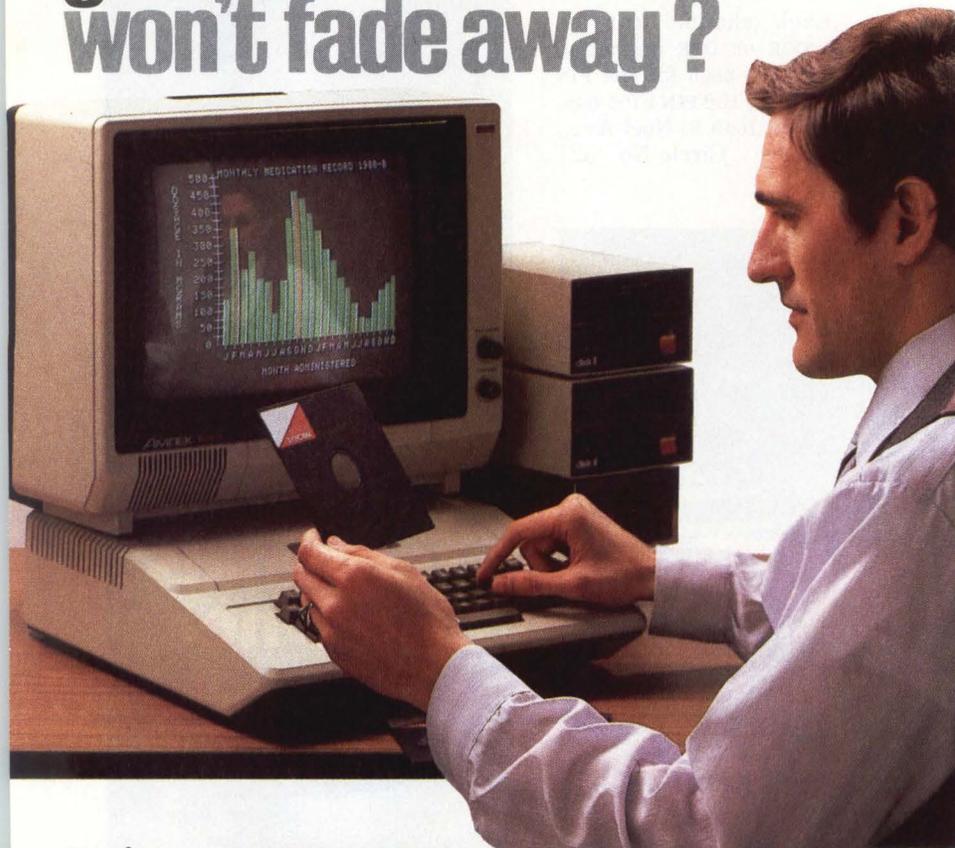
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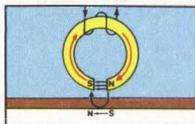
First, with calibrated coercivity—a precisely balanced blend of milled ferrous oxides that allows Ectype® coating to respond fully to “write” signals, for strong, permanent data retention.

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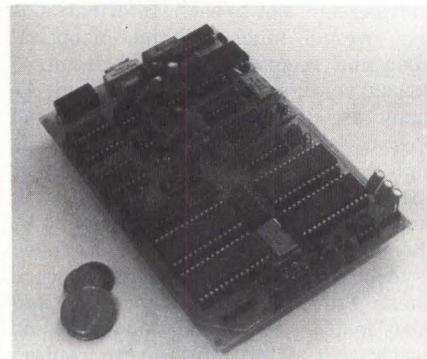
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342

DATA COMM

keyboard of the attached terminal. (The last number dialed is retained for redial purposes.) In the answer mode, the SAM 212A adapts automatically to match the speed of incoming signaling. Operating parameters can be set by a user from a menu of standard options. Indicators and controls can be accessed from the front panel. The SAM 212A also provides self test, analog and digital loopbacks and remote digital loopback diagnostics. It is housed in an 8¾- × 11½- × 1¼-in. enclosure, and rack-mount or stand-alone units are available. Single-unit price is \$618. **Gandalf Data Inc.**, 1019 S. Noel Ave. Wheeling, Ill. 60090.

Circle No 323



Custom integral modem challenges Bell

The compact Bell 212A-compatible WD-212 modem board features a proprietary design that uses four parallel microprocessors—two for modulation and two for demodulation. The WD-212's form factor is less than 20 sq. in., including FCC-approved line coupling. It contains 50 percent fewer components than competitive Bell 212A designs. The WD-212 operates in full-duplex mode at 1200 and 300 bps, uses four-level phase-shift modulation and provides asynchronous operation with a 10-bit character length. It is an originate/auto answer modem and permits interfacing with a standard modular telephone jack. The vendor customizes board designs to meet customer interfacing and form-factor requirements and provides custom software for data encryption and communication handshaking. Prices start at \$250 each in OEM quantities of 1000. **Wolfdata Inc.**, 187 Billerica Rd., Chelmsford, Mass. 01824.

Circle No 324

New Products

SOFTWARE

Record extractor for VAX-11 computers

Vselect extracts fixed-length records that meet user-specified criteria from sequential, relative and indexed RMS files on DEC VAX-11 computers. Fields can be deleted, inserted or rearranged before extracted records are written to an output file. Selection keys include ASCII, signed and unsigned integer, floating point, packed decimal and the relative file-record occupancy flag. Options include hooks for user-coded selection criteria and field transformations, conditional field copying and conditional generation of multiple records from a single input record. The package can be called from languages that support DEC calling conventions. \$1500. **Evans Griffiths & Hart Inc.**, 55 Waltham St., Lexington, Mass. 02173. Phone (617) 861-0670. **Circle No 325**

DBMS for UNIX, IBM PC

The Contel Tools comprises a set of programs for database management and application development that run on a variety of computers under the UNIX operating system and on the IBM PC. The package includes file-update and -entry utilities, a menu system and a report writer. A user fills in a data-entry form on a screen to create or modify data. Password protection is provided at the file level. String, real, integer, money, date and time data types are supported. Users can declare as many as 128 indexes for a file, which can hold an unlimited number of data fields. Prices are \$2995 for the UNIX version and \$795 for the IBM PC version. **Contel Computer Corp.**, 4204 Meridian St., Bellingham, Wash. 98226. Phone (206) 733-6571. **Circle No 326**

Software tools create user-friendly front end

The H-CHAMP environment handles all interactions between system users and a computer until the user has reached a desired application program. H-CHAMP's core module includes UNIX-like mail for sending and receiving messages or text files, tools for access and systems security, a UNIX-like command shell and UNIX-like directory and file-manipulation utilities. Optional utility modules perform sorting, archiving of files and

formatting and scheduling of reports. The package runs on 8080/8085/Z80, 8086/8088, Z8000 and 68000 microprocessors under the standard operating systems. The core module is priced at \$295, and a complete package is priced at \$695. **Helmsman Systems**, 1030 S. Winchester Blvd., San Jose, Calif. 95128. Phone (408) 246-8300.

Circle No 327

Packages solve numeric problems

The TK!SolverPack for mechanical engineering and the TK!SolverPack for financial management are application packages for use with the vendor's TK!Solver program. The packages run on the IBM PC, DEC Professional 350 and Rainbow 100 computers. Each package includes 13 models, each containing equations, values and tables for solving problems. The financial-management package solves problems in investment analysis, options, installment loans, bonds, cost of capital and income statement analysis. Users can modify the models if desired. Prices are \$100 for each package. **Software Arts Inc.**, 27 Mica Lane, Wellesley, Mass. 02181. Phone (617) 237-4000.

Circle No 328

Graphics software features 3D pies, charts

Chartman IV, a high-end business graphics package for the IBM Personal Computer, provides "organizational" graphics including specialized scatter graphs and Gantt charts, intricate line charts and a statistical curve-fitting feature. The Chartman series, consisting of Chartman I through Chartman IV, provides a range of high-quality monochrome and multicolor presentation business graphics in 2D or 3D. The software is menu and input form driven. The graphic pictures provided by Chartman IV can be printed on paper with the Epson MX-80 and MX-100 printers with GrafTrax, and plotted with the HP 7470 two-pen plotter or the HP 7220 eight-pen plotter. Chartman II and Chartman IV are sold as a package for \$500. **Graphic Software Inc.**, 1972 Massachusetts Ave., Cambridge, Mass. 02140. Phone (617) 491-2434.

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New Products

LITERATURE

Updated brochures cover magnetic media

The Consumer Products Division of Maxell Corp. of America has introduced updated versions of two popular documents. The 12-page color, full-line product brochure provides complete technical data and specifications on Maxell's magnetic media line. The 20-page, black-and-white cross-reference manual helps readers to select the specific Maxell floppy disks that are compatible with their computer system. **Maxell Corp. of America**, 60 Oxford Dr., Moonachie, N.J. 07074. Phone (201) 440-8020. **Circle No 330**

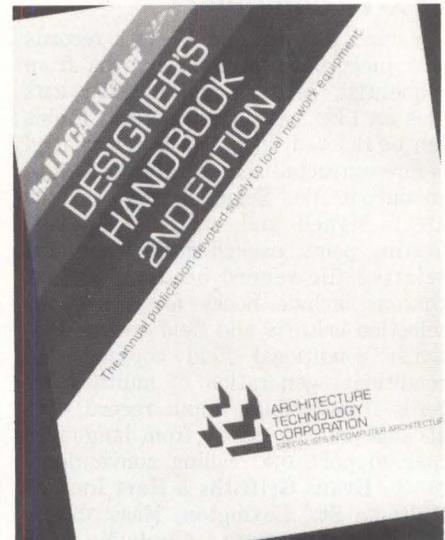
Book explains IBM PC hardware

Inside the IBM Personal Computer explains the operation of the system board's electronics including the clock

and wait-state generators, processor timing, decoders and I/O channels. It also describes a multi-function I/O board design that is compatible with the PC's expansion slots. A programming section with examples covers user-supplied hardware and software interfacing. 36 pages. \$14. **Starware**, 2000 K St. N.W., Washington, D.C. 20006. Phone (202) 331-8833. **Circle No 331**

Statistical multiplexer described

A four-page color brochure includes specifications for the M-860 statistical multiplexer, which is available in six models, each having eight, 16, 24 or 32 channels with single or dual links and single or dual modems. **Telton Corp.**, P.O. Box 657, 10801 120th Ave. N.E., Kirkland, Wash. 98033. Phone (206) 449-2862. **Circle No 332**



Handbook reviews local networks

The second edition of the *LOCAL-Netter Designer's Handbook* is a 328-page guide to local-area network specification, design and selection. It includes product descriptions for LAN systems and accessories; articles on major design issues including LAN selection criteria, building wiring and interconnection; descriptions of proposed and de facto standards; equipment features; comparison charts; manufacturers listings and cross-references; and a bibliography. \$65. **Architecture Technology Corp.**, P.O. Box 24344, Minneapolis, Minn. 55424. Phone (612) 935-2035. **Circle No 333**

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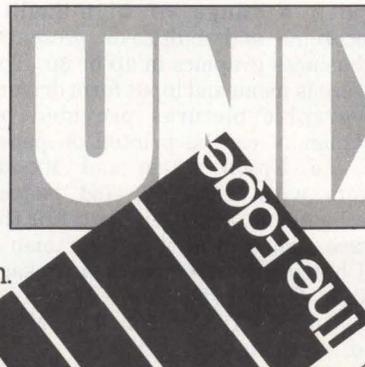
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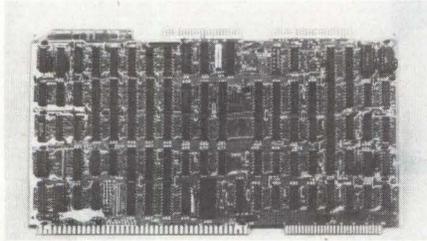


Catalog lists hardware, software for IBM PC

The *Blue Book* is a directory of software, hardware and accessories for the IBM PC and IBM-compatible microcomputers. This reference lists programs in varied subject categories from accounting to word processing. Each listing includes a product description with notations about system requirements, program language and price. Company names and addresses are detailed. 328 pages. \$24.95. **WIDL Video Publications**, 5245 W. Diversey, Chicago, Ill. 60639. Phone (312) 622-9606. **Circle No 334**

New Products

SUBASSEMBLIES



Tape controller is Multibus-compatible

The MT 86 is a Multibus-resident ½-in., magnetic-tape interface to industry-standard reel-to-reel, Pertec-compatible tape drives. The MT 86 provides for 16 tape operations, contains 11 8-bit registers and supports seven- and nine-track NRZI drives and nine-track PE/NRZI drives with transport speeds as high as 125 ips. The DMA control can access as much as 200K bytes per sec. with a 24-bit address scheme and 8-bit data bytes. The package includes a 15-ft. interface cable, software drivers for CP/M, ISIS and MS-DOS and diagnostics. Single-unit price is \$1295, with quantity discounts available. **Comark Corp.**, 93 West St., P.O. Box 474, Medfield, Mass. 02052.

Circle No 335



Data-acquisition system mates with IBM PC

The ISAAC 2000 hardware/software add-on teams with an IBM Personal Computer to form a data-acquisition and control system. The ISAAC includes A/D and D/A conversion hardware, binary I/O hardware and user-friendly software. With its 68000 microprocessor, 128K bytes of RAM, 32K bytes of ROM, two RS232 ports and an IEEE-488 interface, the ISAAC 2000 can acquire, store and manipulate data while the host IBM computer performs data-analysis, programming, word-processing or other personal-computer functions. The ISAAC

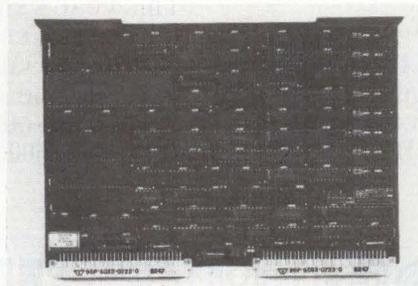
2000 can attain burst sampling rates of 200 KHZ with 12-bit A/D resolution. LabSoft II, ISAAC's easy-to-use English-like language, has simple built-in commands for acquisition and control and allows users to create user-defined commands for repetitive sampling and control sequences in process control. LabSoft is accessed through IBM BASIC. ISAAC model 2000 prices start at \$4100. **Cyborg Corp.**, 55 Chapel St., Newton, Mass. 02158.

Circle No 336

OCR system is compatible with IBM PC

The Series 500 optical-character-recognition system can be used with the IBM PC and the IBM PC XT. Built with LSI technology, the Series 500 consists of a circuit board that can be inserted into the computer's open board slot, and includes a hand-held wand reader. The Series 500 recognizes 80-character strings printed in the standard OCR-A font. Users can program their own data formats, specifying field lengths and character types. The Series 500 scans at speeds from 5 to 20 ips, with rejection rates of less than 1 percent and substitution errors of less than 0.01 percent. Single-unit price is \$1145. **Caere Corp.**, 100 Cooper Court, Los Gatos, Calif. 95030.

Circle No 337



Floating-point accelerator works with 68000 systems

The SKYFFP-E is a VME bus-compatible plug-in floating-point accelerator for MC68000-based systems. It can perform a floating-point multiply in 3 µsec. The processor operates on data in 32-bit, single-precision and 64-bit, double-precision, IEEE-standard, floating-point formats. In addition to basic arithmetic functions, the SKYFFP-E

performs format conversions, square root, logarithmic and trigonometric functions and features a writable control store. It is user transparent and requires no modification to FORTRAN, Pascal or C programs. The vendor supplies a set of run-time modules with the SKYFFP-E to replace software-emulation subroutines. Price is less than \$1000 in OEM quantities. **Sky Computers Inc.**, Foot of John St., Lowell, Mass. 01852.

Circle No 338



Digitizer-based input device is stylus operated

The Sun-Flex input device combines the features of a mouse, a light pen and a bit pad. The product is based on a transparent on-screen digitizer and a small off-screen digitizer pad. The system is stylus operated and offers alternate on- or off-screen cursor manipulation through a common controller. The on-screen digitizer is based on a conductive version of the vendor's optical glare-reducing filter. The conductive filter panel is mounted flush with the curved surface of the display tube. Electrical connections to the mesh are led out via a connector and cable to the controller. The off-screen digitizer pad measures 4 sq. in. and has an active area of 2½ sq. in., so it can be placed on a desk or held in a user's hand. It offers a resolution of 1000 × 1000 points on the active area and can be equipped with touch-sensitive function keys placed around the active area. If a mouse-like cursor movement is required, the stylus can be replaced by a small puck that can be slid over the pad's active area. Single-unit price is \$795, with OEM prices available. **Sun-Flex Co. Inc.**, 20 Pimentel Court, Novato, Calif., 94947.

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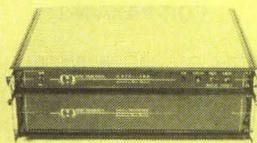
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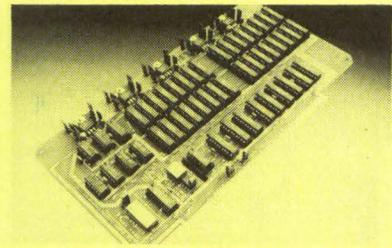
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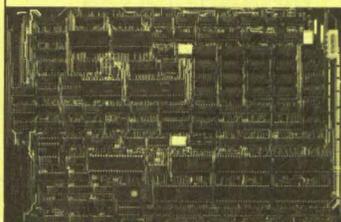
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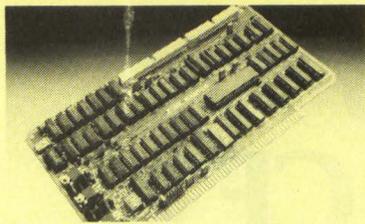
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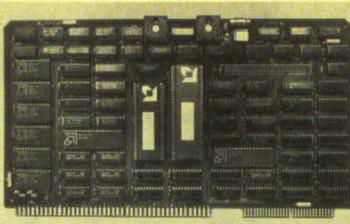
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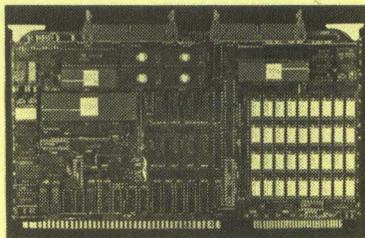
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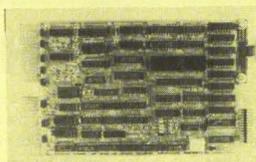
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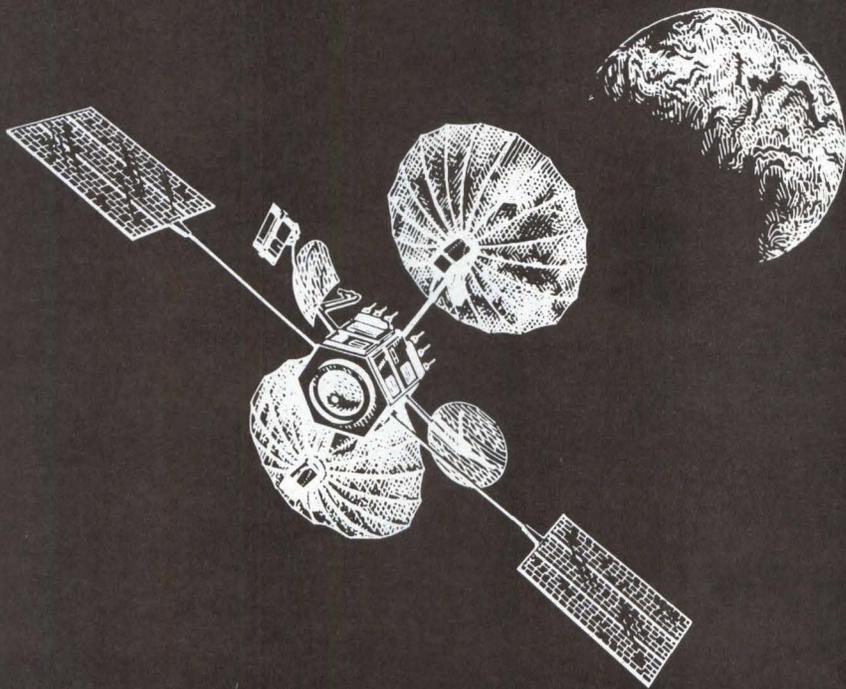
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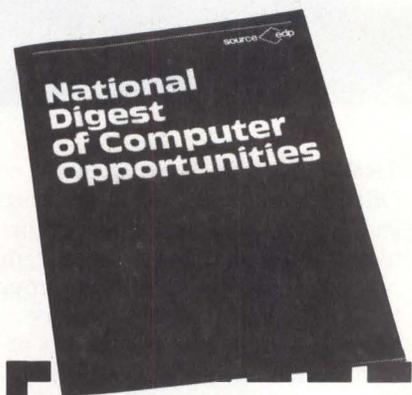
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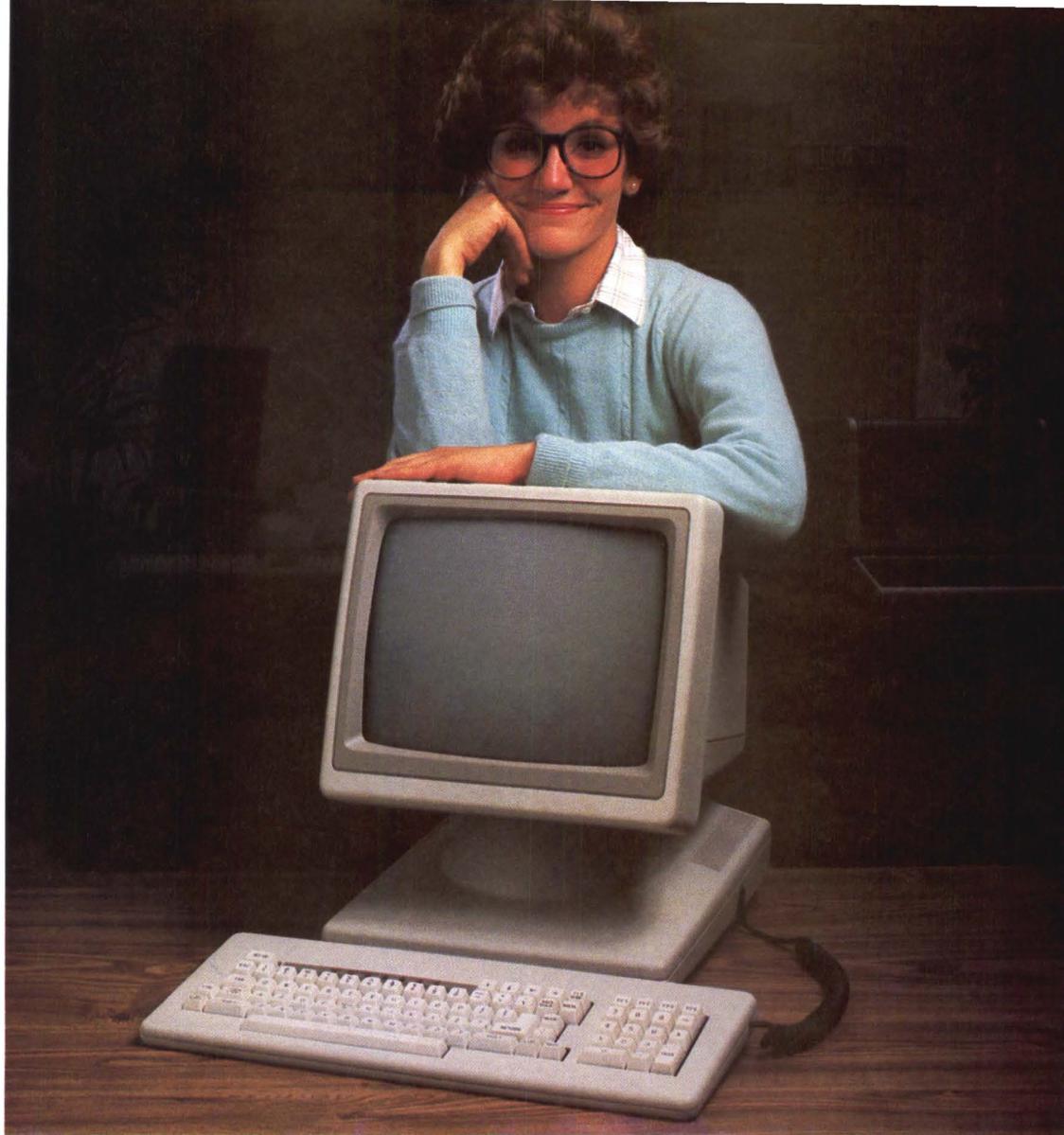
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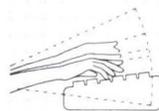
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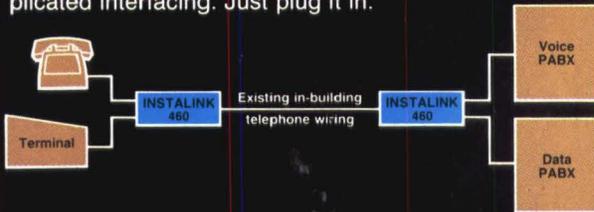
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